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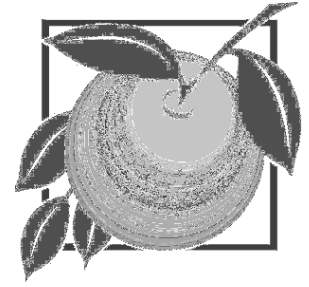
INVITATION FOR BIDS

FOR

**ORANGE COUNTY CONVENTION CENTER NORTH / SOUTH
BUILDING DESTINATION BUILDOUT**

**PART H
TECHNICAL SPECIFICATIONS**

VOLUME II



Destination Lounge

Orange County Convention Center

Orange County, Florida

BID DOCUMENTS

SPECIFICATIONS

Divisions 1 Through 16

Client:

Orange County Convention Center

Capital Planning

9888 Universal Blvd., Suite 200

Orlando, Florida 32819-8199



Owner:

Orange County

400 East South Street, Suite 500

Orlando, Florida 32801



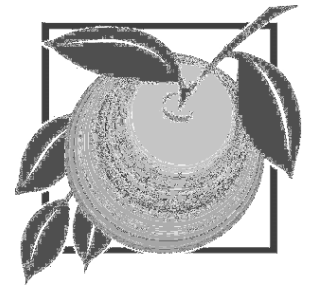
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Destination Lounge

Orange County Convention Center

Orange County, Florida

BID DOCUMENTS

SPECIFICATIONS

Divisions 1 Through 16

April 10, 2015



rhodes + brito
ARCHITECTS

605 E. Robinson St. Ste 750, Orlando FL 32801 . 407.648.7288 phone . 407.648.7289 fax . AA0002809

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Suite 1201
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MECHANICAL, ELECTRICAL, PLUMBING

Milan Engineering
925 S Semoran Blvd
Suite 100
Winter Park, FL 32792

TECHNOLOGY

Technology Research & Consulting Inc.
437 Gaston Foster Rd
Orlando, FL 32807

FIRE PROTECTION

Hughes Associates
725 Primera Blvd
Suite 215
Lake Mary, FL 32746

INTERIOR DESIGN

Ramski & Company, Inc
1235 Mount Vernon St
Orlando, FL 32803

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SECTION 01100 - SUMMARY

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Access to site.
4. Owner occupancy.
5. Work restrictions.
6. Specification and drawing conventions.

1.2 PROJECT INFORMATION

- A. Project Identification: Orange County Convention Center Destination Lounge
- B. Architect: Rhodes + Brito Architects, Orlando, FL

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. Type of Contract:

1. Project will be constructed under a single prime contract.

B. The Work of Project is defined by the Contract Documents and consists of the following:

1. The OCCC Destination Lounge Design project consists of the build-out of an existing 7311sf space at the South Concourse Level 2 Room S222 into a multifunctional meeting and lounge area. The main components in the project are technology driven, and are comprised of features such as video walls, audio system, LED lighting, and wireless access points. A flexible rigging system is included into the space to support corporate branding, such as banners, displays, and artwork.

1.4 ACCESS TO SITE

- A. General: 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. Use of Site: Limit use of Project site to work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways, Walkways and Entrances: Keep driveways, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. 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 OWNER OCCUPANCY

- A. Full Owner Occupancy: The Owner, its tenants, and the public will occupy the site and existing building and adjacent facilities (outside the limits of the construction area unless specified) during the entire construction period. Cooperate with the Owner during construction operations to minimize conflicts, facilitate occupancy usage, and protect persons and property in the project area during the entire construction period. Perform the Work so as not to interfere with the Owner's operations.

1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
 - 2. All work may be carried out without time restrictions, unless otherwise directed by the Owner.
 - 3. Unless otherwise directed by the Owner, work shall be scheduled as Day Shift between the hours of 7AM to 5:00PM each day.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.

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 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01100

SECTION 01230 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This 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 the base bid amount if 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 for each alternate is the net addition to the Contract Sum to incorporate alternate 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. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Base bid includes working daytime hours Monday through Friday. Alternate will allow Contractor to perform night work Monday through Friday.
- B. Alternate No. 2: Alternate includes build out of the Conference Room Space S222A as indicated on Alternate No. 2 drawings. Base bid installation of knock- out partition and installation of partition types 5BC and 10 along Shell Space shall be eliminated in this alternate.
- C. Alternate No. 3: Alternate includes build out of Bar as indicated on Alternate No. 3 drawings, to include additional demolition, bar (millwork), bar back wall, bar equipment, sinks, plumbing, electrical, tile flooring and floor drain. Base bid supply and installation of carpet and bases shall be eliminated in this alternate.

END OF SECTION 01230

SECTION 01250 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for substitutions.

1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1.3 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use Form attached.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution 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 and 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.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution 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 10 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 5 days of receipt of request, or 7 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 qualified testing agency to perform compatibility tests recommended by manufacturers.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 10 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:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

- b. Requested substitution will not adversely affect Contractor's construction schedule.
 - c. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - d. Requested substitution is compatible with other portions of the Work.
 - e. Requested substitution has been coordinated with other portions of the Work.
 - f. Requested substitution provides specified warranty.
 - g. 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: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed or effective date of contract.
- 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.
 - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01250

**SUBSTITUTION
REQUEST**
(After the Bidding Phase)

Project: _____ Substitution Request Number: _____

From: _____
To: _____ Date: _____

A/E Project Number: _____
Re: _____ Contract For: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No.: _____
Installer: _____ Address: _____ Phone: _____
History: New product 2-5 years old 5-10 yrs old More than 10 years old

Differences between proposed substitution and specified product:

 Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item: _____

Similar Installation:
Project: _____ Architect: _____
Address: _____ Owner: _____
_____ Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain _____

Savings to Owner for accepting substitution: _____ (\$ _____).
Proposed substitution changes Contract Time: No Yes [Add] [Deduct] _____ days.

Supporting Data Attached: Drawings Product Data Samples Tests Reports

**SUBSTITUTION
REQUEST
(Continued)**

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

Telephone: _____

Attachments: _____

A/E's REVIEW AND ACTION

- Substitution approved - Make submittals in accordance with Specification Section 013300.
- Substitution approved as noted - Make submittals in accordance with Specification Section 013300.
- Substitution rejected - Use specified materials.
- Substitution Request received too late - Use specified materials.

Signed by:

Date:

Additional Comments: Contractor Subcontractor Supplier Manufacturer A/E _____

SECTION 01260 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

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. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. 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.

- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes 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 Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
- C. Proposal Request Form: Use AIA Document G709 for Proposal Requests.

1.4 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Architect 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.

DESTINATION LOUNGE
ORANGE COUNTY CONVENTION CENTER

CONTRACT MODIFICATION PROCEDURES
SECTION 01260

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01260

SECTION 01290 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms with Continuation Sheets, Submittals Schedule, and Contractor's Construction Schedule.
2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: Use the 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. Submit draft of AIA Document G703 Continuation Sheets.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Progress payments shall be submitted to Architect by the 15 of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
- D. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- E. 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 of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

- F. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is 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 final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner 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. Schedule of unit prices.
 5. Submittals Schedule (preliminary if not final).
 6. List of Contractor's staff assignments.
 7. List of Contractor's principal consultants.
 8. Copies of building permits.
 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 10. Initial progress report.
 11. Report of preconstruction conference.
 12. Certificates of insurance and insurance policies.
- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- J. Final Payment Application: 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, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01290

SECTION 01310 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - a. Coordination Drawings.
 - b. Project meetings.
 - c. Requests for Interpretation (RFIs).
- B. See Division 1 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 DEFINITIONS

- A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.3 COORDINATION

- 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 with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

- 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 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.
 - 9. Project closeout activities.

1.4 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.
 - 1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:
 - a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - b. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
 - 2. Sheet Size: At least 8-1/2 by 11 inches but no larger than 30 by 40 inches.
 - 3. Number of Copies: Submit five (5) copies of each submittal. Architect and Consultants will each retain one copy.
 - 4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

1.5 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 20 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises.
 - m. Work restrictions.
 - n. Owner's occupancy requirements.
 - o. Responsibility for temporary facilities and controls.
 - p. Construction waste management and recycling.
 - q. Parking availability.
 - r. Office, work, and storage areas.
 - s. Equipment deliveries and priorities.
 - t. First aid.

- u. Security.
 - v. Progress cleaning.
 - w. Working hours.
3. Minutes: Record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires 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 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. The Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. 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 parties who should have been present.
 - 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.

- D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) RFIs.
 - 16) Status of proposal requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
 3. Minutes: Record the meeting minutes.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.6 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
 1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Date.
 3. Name of Contractor.
 4. Name of Architect.
 5. RFI number, numbered sequentially.
 6. Specification Section number and title and related paragraphs, as appropriate.
 7. Drawing number and detail references, as appropriate.
 8. Field dimensions and conditions, as appropriate.
 9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 10. Contractor's signature.
 11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
- C. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.
 1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Architect's actions on submittals.
 - f. Incomplete RFIs or RFIs with numerous errors.

2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
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 Division 1 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- D. 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.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were dropped and not submitted.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310

SECTION 01320 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
1. Preliminary Construction Schedule.
 2. Contractor's Construction Schedule.
 3. Submittals Schedule.
 4. Material location reports.
 5. Field condition reports.
 6. Special reports.

1.2 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 activities are activities on the critical path. They must start and finish on the planned early start and finish times.
 2. Predecessor activity is an activity that must be completed before a given activity can be started.
- B. 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.
- C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

- F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, or a similar significant construction element.
- H. Milestone: A key or critical point in time for reference or measurement.
- I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

1.3 SUBMITTALS

- A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
 - 1. Scheduled date for first submittal.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).
 - 4. Name of subcontractor.
 - 5. Description of the Work covered.
 - 6. Scheduled date for Architect's final release or approval.
- B. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.
- C. CPM Reports: Concurrent with CPM schedule, submit three printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- D. Field Condition Reports: Submit two copies at time of discovery of differing conditions.
- E. Special Reports: Submit two copies at time of unusual event.

1.4 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "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 area separations interim milestones and partial Owner occupancy.
 4. Review delivery dates for Owner-furnished products.
 5. Review schedule for work of Owner's separate contracts.
 6. Review time required for review of submittals and resubmittals.
 7. Review requirements for tests and inspections by independent testing and inspecting agencies.
 8. Review time required for completion and startup procedures.
 9. Review and finalize list of construction activities to be included in schedule.
 10. Review submittal requirements and procedures.
 11. Review procedures for updating schedule.

1.5 COORDINATION

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

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

- A. Preparation: After development and acceptance of the Contractor's construction schedule, prepare a complete schedule of submittals utilizing Constructware database. Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Submittal Schedule: Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
 - a. Prepare the schedule on chronological order; include submittals required during the first 90 days of construction. Provide the following information.
 - 1) Scheduled date for the first submittal
 - 2) Related Section number.
 - 3) Submittal category.
 - 4) Name of subcontractor.
 - 5) Description of the part of the Work covered.
 - 6) Scheduled date for resubmittal.
 - 7) Scheduled date of the Architect's final release or approval.
2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 90 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Bar-Chart Schedule: Prepare a fully developed, horizontal-bar chart type Contractor's construction schedule. Submit within 30 days of the date established for "Commencement of the Work."
 1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the Schedule of Values.
 2. Within each time bar indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
 3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
 4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

- C. Activities: Treat each story or separate area as a separate numbered activity for each principal 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 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 Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Startup and Testing Time: Include estimated number days for startup and testing.
 5. 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.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase. Provide notations on the schedule to show how the sequence of the Work is affected by requirements for phased completion to permit Work by separate contractors and partial occupancy by the Owner prior to Substantial Completion.
 2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, testing and installation.
 5. Area Separations: 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.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- F. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.
- G. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Preliminary 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 CPM network analysis diagram.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work.
 - 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.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary 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. Purchase of materials.
 - c. Delivery.
 - d. Fabrication.
 - e. Installation.
 - 2. Processing: Process data to produce output data or 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.
- E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Principal 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).
- F. 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.

2.4 REPORTS

- A. Material Location Reports: At Owner's request prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. 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 Actual Completion percentage for each activity.
- B. 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.

END OF SECTION 01320

SECTION 01323 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.

1.2 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within two days of taking photographs.
 - 1. Digital Camera: Minimum sensor resolution of 4 megapixels.
 - 2. Format: Minimum 1600 by 768 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date- and time- stamped, in folder named by date of photograph, accompanied by key plan file.
 - 3. Identification: Provide the following information with each image description in file metadata tag:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.3 USAGE RIGHTS

- A. Transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 4 megapixels, and at an image resolution of not less than 1024 x 768 pixels.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take color photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- C. Preconstruction Photographs: Before commencement of demolition and starting construction, take color photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take multiple photographs to show existing conditions adjacent to property before starting the Work.
- D. Periodic Construction Photographs: Take color photographs within a few days associated with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

- E. Architect-Directed Construction Photographs: From time to time Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
 - 1. Final Completion Construction Photographs: Take color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.

END OF SECTION 01323

SECTION 01330 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

1.2 DEFINITIONS

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

1.3 SUBMITTAL PROCEDURES

- A. General: One electronic copy of CAD Drawings of the Contract Drawings will be provided by Architect, with appropriate disclaimers, for Contractor's use in preparing submittals.
- 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. Coordinate transmittal of different types of submittals for related parts of the Work 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. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

- D. Processing Time: Allow sufficient time for submittal review, including time for resubmittals, so that installation will not be delayed as a result of the time required to process submittals. Time for review shall commence on Architect's receipt of submittal.
1. Initial Review: Allow two weeks for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Allow two weeks for processing each resubmittal.
 4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide two spaces approximately 4 by 5 inches on label or beside the title block to record Architect and Contractor's review and approval markings and action taken.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Number and title of appropriate Specification Section.
 - i. Drawing number and detail references, as appropriate.
 - j. Contractor/ Architect's log number.
 - 1) Example: 03000-1A-B
 - k. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
- G. Transmittal Form: Submit transmittal for to the Architect for review. The Architect will make revisions if necessary.
1. Process transmittal forms to provide a record of activity.

- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
 - 1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
 - 2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
 - 1. Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession.
- J. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
 - 1. Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:
 - a. Initial Submittal: Submit two preliminary copies of each submittal where selection of options, color, pattern, texture, or similar characteristics is required. Architect will return one submittal with options selected.
 - b. Final Submittal: Submit three copies, unless copies are required for operation and maintenance manuals. Submit five copies where copies are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Document.
- B. Product Data: Collect information into a single submittal for each element of construction or system.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable 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. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operating and maintenance manuals.
 - k. Compliance with recognized trade association standards.
 - l. Compliance with recognized testing agency standards.
 - m. Application of testing agency labels and seals.
 - n. Notation of dimensions verified by field measurement.
 - o. Notation of coordination requirements.
 4. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.
1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products and materials.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Signed and sealed specialty engineering documents.
 - k. Compliance with specified standards.
 - l. Notation of coordination requirements.
 - m. Notation of dimensions established by field measurement.
 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

3. 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 40 inches.
4. Number of Copies: Submit copies of each submittal, as follows:
 - a. Initial Submittal: Submit one correctable, translucent, reproducible print and one blue- or black-line print. Architect will return the reproducible print.
 - b. Final Submittal: Submit three blue- or black-line prints, unless prints are required for operation and maintenance manuals. Submit five prints where prints are required for operation and maintenance manuals. Architect will retain two prints; remainder will be returned.
 - 1) Maintain one of the returned prints as a Record Document.
- D. Coordination Drawings: Comply with requirements in Division 1 Section "Project Management and Coordination."
- E. Samples: Prepare physical units of materials or products, including the following:
 1. 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.
 2. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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.
 3. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
 - a. Generic description of Sample.
 - b. Product name or name of manufacturer.
 - c. Sample source.
 4. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:
 - a. Size limitations.
 - b. Compliance with recognized standards.
 - c. Availability.
 - d. Delivery time.

5. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
 - a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit multiple units (not less than 3) that show approximate limits of the variations.
 - b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
6. Number of Samples for Initial Selection: Submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return one set with options selected.
7. Number of Samples for Verification: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
8. 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.
9. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, and installers, and others as required for performance of the Work. Show distribution on transmittal forms.
 - a. Field samples specified in individual Sections are special types of samples. Field samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the Work will be judged.
- F. Delegated-Design Submittal: Comply with requirements in Division 01 Section "Quality Requirements."
- G. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation."

- H. Application for Payment: Comply with requirements in Division 01 Section "Payment Procedures."
- I. Schedule of Values: Comply with requirements in Division 01 Section "Payment Procedures."
- J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized 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.
 - 3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."
- B. Contractor's Construction Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- J. Preconstruction Test Reports: Prepare 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.
- K. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.
- M. Product Test Reports: For individual Specification Sections requiring Test Reports prepare written reports indicating current product produced by manufacturer complies with requirements. 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.
- N. Research/Evaluation Reports: For individual Specification Sections requiring Research/Evaluation Reports prepare 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:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures."

- P. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
 2. Required substrate tolerances.
 3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.
- Q. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service 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 whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- R. Construction Photographs: Comply with requirements in Division 1 Section "Construction Progress Documentation."

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
1. Final Unrestricted Release: When submittals are marked "Accepted", that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 2. Final-But-Restricted Release: When submittals are marked "Accepted as Noted", that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and with requirements of the Contract Documents; final acceptance will depend upon that compliance
 3. Returned for Resubmittal: When submittal is marked "Revise and Resubmit as Requested", do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 4. Rejected: When submittal is marked "Not Accepted", do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations, resubmit without delay.
 5. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "No Action Taken" or similar identifier.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Other Submittals: Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 01330

SECTION 01330 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

1.2 DEFINITIONS

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

1.3 SUBMITTAL PROCEDURES

- A. General: One electronic copy of CAD Drawings of the Contract Drawings will be provided by Architect, with appropriate disclaimers, for Contractor's use in preparing submittals.
- 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. Coordinate transmittal of different types of submittals for related parts of the Work 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. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.

- D. Processing Time: Allow sufficient time for submittal review, including time for resubmittals, so that installation will not be delayed as a result of the time required to process submittals. Time for review shall commence on Architect's receipt of submittal.
1. Initial Review: Allow two weeks for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Allow two weeks for processing each resubmittal.
 4. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- E. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
 2. Provide two spaces approximately 4 by 5 inches on label or beside the title block to record Architect and Contractor's review and approval markings and action taken.
 3. Include the following information on label for processing and recording action taken:
 - a. Project name.
 - b. Date.
 - c. Name and address of Architect.
 - d. Name and address of Contractor.
 - e. Name and address of subcontractor.
 - f. Name and address of supplier.
 - g. Name of manufacturer.
 - h. Number and title of appropriate Specification Section.
 - i. Drawing number and detail references, as appropriate.
 - j. Contractor/ Architect's log number.
 - 1) Example: 03000-1A-B
 - k. Other necessary identification.
- F. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals.
- G. Transmittal Form: Submit transmittal for to the Architect for review. The Architect will make revisions if necessary.
1. Process transmittal forms to provide a record of activity.

- H. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal from Contractor to Architect using a transmittal form. Submittals received from sources other than the Contractor will be returned without action.
 - 1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
 - 2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
 - 1. Do not proceed with installation until an applicable copy of Product Data applicable is in the installer's possession.
- J. Use for Construction: Use only final submittals with mark indicating action taken by Architect in connection with construction.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
 - 1. Number of Copies: Submit copies of each submittal, as follows, unless otherwise indicated:
 - a. Initial Submittal: Submit two preliminary copies of each submittal where selection of options, color, pattern, texture, or similar characteristics is required. Architect will return one submittal with options selected.
 - b. Final Submittal: Submit three copies, unless copies are required for operation and maintenance manuals. Submit five copies where copies are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Document.
- B. Product Data: Collect information into a single submittal for each element of construction or system.
 - 1. If information must be specially prepared for submittal because standard printed data are not suitable 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. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate the applicable information.
 3. Include the following information, as applicable:
 - a. Manufacturer's written recommendations.
 - b. Manufacturer's product specifications.
 - c. Manufacturer's installation instructions.
 - d. Standard color charts.
 - e. Manufacturer's catalog cuts.
 - f. Wiring diagrams showing factory-installed wiring.
 - g. Printed performance curves.
 - h. Operational range diagrams.
 - i. Mill reports.
 - j. Standard product operating and maintenance manuals.
 - k. Compliance with recognized trade association standards.
 - l. Compliance with recognized testing agency standards.
 - m. Application of testing agency labels and seals.
 - n. Notation of dimensions verified by field measurement.
 - o. Notation of coordination requirements.
 4. Do not submit Product Data until compliance with requirements of the Contract Documents has been confirmed.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Do not use Shop Drawings without an appropriate final stamp indicating action taken in connection with construction.
1. Preparation: Include the following information, as applicable:
 - a. Dimensions.
 - b. Identification of products and materials.
 - c. Fabrication and installation drawings.
 - d. Roughing-in and setting diagrams.
 - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
 - f. Shopwork manufacturing instructions.
 - g. Templates and patterns.
 - h. Schedules.
 - i. Design calculations.
 - j. Signed and sealed specialty engineering documents.
 - k. Compliance with specified standards.
 - l. Notation of coordination requirements.
 - m. Notation of dimensions established by field measurement.
 2. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

3. 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 40 inches.
4. Number of Copies: Submit copies of each submittal, as follows:
 - a. Initial Submittal: Submit one correctable, translucent, reproducible print and one blue- or black-line print. Architect will return the reproducible print.
 - b. Final Submittal: Submit three blue- or black-line prints, unless prints are required for operation and maintenance manuals. Submit five prints where prints are required for operation and maintenance manuals. Architect will retain two prints; remainder will be returned.
 - 1) Maintain one of the returned prints as a Record Document.
- D. Coordination Drawings: Comply with requirements in Division 1 Section "Project Management and Coordination."
- E. Samples: Prepare physical units of materials or products, including the following:
 1. 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.
 2. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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.
 3. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
 - a. Generic description of Sample.
 - b. Product name or name of manufacturer.
 - c. Sample source.
 4. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:
 - a. Size limitations.
 - b. Compliance with recognized standards.
 - c. Availability.
 - d. Delivery time.

5. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
 - a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit multiple units (not less than 3) that show approximate limits of the variations.
 - b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
 6. Number of Samples for Initial Selection: Submit two full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return one set with options selected.
 7. Number of Samples for Verification: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned.
 - a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 8. 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.
 9. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, and installers, and others as required for performance of the Work. Show distribution on transmittal forms.
 - a. Field samples specified in individual Sections are special types of samples. Field samples are full-size examples erected on site to illustrate finishes, coatings, or finish materials and to establish the standard by which the Work will be judged.
- F. Delegated-Design Submittal: Comply with requirements in Division 01 Section "Quality Requirements."
- G. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation."

- H. Application for Payment: Comply with requirements in Division 01 Section "Payment Procedures."
- I. Schedule of Values: Comply with requirements in Division 01 Section "Payment Procedures."
- J. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.

2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
 - 1. Number of Copies: Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
 - 2. Certificates and Certifications: Provide a notarized 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.
 - 3. Test and Inspection Reports: Comply with requirements in Division 1 Section "Quality Requirements."
- B. Contractor's Construction Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation."
- C. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements.
- E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
- F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.

- G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
- H. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- I. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- J. Preconstruction Test Reports: Prepare 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.
- K. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, 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.
- M. Product Test Reports: For individual Specification Sections requiring Test Reports prepare written reports indicating current product produced by manufacturer complies with requirements. 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.
- N. Research/Evaluation Reports: For individual Specification Sections requiring Research/Evaluation Reports prepare 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:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- O. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 1 Section "Closeout Procedures."

- P. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
 2. Required substrate tolerances.
 3. Sequence of installation or erection.
 4. Required installation tolerances.
 5. Required adjustments.
 6. Recommendations for cleaning and protection.
- Q. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service 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 whether conditions, products, and installation will affect warranty.
 7. Other required items indicated in individual Specification Sections.
- R. Construction Photographs: Comply with requirements in Division 1 Section "Construction Progress Documentation."

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
1. Final Unrestricted Release: When submittals are marked "Accepted", that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
 2. Final-But-Restricted Release: When submittals are marked "Accepted as Noted", that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and with requirements of the Contract Documents; final acceptance will depend upon that compliance
 3. Returned for Resubmittal: When submittal is marked "Revise and Resubmit as Requested", do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark.
 4. Rejected: When submittal is marked "Not Accepted", do not proceed with that part of the work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations, resubmit without delay.
 5. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "No Action Taken" or similar identifier.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Other Submittals: Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION 01330

SECTION 01400 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting 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 -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

- A. 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.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.

2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

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

1.4 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

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. 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.
- D. 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.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, 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. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time 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.
 - 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.
- 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 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, and telephone number 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 inspecting.
 - 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, and telephone number 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 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, and telephone number 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 whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.8 QUALITY ASSURANCE

- A. General: 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.
- 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, 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 are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
 - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
 - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- 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 installation 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 responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

- c. 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. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, 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, 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 in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow seven days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.
- M. Room Mockups: Construct room mockups incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Provide room mockups of the following rooms:
1. Where indicated on the Drawings.

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 inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. 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 required to verify that the Work complies with requirements, whether specified or not.
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. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting 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 inspecting 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. 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."
- D. 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.

- E. 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.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location 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 any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. 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 inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 6. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 - 1. Distribution: Distribute schedule to Owner, Architect, 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: Conducted by a qualified testing agency or special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
 2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
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 01400

SECTION 01420 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01420

SECTION 01420 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
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- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01420

SECTION 01500 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities.
- B. Temporary utilities include, but are not limited to, the following:
 - 1. Water service and distribution.
 - 2. Electric power service.
 - 3. Lighting.
 - 4. Telephone service.
 - 5. Storm and sanitary sewer.
 - 6. Storm water run-off control.
- C. Support facilities include, but are not limited to, the following:
 - 1. Temporary roads and paving.
 - 2. Dewatering facilities and drains.
 - 3. Project identification and temporary signs.
 - 4. Waste disposal facilities.
 - 5. Field offices.
 - 6. Storage and fabrication sheds.
 - 7. Lifts and hoists.
 - 8. Construction aids and miscellaneous services and facilities.
 - 9. Sanitary facilities, including drinking water.
 - 10. Temporary heat.
- D. Security and protection facilities include, but are not limited to, the following:
 - 1. Environmental protection.
 - 2. Stormwater control.
 - 3. Tree and plant protection.
 - 4. Pest control.
 - 5. Barricades, warning signs, and lights.
 - 6. Sidewalk bridge or enclosure fence for the site.
 - 7. Temporary enclosures.
 - 8. Temporary partitions.
 - 9. Fire protection.

1.2 DEFINITIONS

- A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.3 USE CHARGES

- A. General: Cost or use charges for temporary facilities are not chargeable to Owner or Architect and shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, the following:
 - 1. Architect.
 - 2. Testing agencies.
 - 3. Personnel of authorities having jurisdiction.
- B. Sewer Service: Pay sewer service use charges for sewer usage, by all parties engaged in construction, at Project site.
- C. Water Service: Pay water service use charges, whether metered or otherwise, for water used by all entities engaged in construction activities at Project site.
- D. Electric Power Service: Pay electric power service use charges, whether metered or otherwise, for electricity used by all entities engaged in construction activities at Project site.

1.4 SUBMITTALS

- A. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.
- B. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.
- C. Temporary Partitions: Provide plan showing location of temporary partitions for review and approval by the Owner and the Architect.

1.5 QUALITY ASSURANCE

- A. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:
 - 1. Building Code requirements.
 - 2. Health and safety regulations.
 - 3. Utility company regulations.
 - 4. Police, Fire Department, and Rescue Squad rules.
 - 5. Environmental protection regulations.

- B. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 - 2. Industry Recommendations: Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.
 - 3. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 PROJECT CONDITIONS

- A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.
 - 1. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
 - 1. Keep temporary services and facilities clean and neat.
 - 2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Lumber and Plywood: Comply with requirements in Division 6 Section "Rough Carpentry."
 - 1. For job-built temporary offices, shops and sheds within the construction area provide UL labeled, fire treated lumber and plywood for framing, sheathing and siding.
 - 2. For signs and directory boards, provide exterior type, Grade B-B High Density Concrete Form Overlay Plywood conforming to PS-1, of sizes and thickness indicated.

3. For fences and vision barriers, provide exterior type, minimum 3/8" thick plywood.
 4. For safety barriers, sidewalk bridges and similar uses, provide minimum 5/8" thick exterior plywood.
- C. Roofing: UL Class A, Standard-weight, mineral-surfaced, asphalt shingles or asphalt-impregnated and -coated, mineral-surfaced, roll-roofing sheet.
- D. Gypsum Board: Minimum 1/2 inch thick by 48 inches wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
- F. Paint: Comply with requirements in Division 9 Section "Painting."
- G. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.
- H. Water: Potable.
- I. Fencing: Provide minimum 11-gauge, galvanized 2-inch chain link fabric fencing 6-feet high with galvanized steel pipe posts, 1-1/2" I.D. for line posts and 2-1/2" I.D. for corner posts.
1. For fence facing the Hotel provide windscreen as follows:
 - a. Type: Vinyl coated polyester, open mesh with half-moon air vents.
 - b. Opacity: 80%, minimum.
 - c. Weight: Minimum 10 ounces per square yard.
 - d. Accessories: Provide with brass grommets and plastic break-away cable ties.

2.2 EQUIPMENT

- A. General: Provide new equipment, if acceptable to the Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.
- B. Field Offices: Prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading. Provide the following for job-built construction:
1. Exposed Lumber and Plywood: Paint with exterior-grade, acrylic-latex emulsion over exterior primer.
 2. Interior Walls: Paint with two coats of interior latex-flat wall paint.
 3. Roofs: Asphalt shingles or roll roofing.

- C. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
 - 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- D. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation, or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- E. Heating Equipment: Provide self-contained heaters with individual space thermostatic control.
 - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
 - 2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.
- F. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
 - 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
 - 3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.

- B. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.
1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
 2. Connect temporary sewers to municipal system as directed by sewer department officials.
 3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
 3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.
 - a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
 4. Drinking-Water Facilities: Provide bottled-water, drinking-water units; include paper supply.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

- G. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
 - 1. Install electric power service underground, unless overhead service must be used.
 - 2. Install power distribution wiring overhead and rise vertically where least exposed to damage.
- H. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment.
 - 1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- J. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.
 - 1. Provide additional telephone lines for the following:
 - a. In field office with more than two occupants, install a telephone for each additional occupant or pair of occupants.
 - 2. At each telephone, post a list of important telephone numbers.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
 - 2. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.

- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Review proposed modifications to permanent paving with the Architect. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 2. Coordinate temporary paving development with subgrade grading, compaction, installation and stabilization of subbase, and installation of base and finish courses of permanent paving.
 3. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 2 Section "Earthwork."
 4. Install temporary paving to minimize the need to rework the installations as to result in permanent roads and paved areas that are without damage or deterioration when occupied by the Owner.
 5. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 6. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 2 Section "Asphalt Paving." Coordinate with weather conditions to avoid unsatisfactory results.
- C. Dewatering Facilities and Drains: Comply with requirements in applicable Division 2 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.
- D. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
 2. Prepare temporary signs to provide directional information to construction personnel and visitors.
 3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thickness indicated. Support on posts or framing of preservative-treated wood or steel.
 4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.

- E. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements.
 - 1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
 - 2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.
- F. Janitorial Services: Provide janitorial services on a daily basis for temporary offices, toilets, wash facilities, and similar areas.
- G. General Contractor's Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 10 persons at Project site. Keep office clean and orderly.
 - 1. Furnish and equip offices as follows:
 - a. Desk and four chairs, four-drawer file cabinet, a plan table, a plan rack, and bookcase.
 - b. Water cooler and private toilet complete with water closet, lavatory, and medicine cabinet with mirror.
- H. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.
 - 1. Construct framing, sheathing, and siding using fire-retardant-treated lumber and plywood.
 - 2. Paint exposed lumber and plywood with exterior-grade acrylic-latex emulsion over exterior primer.
- I. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.
- B. Stormwater Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of stormwater from heavy rains.
- C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from construction damage. Protect tree root systems from damage, flooding, and erosion.
- D. Site Enclosure Fence: When excavation begins, install chain-link fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates.
 - 1. Set fence posts in compacted mixture of gravel and earth.
 - 2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
- E. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- F. Temporary Exterior Lighting: Install exterior yard and sign lights so that signs are visible when Work is being performed.
- G. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
- H. Covered Walkway: Erect a structurally adequate, protective, covered walkway for passage of persons along adjacent public street. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.
 - 1. Construct covered walkways using scaffold or shoring framing.
 - 2. Provide wood-plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 - 3. Extend back wall beyond the structure to complete enclosure fence.

4. Paint and maintain in a manner approved by Owner and Architect.
 5. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch-thick exterior plywood.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
 2. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
 3. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
 4. Where temporary wood or plywood enclosure exceeds 100 sq. ft.in area, use fire-retardant-treated material for framing and main sheathing.
- J. Temporary Partitions: Walls shall be constructed to keep public areas TOTALLY free from dust and debris, and to maintain separation between the construction and public areas, and to prevent visual observation of the construction.
1. Do not mechanically fasten demining wall framing members to existing construction (concrete slab, concrete walks, walls, etc.). Design, brace, and support walls as required to provide protection necessary.
 2. Construct partitions to completely seal the return air plenum areas from the construction areas. Install partitions to underside of slab and seal air-tight.
 3. Construct walls with metal studs, structurally sound, properly braced, and not more than 24-inches on center. The studs shall be covered with a minimum one-half-inch thick Type X gypsum board complying with ASTM C 1396. Install bracing in a manner that minimizes the damage to the finishes existing or proposed. The gypsum drywall shall be constructed and finished in accordance with Section 09290 Gypsum Board. Install a 1" x 6" high painted wood base the full length of the partition; color to be selected by the Architect.
 4. Install 6 mil thick (minimum thickness) polyethylene sheet around the entire perimeter of the partition from the underside of the deck above to the top of the wall. The polyethylene sheet shall be installed in a manner to assure the public is not affected by the construction activities.
 5. Provide air filtration, as required, for all interior work areas for total dust control. Locate filtration equipment inside the construction area and within the partition perimeters. Provide equipment to prevent dust from migrating into occupied areas. Provide additional filtration units if resultant dust levels are not acceptable to the Owner.
 6. Provide access door with lockset, and automatic closing device. Lockset shall be mortise or cylindrical type, with large format removable cores, in compliance with the Owner's standards. All locks shall be keyed to the Building System to allow emergency access by the Owner to all construction areas.
 - a. Paint door and frame to match the wall color specified.

- K. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
 - a. Field Offices: Class A stored-pressure water-type extinguishers.
 - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
 - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
 2. Store combustible materials in containers in fire-safe locations.
 3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
 4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
 5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
 6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.5 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

- D. Termination and Removal: Unless the Architect requests that temporary facilities be maintained longer, remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 1 Section "Closeout Procedures".

END OF SECTION 01500

SECTION 01600 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other manufacturers.

1.3 ACTION SUBMITTALS

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

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. Refer to Divisions 02 through 49. Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "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 not in conflict with 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 the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. 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.
 2. 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.
 3. Products:
 - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered, unless otherwise indicated.

- b. Nonrestricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
 - 4. Manufacturers:
 - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered, unless otherwise indicated.
 - b. Nonrestricted List: 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. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
 - 5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "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 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: 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 these requirements:
 - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01600

SECTION 01730 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. General installation of products.
 - 4. Coordination of Owner-installed products.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.

1.2 SUBMITTALS

- A. Qualification Data: For professional engineer to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit two copies signed by professional engineer.
- E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
1. Before construction, verify the location and points of connection of utility services.
- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - a. Description of the Work.
 - b. List of detrimental conditions, including substrates.
 - c. List of unacceptable installation tolerances.
 - d. Recommended corrections.
 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and the Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

- B. 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 to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- C. 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.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. 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. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

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. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a professional engineer to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 3. Inform installers of lines and levels to which they must comply.
 - 4. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 5. 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 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.

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. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- 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.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of indicated in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 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.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 - 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 forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. 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.
- J. 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.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- 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: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.9 PROTECTION OF INSTALLED CONSTRUCTION

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

3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01730

SECTION 01770 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Inspection procedures.
 2. Project record documents; refer to Section 017839, Project Record Documents.
 3. Operation and maintenance manuals; refer to Section 017823, Operation and Maintenance Data.
 4. Warranties.
 5. Instruction of Owner's personnel.
 6. Final cleaning.

1.2 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 2. Advise Owner of pending insurance changeover requirements.
 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 7. Complete startup testing of systems.
 8. Submit test/adjust/balance records.
 9. Terminate and remove temporary facilities from Project site, construction tools, and similar elements.
 10. Advise Owner of changeover in heat and other utilities.
 11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 12. Complete final cleaning requirements, including touchup painting.
 13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

- B. Inspection: Submit a written request for inspection for Substantial Completion. 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 - 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
 - 1. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and photographic negatives, damage or settlement surveys, property surveys, and similar final record information.
 - 2. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
 - 3. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 4. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training videotapes.
- B. Inspection: Submit a written request for final inspection for acceptance. 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies 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.
 2. Organize items applying to each space by major element, including categories for ceiling, 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.

1.5 PROJECT RECORD DOCUMENTS

- A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.
- B. Project Record Documents: Refer to Section 017839, Project Record Documents.

1.6 OPERATION AND MAINTENANCE MANUALS

- A. General: Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
1. Operation and Maintenance Manuals: Refer to Section 017823, Operation and Maintenance Data.

1.7 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

- A. Instruction: Instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Provide instructors experienced in operation and maintenance procedures.
 - 2. Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at the start of each season.
 - 3. Schedule training with Owner with at least seven days' advance notice.
 - 4. Coordinate instructors, including providing notification of dates, times, length of instruction, and course content.
- B. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. For each training module, develop a learning objective and teaching outline. Include instruction for the following:
 - 1. System design and operational philosophy.
 - 2. Review of documentation.
 - 3. Operations.

4. Adjustments.
5. Troubleshooting.
6. Maintenance.
7. Repair.

3.2 FINAL CLEANING

- A. General: Provide 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 portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. 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.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

- m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Replace parts subject to unusual operating conditions.
 - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
 - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 - s. Leave Project clean and ready for occupancy.
2. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

SECTION 01782 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes and systems and equipment.

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 SUBMITTALS

- A. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return 1 copy of draft and mark whether general scope and content of manual are acceptable.
- B. Final Submittal: Submit 1 copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
 - 1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

1.4 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

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

2.2 MANUALS, GENERAL

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. 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, address, and telephone number of Contractor.
 - 6. Name and address of Architect.
 - 7. Cross-reference to related systems in other operation and maintenance manuals.

- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch, 20-lb/sq. ft. white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
 2. Performance and design criteria if Contractor is delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:
1. Product name and model number.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information: Include the following, as applicable:
 - 1. Product name and model number.
 - 2. Manufacturer's name.
 - 3. Color, pattern, and texture.
 - 4. Material and chemical composition.
 - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 - 1. Inspection procedures.
 - 2. Types of cleaning agents to be used and methods of cleaning.
 - 3. List of cleaning agents and methods of cleaning detrimental to product.
 - 4. Schedule for routine cleaning and maintenance.
 - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in the 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.

- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard printed maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
 - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 - 2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."
- G. Comply with Division 01 Section "Closeout Procedures" for the schedule for submitting operation and maintenance documentation.

END OF SECTION 01782

SECTION 01783 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.

1.2 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up Record Prints.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.
 - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as Record Product Data.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
 - 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 prepare the 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 understandable drawing technique.
 - c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

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 below first floor.
 - 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 or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.

3. Record the name of the 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 Drawings, and Product Data where applicable.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Drawings, and Product Data where applicable.

2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours

END OF SECTION 01783

SECTION 01790 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for instructing Owner's personnel. The General Contractor shall train the Owner's personnel in the operation and maintenance of equipment specified. Training shall include, but not be limited to, the following:
 - a. Demonstration of operation of systems, subsystems, and equipment.
 - b. Training in operation and maintenance of systems, subsystems, and equipment.

1.2 SUBMITTALS

- A. Instruction Program: Submit two copies of 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.
 1. At completion of training, submit one complete training manual for Owner's use.
- B. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.
- E. Demonstration and Training Videotape: Training sessions shall be videotaped. Submit two copies at end of each training module.
- F. Additional Training: Provide additional training when requested by the Owner.

1.3 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 Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 - 1. Inspect and discuss locations and other facilities required for instruction.
 - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 - 3. Review required content of instruction.
 - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections, including, but not limited to, the following:
 - 1. Motorized doors, including overhead coiling doors.
 - 2. Equipment, including food-service equipment.
 - 3. Fire-protection systems, including fire alarm, fire pumps, and fire-extinguishing systems.
 - 4. Refrigeration systems.

5. HVAC systems, including air-handling equipment air distribution systems and terminal equipment and devices.
 6. HVAC instrumentation and controls.
 7. Electrical service and distribution, including transformers switchboards panelboards uninterruptible power supplies and motor controls.
 8. Lighting equipment and controls.
- 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:
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. Operations manuals.
 - c. Maintenance manuals.
 - d. Project Record Documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
 3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
 4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.

- f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
- B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

- A. The General Contractor shall 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.

- B. 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, with at least seven days' advance notice.

- C. Demonstration and Training Videotape: 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.

- D. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 01790

SECTION 02411 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of building components and materials.
2. Disconnecting, capping or sealing, abandoning in-place and removing site utilities.

1.2 DEFINITIONS

- A. Demolish: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and reinstalled.
- B. Remove and Store: Detach items from existing construction and deliver them to Owner's on site storage area ready to be reinstalled.
- C. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed or removed and 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 SUBMITTALS

- A. Proposed Protection Measures: Submit informational report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

- B. 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. Coordination of Owner's continuing occupancy of portions of existing building.
 5. Means of protection for items to remain and items in path of waste removal from building site.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by building demolition operations. Submit before the Work begins.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI A10.6 and NFPA 241.
- C. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition including, but not limited to, the following:
1. Review methods and procedures for vermin eradication and cleanup.
 2. Inspect and discuss condition of construction to be demolished.
 3. Review structural load limitations of existing structures.
 4. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 5. Review and finalize protection requirements.
 6. Review procedures for noise control and dust control.
 7. Review procedures for protection of adjacent buildings.

1.6 PROJECT 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. Owner assumes no responsibility for buildings and structures to be demolished.
- C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. On-site storage or sale of removed items or materials is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.
- G. Building exclusion and rodent eradication and removal shall be completed prior to the beginning of Selective Structural Demolition operations.

1.7 COORDINATION

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

1.8 WARRANTY

- A. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

- E. 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 building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces, to prevent water leakage and damage to structure and interior areas.

3. Comply with requirements specified in Division 01 Section "Temporary Facilities and Controls."
- C. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 2. Arrange to shut off indicated utilities with utility companies.
 3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
 4. Cut off pipe or conduit a minimum of **24 inches** below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
- D. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of demolition.

3.4 PROTECTION

- A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.
- B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
 2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.
- C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Division 01 Section "Temporary Facilities and Controls."
1. Protect adjacent buildings and facilities from damage due to demolition activities.
 2. Protect existing site improvements, appurtenances, and landscaping to remain.
 3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

- A. General: Demolish indicated existing building components and materials completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 2. Maintain fire watch after flame cutting operations.
 3. Maintain adequate ventilation when using cutting torches.
 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Removed and Stored and Reinstalled Items:
1. Pack or crate items as directed by the Owner. Identify contents of containers.
 2. Store items as directed by the Owner.
 3. Transport items to Owner's storage area on-site.
 4. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Reinstall items in locations indicated. Comply with installation requirements for new materials. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.
- E. Engineering Surveys: During demolition, perform surveys to detect hazards that may result from building demolition activities.

- F. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
 - 2. Limit spread of dust and dirt. Comply with governing environmental-protection regulations.

3.6 DEMOLITION BY MECHANICAL MEANS

- A. Remove debris from building in a controlled manner.
- B. Existing Utilities: Demolish and remove existing indicated.
 - 1. Piping: Disconnect piping at unions, flanges, valves, or fittings.
 - 2. Wiring Ducts: Disassemble into unit lengths and remove plug-in and disconnecting devices.

3.7 REPAIRS

- A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
 - 4. Comply with requirements specified in Division 01 Section "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

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 02411

SECTION 05400 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal framing at raised platform.

1.2 SUBMITTALS

A. Product Data: For cold-formed steel framing products and accessories.

B. Shop Drawings:

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

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

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, registered in the state of Florida, to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

C. Cold-Formed Steel Framing Design Standards:

1. Floor Systems: AISI S210.
2. Wall Studs: AISI S211.
3. Headers: AISI S212.
4. Lateral Design: AISI S213.

- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

2.2 COLD-FORMED STEEL FRAMING, GENERAL

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

1. Grade: As required by structural performance.
2. Coating: G60

2.3 FRAMING ACCESSORIES

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

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

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

2.4 ANCHORS, CLIPS, AND FASTENERS

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

- B. Anchor Bolts: ASTM F 1554.

- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.5 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20.
- B. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.6 FABRICATION

- A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.3 INSTALLATION, GENERAL

- A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
 - 1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- H. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 REPAIRS AND PROTECTION

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

END OF SECTION 05400

SECTION 05500 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous framing and supports.
 - 2. Metal mesh panels.
 - 3. Perforated metal panels.

1.2 SUBMITTALS

- A. Product Data: For fabricated items.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.

PART 2 - PRODUCTS

2.1 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- C. Steel Tubing: ASTM A 500, cold-formed steel tubing.

2.2 PAINT

- A. Shop Primer for Ferrous Metal: Refer to Section 099100, Painting.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports that are not a part of structural-steel framework as necessary to complete the Work.
- B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.6 METAL MESH PANELS

- A. Manufacturer – Basis of Design: McNichols Co., Tampa, FL
 - 1. Type: Decorative mesh.
 - 2. Material: Steel.
 - 3. Finish: Painted.
 - 4. Style: Match Architect's sample.
- B. Other Acceptable Manufacturers: Subject to compliance with requirements for Basis of Design indicated available manufacturers include, but are not limited to, the following:
 - 1. Diamond Manufacturing Company
 - 2. Gage Architectural Products

2.7 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.

- E. Weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
 - 1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches on center, unless otherwise indicated.

2.8 PERFORATED METAL PANELS

- A. Manufacturers: Subject to compliance with requirements for Basis of Design indicated available manufacturers include, but are not limited to, the following:
 - 1. Accurate Perforating
 - 2. AMP (American Metal Perforating) Co
 - 3. Harrington & King Perforating Co
 - 4. Marco Specialty Steel Inc.
- B. Panel Description:
 - 1. Material: 20 gauge Type 316 stainless steel.
 - 2. Finish: #4 Satin finish.
 - 3. Perforation Pattern: As indicated on the Drawings.
 - 4. Panel Length: Minimum 4-feet, maximum 6-feet.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

3.3 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099100 Painting.

END OF SECTION 05500

SECTION 05521 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum railings.

1.2 COORDINATION

- A. Coordinate installation of anchorages for railings. 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.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Railing brackets.
2. Anchoring cement.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Brackets.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Qualification Data: For testing agency.

F. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2, "Structural Welding Code - Aluminum."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, registered in the state of Florida, to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: Local ambient.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 - 1. Provide type of bracket indicated.

2.3 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Tubing: ASTM B 221, Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.
 - 1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.
- G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.4 FASTENERS

- A. General: Provide the following:
 - 1. Aluminum Railings: Type 316 stainless-steel fasteners.
 - 2. Provide exposed fasteners with finish matching appearance of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
 - 1. Material for Exterior Locations: Alloy Group 1 or Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- H. Form Changes in Direction as Follows:
 - 1. As detailed.
- I. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- J. Close exposed ends of railing members with prefabricated end fittings.

- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- M. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 ALUMINUM FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A41.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install railings as indicated.
- B. Fit exposed connections together to form tight, hairline joints.
- C. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
- E. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- F. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 ANCHORING POSTS

- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

3.4 ADJUSTING AND CLEANING

- A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

3.5 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05521

SECTION 05581 – COLUMN COVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Column covers.

1.2 SUBMITTALS

- A. Product Data: Column covers.
- B. Shop Drawings: Show fabrication and installation details for column covers.
 - 1. Include plans, elevations, sections, and details including profiles and connections. Show anchorage and accessory items.
- C. Samples for Verification: For exposed finish required, prepared on 6-inch- square samples of metal of same thickness and material indicated for the Work.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver components in clearly marked containers and packages suitable for shipment of specified products to prevent finish damage.
- B. Store components in locations that will avoid damage from job-site traffic, moisture, stacking or other job-site contamination.
- C. Handle components to avoid racking, twisting, denting or scratching of finished surfaces.

1.4 WARRANTY

- A. Provide manufacturer's warranty against defects in material and workmanship for a period of one year beginning on Date of Substantial Completion.
- B. Finish warranty: Warrant fluoropolymer coating to remain free, under normal atmospheric conditions, from peeling, checking, cracking, chalking in excess of numerical rating of 8 when measured in accord with ASTM D4214, of fading in excess of 5 N.B.S. Units during warranty period.
 - 1. Warranty Period: 20 years beginning at Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL COLUMN COVERS

A. Product and Manufacturer – Basis of Design:

1. ALUCOBOND; 3A Composites USA, Inc., Benton, KY
 - a. Total Panel Thickness: 4mm
2. Composition: Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials. The core material shall be free of voids and/or air spaces and not contain foamed insulation material. Products laminated sheet by sheet in a batch process using glues or adhesives between materials shall not be acceptable.
 - a. Face Sheet Thickness: 0.50mm nominal.

B. Other Acceptable 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. Citadel Architectural Products
2. Fry Reglet

2.2 FABRICATION

- A. Form column covers to specified dimensions and diameters as indicated on shop drawings.
- B. Provide column covers in sections a maximum 16'-0" tall per section where required, provide stacking joints to allow for heights above 16'-0".
- C. Provide additional sections to achieve finished heights above 12'-0".
- D. Columns shall have no exposed fasteners.
- E. Provide support structures including additional bracing components as necessary to stiffen substructure and insure solid mid-span bracings and connections.
- F. Openings in column covers shall be laser cut at factory.
- G. Provide operable metal cover access panel with concealed hinge and cylinder lock keyed to the building system. Construct access panel to fit flush with column surface and to appear concealed from view.

2.3 ACCESSORIES

- A. Extrusions, formed members, sheet, and plate shall conform with ASTM B209 and the recommendations of the manufacturer.
- B. Panel stiffeners, if required, shall be structurally fastened or restrained at the ends and shall be secured to the rear face of the composite panel with silicone of sufficient size and strength to maintain panel flatness. Stiffener material and/or finish shall be compatible with the silicone.
- C. Sealants and gaskets within the panel system shall be as per manufacturer's standards to meet performance requirements.
- D. Fasteners (concealed/exposed/non-corrosive): Fasteners as recommended by panel manufacturer. Do not expose fasteners except where unavoidable and then match finish of adjoining metal.

2.4 ALUMINUM FINISHES

- A. High-Performance Organic Finish: KYNAR 500 or HYLAR 5000 based Polyvinylidene Fluoride (PVDF) or Fluoro Ethylene – Alkyl Vinyl Ether (FEVE) resin in conformance with general requirements of AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 1. Color: Custom to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine job-site conditions for conditions that may adversely affect installation of column covers.
- B. Verify dimensions of column covers prior to installation to assure compatibility with job-site conditions.
- C. Verify post structure is plumb, level, and parallel prior to installation of column covers.
- D. Visually examine finished surfaces to assure that blemished or dented surfaces are not present prior to installation.

3.2 INSTALLATION

- A. Install components in accord with manufacturer's installation instructions and recommendations and approved shop drawings.
- B. Anchor components as indicated. Use anchors with holding strength to provide a solid installation. Use 300 Series stainless steel anchors.

3.3 CLEANING

- A. Remove protective coverings and clean column covers in accordance with manufacturer's instructions and recommendations. Test all solvents on non-exposed surfaces prior to use.
- B. Visually inspect all exposed surfaces for scratches or blemishes.
- C. Protect column covers from damage during remainder of construction period.
- D. Replace damaged column covers where required by the Architect.

END OF SECTION 05581

SECTION 05730 - ORNAMENTAL FORMED METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless steel base.
2. Stainless steel cap.

1.2 SUBMITTALS

- A. Product Data: For each type of product, including finishing materials.
- B. Samples for Initial Selection: For mechanical finishes.
- C. Samples for Verification: For exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

1.4 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SHEET METAL

- A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.
- B. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 316, stretcher-leveled standard of flatness.

2.2 MISCELLANEOUS MATERIALS

- A. Sealants, Interior: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834; of type and grade required to seal joints in decorative formed metal; and as recommended in writing by decorative formed metal manufacturer.

2.3 FABRICATION, GENERAL

- A. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.

2.4 STAINLESS STEEL BASE

- A. Form metal base from metal of type and thickness indicated below:
 - 1. Stainless-Steel Sheet: 0.050 inch.
 - a. Finish: No. 4 finish.

2.5 STAINLESS STEEL CAP

- A. Form metal cap from metal of type and thickness indicated below:
 - 1. Stainless-Steel Sheet: 0.050 inch.
 - a. Finish: No. 4 finish.
- B. Weld seams at end closures.

2.6 GENERAL FINISH REQUIREMENTS

- A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

- A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.
 - 1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.
- B. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

3.3 ADJUSTING AND CLEANING

- A. Clean metals to remove fingerprints, soil, and other blemishes and contaminates. Polish exposed surfaces.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

- A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05730

SECTION 06100 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Wood nailers and blocking.

1.2 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, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
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, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.

1.3 QUALITY ASSURANCE

A. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

- A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.
- B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. SPIB - Southern Pine Inspection Bureau.
 - 2. WCLIB - West Coast Lumber Inspection Bureau.
 - 3. WWPA - Western Wood Products Association.
- C. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - 1. Provide dressed lumber, S4S, unless otherwise indicated.
 - 2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Pressure Treatment: Wolmanized Natural Select (CBA) preserve pressure treatment; Arch Wood Protection, USA.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWWA C20 (lumber). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber.
 - 2. Use treatment that does not promote corrosion of metal fasteners.
 - 3. Use Interior Type A unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.

2.4 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including but not limited to, the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Where necessary for installation of other work and not otherwise prohibited.
- B. Fabricate miscellaneous lumber from fire-retardant-treated dimension lumber of sizes indicated and into shapes shown.
- C. Moisture Content: 19 percent maximum for lumber items are not specified to receive wood preservative treatment.
- D. Grade: For dimension lumber sizes, provide No. 3 or Standard grade lumber per ALSC's NGRs of any species. For board-size lumber, provide No. 3 Common grade per NELMA, NLGA, or WWPA; No. 2 grade per SPIB; or Standard grade per NLGA, WCLIB or WWPA of any species.

2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where miscellaneous carpentry is in contact with roofing or flashing, provide fasteners with a hot-dip zinc coating per ASTM A 153 or of Type 304 stainless steel.

- B. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. All rough carpentry related to roofing construction shall be installed in accordance with FM 1-49.
- B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the Building Code.
- D. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.
- F. Fit carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
- G. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber.
- H. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- I. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.

3.2 WOOD SLEEPERS, BLOCKING, AND NAILER INSTALLATION

- 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 items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

END OF SECTION 06100

SECTION 06412 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

1.2 SUBMITTALS

A. Product Data: For products indicated, including high-pressure decorative laminate and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
3. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each color, pattern, and surface finish, with one sample applied to core material.

1.3 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in Field Conditions Article.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels 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, 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.

1.6 COORDINATION

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

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-faced architectural cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. Provide labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Grade: Custom.
- B. Type of Construction: As indicated.
- C. Cabinet, Door, and Drawer Front Interface Style: As indicated.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
 - 1. Products and Manufacturers: Refer to the Finish Material List.

- E. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Vertical Surfaces: Grade VGS.
 - 3. Edges: Grade HGS.

- F. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade CLS.
 - a. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade CLS.
 - 2. Drawer Sides and Backs: White Birch or White Maple plywood; not less than 3/8-inch thick; clear finish.
 - 3. Drawer Bottoms: White Birch or White Maple plywood; not less than 1/4-inch thick; clear finish.

- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

- 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 or glued dovetail joints.

- 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. Refer to the Material Code Schedules.

2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

- B. Plywood: APA Grade A-C; HPVA HP-1, made with adhesive containing no urea formaldehyde.
 - 1. Thickness: 3/4-inch unless otherwise indicated.

2.4 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.

- B. Hinges: Concealed, overlay, self-closing, all metal, 165-degree opening, independent screw action. Hinge plate shall be T-type, fully adjustable. Provide number of hinges per door as recommended by the manufacturer based on door dimensions.
 - 1. Products and Manufacturer: Subject to compliance with requirements, available products and manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Blum, Inc.
 - b. Grass America, Inc.
 - c. Hafele America Co.
- C. Pulls: Solid wire pull.
 - 1. Product and Manufacturer – Basis of Design: DP57B; Doug Mockett & Company, Inc.
 - a. Size: 4-5/32" long; 3/8" diameter; 1-13/32" projection.
 - b. Material: Stainless steel; satin finish.
 - c. Fasteners: Provide with mounting screws.
- D. Adjustable Shelf Supports/ Shelf Rests: plastic two-pin type with shelf hold-down clip.
 - 1. Product and Manufacturer – Basis of Design: Item No. 282.47.402 Shelf Support, Double Pin, transparent plastic; Hafele America, Archdale, NC
- E. Drawer Slides:
 - 1. Product and Manufacturer – Basis of Design: Series 3832 AA Action Assist, full extension drawer slide; 100 pound rating; Accuride International
- F. PVC Edge Banding: Polyethylene molding strip for cabinet edges; PVC edge banding for all cabinet doors, and drawers.
 - 1. Products and Manufacturer: Subject to compliance with requirements, available products and manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. 3M and Charter Industries, Grand Rapids, MI.
 - 1) Colors: To be selected by the Architect.
 - 2) Thickness: 3mm.
 - 3) Width: Full width of edge.
- G. Metal Base and Wall Cap: Type 316 stainless steel; #4 stain finish.
 - 1. Thickness: 3/16-inch.

2.5 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood 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. Adhesives: Do not use adhesives that contain urea formaldehyde.

2.6 FABRICATION

- A. General: Fabricate cabinets and shelves to dimensions, profiles, and details indicated.
 - 1. 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.
 - 2. 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.
- B. Veneer Core Substrate: Plywood, unless otherwise indicated.
- C. Shelves: High pressure laminate all sides, ends and edges unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
 - 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
- G. Countertops: Anchor securely.
 - 1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 - 2. Secure backsplashes.
 - 3. Fill and cover space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 06412

SECTION 06615 – SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz surface.

1.2 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.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

1.3 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

PART 2 - PRODUCTS

2.1 QUARTZ SURFACE

A. Products and Manufacturers: Refer to the Finish Material List.

B. Configuration: As indicated.

C. Fabrication: Fabricate tops in one piece, unless otherwise indicated. Comply with material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

D. Adhesives: Types recommended by the manufacturer for applications indicated. Adhesives shall not contain urea formaldehyde.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet.
- B. Fasten countertops securely to base cabinet. 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.

END OF SECTION 06615

SECTION 07210 - BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.
- B. Fire Performance Characteristics: Insulation materials shall be identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated, by a testing agency acceptable to authorities having jurisdiction.
 - 1. Surface Burning Characteristics: ASTM E-84
 - 2. Combustion Characteristics: ASTM E-136

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - 1. Sound Attenuation Insulation:
 - a. CertainTeed Corporation
 - b. Knauf Fiber Glass GmbH
 - c. Owens-Corning Fiberglas Corporation

2.2 INSULATION

- A. Sound Attenuation Insulation: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Thickness: As indicated.

2.3 ACCESSORIES

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation, of thickness indicated, securely in position indicated with self-locking washer in place.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION OF INSULATION - GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Install insulation in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07210

SECTION 07841 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
 - a. Walls and partitions.
 - b. Floors, ceilings, and roofs.
 - c. Smoke barriers.

1.2 PERFORMANCE REQUIREMENTS

- A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
 1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
 2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.
 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.3 SUBMITTALS

- A. Product Data: For each type of through-penetration firestop system product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
 - 2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and Owners, and other information specified.
- D. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
- E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Installer Qualifications: An experienced installer who is qualified by having the necessary experience, staff, and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to Contractor or to an installer engaged by Contractor does not in itself confer qualification on buyer.
- C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

- D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
 - 1) UL in "Fire Resistance Directory."
- E. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hilti Construction Chemicals, Inc.
 - 2. Nelson Firestop Products.
 - 3. 3M Fire Protection Products.
 - 4. Tremco

2.2 FIRESTOPPING, GENERAL

- A. Compatibility: 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.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
 - 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fiber insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.

- c. Fire-rated form board.
 - d. Fillers for sealants.
- 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.
- B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- C. Firestop 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 elastomeric sheet bonded to galvanized steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- 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: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
- 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: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade: Pourable (self-leveling) formulation for openings in horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in other horizontal surfaces.
3. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.

2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing 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, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 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 Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

- A. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - 1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.

3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop 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 through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07841

SECTION 07920 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Joint sealants.

1.2 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range for this characteristic.

2.2 PRODUCTS AND MANUFACTURERS

- A. Products: Substitutions for exterior building joint sealants shall be listed on the Validated Products list published by the Sealant, Waterproofing, and Restoration Institute (SWRI).
- B. Joint-Sealant: One-part silicone sanitary sealant.
 - 1. Application: Interior joints in vertical and horizontal non-traffic surfaces – sanitary sealant.
 - 2. Joint Locations: At plumbing fixtures in toilets and janitor closets, and horizontal and vertical joints of dissimilar materials in toilets and other wet areas.

3. Products and Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. 786; Dow Corning Corp.
 - b. 898; Pecora Corp.
 - c. 600; Tremco, Inc.
 4. Manufacturer's Warranty: Minimum 15 years.
- C. Joint-Sealant: One-part latex sealant.
1. Application: Interior joints in vertical and horizontal non-traffic surfaces.
 2. Joint Locations: Horizontal and vertical joints around door frames, and joints between dissimilar materials.
 3. Products and Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AC-20; Pecora Corp.
 - b. Sonolac; BASF Building Systems
 - c. Tremco Acrylic Latex 834; Tremco, Inc.
 4. Manufacturer's Warranty: Minimum 15 years.

2.3 JOINT-SEALANT BACKING

- A. Backer Rod (Joint Fillers, Compressible Filler): Type B, ASTM C 1330, preformed, cylindrical, flexible, compressible, resilient, non-staining, bi-cellular material, with a density of 24-48 km/m³ per ASTM D1622, tensile strength greater than 200 kPa per ASTM D 1623, and water absorption less than 0.1 g/cc per ASTM C 1016.
1. Product and Manufacturer - Basis of Design: Sof Rod; Nomaco, Inc., Zebulon, NC.
 2. Other Acceptable 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. C.R. Laurence Co., Inc.
 - b. Industrial Thermo Polymers Limited

2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, 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 joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- 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 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.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Acoustical Sealant Installation: At sound-rated assemblies, fire-rated assemblies, and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile unless otherwise indicated.

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 joint sealants and of products in which joints occur.

3.5 PROTECTION

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

END OF SECTION 07920

SECTION 08111 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hollow metal doors.
2. Hollow metal frames.

1.2 SUBMITTALS

A. Product Data: For products indicated.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
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 each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.

C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

D. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

E. pressure according to NFPA 252 or UL 10C.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld Building Products, Inc.
2. Ceco Door Products
3. Curries Company
4. Steelcraft

2.2 INTERIOR DOORS AND FRAMES

- A. Interior Doors: Comply with ANSI/SDI A250.8. Face sheets fabricated from steel sheet. 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.
2. Performance Level: Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
3. Door Thickness: As indicated.
4. Face: Uncoated, cold-rolled steel sheet, minimum thickness 0.053 inches (16 gauge)
5. Vertical Edges for Single-Acting Doors: Beveled edge, 1/8 inch in 2 inches.
6. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
7. Tolerances: SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

- B. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

- C. Hardware Reinforcement: ANSI/SDI A250.6.

2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.

- B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

- C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143.

2.4 FRAMES

- A. General: Comply with ANSI/SDI A250.8.
- B. Interior Frames: Fabricated from cold-rolled steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as face welded.
 - 3. Frames for Level 3 Steel Doors: 0.067-inch- (14 gauge) thick steel sheet.
- C. Hardware Reinforcement: ANSI/SDI A250.6.
- D. Supports and Anchors: Fabricated from not less than 0.042-inch- thick, electrolytic zinc-coated or metallic-coated steel sheet.
 - 1. Wall Anchors in Masonry Construction: 0.177-inch- diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units.

2.5 FABRICATION

- A. General: Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
 - 2. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
 - 3. Bottom Edge Closures: Close bottom edges of doors with end closures or channels of same material as face sheets.

- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Sidelight 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.
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
 5. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - b. Compression Type: Not less than two anchors in each frame.
 - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 6. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
- D. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.6 FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

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 embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

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 SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable stops located on secure side of opening.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
 - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch, unless otherwise indicated or required by Code.
 - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

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 Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08111

SECTION 08311 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors.

1.2 SUBMITTALS

- A. Product Data: For each type of access door assembly specified, including details of construction relative to materials, individual components, profiles, finishes, and fire-protection ratings (if required).

1. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, latching or locking provisions, and other data pertinent to installation.

- B. Shop Drawings: Showing fabrication and installation of customized access doors and frames, including details of each frame type, elevations of door design types, anchorage, and accessory items.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain access doors for entire Project from one source and by a single manufacturer.

- B. Fire-Rated Door Assemblies: Provide units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per test method as indicated below, and are labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

1.4 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified under "Submittals" Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Karp Associates, Inc.
 2. Milcor, Inc.
 3. Nystrom, Inc.

2.2 ACCESS DOORS

- A. Insulated, Fire-Rated Access Doors: Self-latching units consisting of frame, trim, door, insulation, and hardware, including automatic closer, interior latch release, and complying with the following requirements:
1. Trimless Frame: Perimeter frame complying with the following requirements:
 - a. Metal: 0.0598-inch- thick steel sheet.
 - b. Frame Configuration: Flange integral with frame and overlapping face of adjoining gypsum board, with surface formed to receive joint compound.
 2. Door: 0.0359-inch- thick steel sheet, welded pan type.
 3. Hinges: Continuous type.
 4. Locks: Key-operated cylinder lock; cylinders to match building keying system.
 5. Insulation: 2-inch- thick mineral-fiber insulation.
 6. Fire-Protection Rating for Walls: 1-1/2 hours with a temperature rise not exceeding 250 degrees F at the end of 30 minutes.
 7. Fire-Protection Rating for Ceilings: 1 hour combustible or 3 hour non-combustible as required for constructed indicated.
- B. Noninsulated, Fire-Rated Doors for Walls: Self-latching units consisting of frame, trim, door, and hardware, including automatic closer, interior latch release, and complying with the following requirements:
1. Frame: 0.0598-inch- thick steel sheet.
 2. Door: 0.0598-inch- thick steel sheet.
 3. Hinge: Continuous type.
 4. Locks: Key-operated cylinder lock; cylinders to match building keying system.
 5. Fire-Protection Rating for Walls: 1-1/2 hours.
- C. Trimless, Flush Access Doors for Gypsum Board: Units consisting of frame, concealed edge trim, door, hardware, and complying with the following requirements:
1. Frame: 0.0598-inch- thick steel sheet.
 2. Door: 0.0747-inch- thick steel sheet.
 3. Concealed, Gypsum Board Edge Trim: 0.0299-inch zinc-coated or galvanized-steel sheet with face flange formed to receive joint compound.

4. Hinge: Concealed spring pin or continuous type.
 5. Locks: Key-operated cylinder lock; cylinders to match building keying system.
- D. Concealed Frame Access Doors for Gypsum Board Ceilings: Provide with gypsum board insert.
1. Product and Manufacturer: Subject to compliance with requirements, available products and manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. Model CTWB; JL Industries, Inc.

2.3 FABRICATION

- A. General: Manufacture each access door assembly as an integral unit ready for installation.
1. Door Sizes: Size doors as required for applications indicated.
- B. Access Doors and Frames: Continuous welded construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
1. Exposed Flange: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
 2. For gypsum board assemblies or gypsum veneer plaster, furnish frames with edge trim for gypsum board or gypsum base.
 3. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
- C. Locking Devices: Furnish number required to hold door in flush, smooth plane when closed.
1. Provide cylinder locks, furnish 2 keys per lock and key all locks alike and key to match building system.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Advise Installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices. Furnish inserts and anchoring devices for access doors that must be built into other construction. Coordinate delivery with other work to avoid delay.

3.2 INSTALLATION

- A. General: Comply with manufacturer's instructions for installing access doors.
 - 1. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finished surfaces.
 - 2. Paint exposed surface of access doors and frames to match adjacent surface finish.

3.3 ADJUST AND CLEAN

- A. Adjust hardware and panels after installation for proper operation.
- B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08311

SECTION 08411 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior storefront.
2. Interior entrance doors and frames.

1.2 SUBMITTALS

A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.

1. Engineering Responsibility: Prepare engineering data for entrance systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project as prepared by a professional engineer registered in the state of Florida.

- a. Include structural analysis data signed and sealed by professional engineer registered in the state of Florida responsible for their preparation.
- b. Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, and attachments to other work.
- c. Include all drawings and installation details required to insure the elements installed on this Project will be installed in the same manner as they were tested and approved.

C. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

D. Samples for Verification: Of exposed finish selected in manufacturer's standard sizes.

E. Samples: For the following.

1. Aluminum Framing:

- a. Samples for Verification: Of exposed metal finish selected in manufacturer's standard sizes.

2. Glass: Glass products, in the form of 12-inch-square Samples for each type of glass indicated.

F. Warranties: Warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to assume engineering responsibility and perform work of this Section who has specialized in installing glazing systems similar to those required for this Project and who is acceptable to manufacturer.

1. Engineering Responsibility: Preparation of engineering data including the following:
 - a. Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
 - b. Shop Drawings, pre-construction testing program development, and comprehensive engineering analysis by a qualified professional engineer registered in the state of Florida.

B. Pre-Installation Conference: Conduct conference at Project site.

1. Review structural load limitations.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review required testing, inspecting, and certifying procedures.

C. Source Limitations: Obtain each type of entrance system through one source from a single manufacturer.

D. Welding Standards: Comply with applicable provisions of AWS D1.2, "Structural Welding Code--Aluminum."

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 WARRANTY

- A. **Manufacturer's Warranty:** Submit a written warranty, beginning on the date of Substantial Completion, executed by the manufacturer agreeing to repair or replace components of glazing systems that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:
1. Structural failures including, but not limited to, the following:
 - a. Excessive deflection.
 - b. Adhesive sealant failures.
 - c. Cohesive sealant failures.
 - d. Failure of system to meet performance requirements.
 - e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - f. Failure of operating components to function normally.
 2. Warranty Period: 2 years from date of Substantial Completion.
- B. **Finish Warranty:** Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.
1. Warranty Period: Minimum 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR STOREFRONT

- A. **Model and Manufacturer – Basis of Design:** Trifab VersaGlaze 450 Standard; Kawneer North America
1. Glass: 1/4- inch thick, fully tempered, clear.
- B. **Other Acceptable 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. EFCO Manufacturing, Inc.
 2. Oldcastle BuildingEnvelope

2.2 INTERIOR ENTRANCE DOORS AND FRAMES

- A. **Model and Manufacturer – Basis of Design:** 350 Medium Stile Entrances; Kawneer North America
1. Glass: 1/4- inch thick, fully tempered, clear.

- 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. EFCO Manufacturing, Inc.
 - 2. Oldcastle BuildingEnvelope

2.3 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
 - 1. Sheet and Plate: ASTM B 209.
 - 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
 - 3. Extruded Structural Pipe and Tubes: ASTM B 429.
 - 4. Bars, Rods, and Wire: ASTM B 211.
 - 5. Welding Rods and Bare Electrodes: AWS A5.10.
- B. Steel Reinforcement: Complying with ASTM A 36 for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 for hot-rolled sheet and strip.
- C. Glazing Gaskets: As required to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- D. Spacers, Setting Blocks, Gaskets, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types in hardness recommended by manufacturer, compatible with sealants, and suitable for system performance requirements.
- E. Framing system gaskets, sealants, and joint fillers as recommended by manufacturer for joint type.

2.4 COMPONENTS

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Reinforce members as required to retain fastener threads.
 - 2. Do not use exposed fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
- B. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

2.5 ENTRANCE DOOR HARDWARE

- A. General: Provide entrance door hardware for each entrance door to comply with requirements in this Section.
 - 1. Entrance Door Hardware Sets: Refer to Section 087100 Door Hardware and the following.

2.6 FABRICATION

- A. General: Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
 - 1. Fabricate components for screw-spline (concealed fastener) frame construction.
 - 2. Forming: Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
 - 3. Prepare components to receive concealed fasteners and anchor and connection devices.
- B. Welding: Weld components to comply with referenced AWS standard. Weld before finishing components to greatest extent possible. 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. Glazing Channels: Provide minimum clearances for thickness and type of glass indicated according to FGMA's "Glazing Manual."
- D. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of glazing systems. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing glazing systems. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints.
- B. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install the system plumb and true in alignment with established lines and grades without warp or rack. Lubricate operating hardware and other moving parts according to hardware manufacturers' written instructions.
- D. Install glazing to comply with requirements of Division 8 Section "Glazing," unless otherwise indicated.

3.3 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure glazing systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 08411

SECTION 08710 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Door hardware.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

2. Content: Include the following information:

- a. Identification number, location, hand, fire rating, size, and material of each door and frame.
- b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
- c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
- d. Fastenings and other pertinent information.
- e. Explanation of abbreviations, symbols, and codes contained in schedule.
- f. Mounting locations for door hardware.

C. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

D. Warranty: Warranty specified in this Section.

E. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.3 QUALITY ASSURANCE

- A. General: All hardware shall meet the requirements of Federal, State and Local codes having jurisdiction.
- B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in 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 NFPA 252 or UL 10C, unless otherwise indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- 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 keys to Owner.

1.5 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. The following is a listing of product descriptions, specified manufacturers, and other acceptable manufacturers.

PRODUCT DESCRIPTION	SPECIFIED MANUFACTURER	ACCEPTABLE SUBSTITUTE
Hinges	Ives	Hager, Stanley, Bommer
Cylinders and Keying	Best Access	None (Owners Standard)
Locks and Latches	Best Access	None (Owners Standard)
Fire Exit Device	Von Duprin	None (Owners Standard)
Closers	LCN	None (Owners Standard)
OH Stops/holders	Glynn Johnson	Rixson
ADA Operator	LCN	Stanley, Beasam
Wall Bumpers, Floor Stops, Flushbolts	Ives	Trimco, Rockwood
Push Plates and Pulls	Ives	Trimco, Rockwood
Kick Plates/Armor Plate	Ives	Trimco, Rockwood
Power Supplies	VonDuprin	None (Owners Standard)
Threshold/Weatherstrip	Zero	National Guard, Pemko

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

2.3 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

2.4 EXIT AND PANIC DEVICES AND AUXILIARY ITEMS

- A. Exit and Panic Devices and Auxiliary Items: BHMA A156.3.

2.5 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

2.6 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.7 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.8 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
- B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2.9 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
- C. Security: Provide a secure lock-up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items that are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses both before and after installation.

3.3 INSTALLATION

- A. 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: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's 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 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 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.
1. Where door hardware is installed more than one month prior to acceptance or occupancy, return to the installation during the week prior to acceptance or occupancy and make a final check and adjust all hardware items. Clean operating items as necessary to restore proper function and finish. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.5 CLEANING AND PROTECTION

- A. Clean operating items as necessary to restore proper function and finish.

3.6 DOOR HARDWARE SCHEDULE

- A. Hardware Groups:

1. Hardware Group No. 1: Provide the following:

Qty		Description	Catalog Number	Finish	Mfr
8	EA	HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	9849-EO-LBL	626	VON
1	EA	PANIC HARDWARE	9849-NL-OP-110MD-LBL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
2	EA	90 DEG OFFSET PULL	8190HD 10" H-I-L	630	IVE
2	EA	SURFACE CLOSER	4040XP	689	LCN

Balance of Door Hardware to be supplied by Aluminum Door Supplier 084100

2. Hardware Group No. 2: Provide the following:

Qty	Description	Catalog Number	Finish	Mfr
6	EA HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
2	EA ELECTRIC HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
2	EA ELEC FIRE EXIT HARDWARE	RX-QEL+-9849-WDC-L-NL-F-996-06-LBL-SNB	626	VON
2	EA RIM CYLINDER	1E72	626	BES
1	EA SURF. AUTO OPERATOR	9553 REG/STD HL/D MS	ANCLR	LCN
2	EA ACTUATOR, WALL MOUNT	8310-852	630	LCN
1	SET SEALS	188S	BLK	ZER
1	EA ASTRAGAL	156AA X 56AA	AL	ZER
2	EA DOOR BOTTOM	350A	AL	ZER
1	EA POWER SUPPLY	PS902 900-2RS-FA	LGR	VON

Card reader to unlock electric lock by security supplier
Wiring Diagram by Hardware Supplier
Card reader to release both panic devices - for use with timed access
ADA operator by actuators

3. Hardware Group No. 3: Provide the following:

Qty	Description	Catalog Number	Finish	Mfr
4	EA HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
2	EA ELECTRIC HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
2	EA ELEC FIRE EXIT HARDWARE	RX-QEL+-9849-WDC-L-NL-F-996-06-LBL-SNB	626	VON
2	EA RIM CYLINDER	1E72	626	BES
2	EA SURFACE CLOSER	4111 AVB SCUSH	689	LCN
1	SET SEALS	188S	BLK	ZER
1	EA ASTRAGAL	156AA X 56AA	AL	ZER
2	EA DOOR BOTTOM	350A	AL	ZER
1	EA POWER SUPPLY	PS902 900-2RS-FA	LGR	VON

Card reader to unlock electric lock by security supplier
Wiring Diagram by Hardware Supplier
Card reader to release both panic devices - for use with timed access

4. Hardware Group No. 4: Provide the following:

Qty	Description	Catalog Number	Finish	Mfr
5	EA HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA ELECTRIC HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	SET CONST LATCHING BOLT	TW8 FB53	630	IVE
1	EA SINGLE CYL. DEADLATCH EU	47HW7DEU 15R RQE	626	BES
1	EA COORDINATOR	COR X FL	628	IVE
2	EA SURFACE CLOSER	4011 DEL	689	LCN
2	EA KICK PLATE	8400 10" X 1" LDW	630	IVE
2	EA WALL STOP	B4E WS406/407CCV	630	IVE
1	SET SEALS	188S	BLK	ZER
1	EA POWER SUPPLY	PS902	LGR	VON

Card reader to unlock electric lock by security supplier
Wiring Diagram by Hardware Supplier

5. Hardware Group No. 5: Provide the following:

Qty	Description	Catalog Number	Finish	Mfr
2	EA HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA ELECTRIC HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA ELEC FIRE EXIT HARDWARE	TW8 QEL+-98-L-NL-F-996-06	626	VON
1	EA RIM CYLINDER	1E72	626	BES
1	EA SURFACE CLOSER	4111 AVB EDA	689	LCN
1	EA KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA WALL STOP	B4E WS406/407CCV	630	IVE
1	SET SEALS	188S	BLK	ZER
1	EA DOOR BOTTOM	350A	AL	ZER
1	EA POWER SUPPLY	PS902 900-2RS-FA	LGR	VON

Card reader to unlock electric lock by security supplier
Wiring Diagram by Hardware Supplier
Card reader to release both panic devices - for use with timed access

6. Hardware Group No. 6: Provide the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HW HINGE	3CB1HW 4.5 X 4.5	652	IVE
			TW8		
1	EA	SINGLE CYL. DEADLATCH EU	47HW7DEU 15R RQE	626	BES
1	EA	SURFACE CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
			B4E		
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	SET	SEALS	188S	BLK	ZER
1	EA	POWER SUPPLY	PS902	LGR	VON

Card reader to unlock electric lock by security supplier
Wiring Diagram by Hardware Supplier

7. Hardware Group No. 7: Provide the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	3PB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM	45H7R 15R	626	BES
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION 08710

SECTION 08800 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior glass.
2. Window film.

1.2 SUBMITTALS

A. Product Data: For the following.

1. Interior glass.
2. Window film.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Safety Glazing Labeling: Permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

2.2 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Quality-Q3.
1. Color: Match Architect's sample.

2.3 GLAZING SEALANTS

A. General:

1. 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.
2. Field-applied sealants shall have a VOC content of not more than 250 g/L.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.4 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Glazing Channel:

1. Material: Extruded aluminum; mill finish.
2. Profiles and Sizes: As indicated.

2.5 WINDOW FILM

A. Product and Manufacturer: Refer to the Material List.

2.6 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.

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. Minimum required face and edge clearances.
 - 3. 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.

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. 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.
- D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. 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.

3.4 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. 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.

3.5 INSTALLING WINDOW FILM

- A. Comply with manufacturer's instructions and recommendations.
- B. Remove and replace window film that is damaged during construction period.

3.6 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances.
 - 1. If, despite such protection, contaminating substances do come into 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 and window film as recommended in writing by glass manufacturer.

3.7 GLASS SCHEDULE

- A. Tempered Glass: Fully tempered float glass.
 - 1. Thickness: As indicated.
 - 2. Tinted Glass: Match Architect's sample.

END OF SECTION 08800

SECTION 09221 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings and soffits.

1.2 SUBMITTALS

- A. Product Data: For products indicated.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by, and displaying a classification label from, an independent testing agency acceptable to the authority having jurisdiction.
1. Construct fire-resistance-rated partitions in compliance with tested assembly requirements indicated in drawings.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 2. Protective Coating: Comply with ASTM C645; roll-formed from hot-dipped galvanized steel; complying with ASTM A1003/A1003M and ASTM A653/A653M G40 (Z120) or equivalent corrosion resistant coating. A40 galvanized products are not acceptable.
- B. Steel Studs and Runners: ASTM C 645.
1. Non-structural Studs: Cold-formed galvanized steel C-studs drywall studs.

- C. Slip-Type Head Joints:
 - 1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
- E. Cold-Rolled Channel Bridging and Bracing: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
- G. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
 - 1. Anchors: Capable of sustaining a load equal to 5 times that imposed as determined by ASTM E 488.
 - 2. Powder-Actuated Fasteners: Capable of sustaining, a load equal to 10 times that imposed as determined by ASTM E 1190.
- C. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.
- E. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Runners: ASTM C 645.
 - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armstrong World Industries, Inc.; Drywall Grid Systems.
 - b. Chicago Metallic Corporation; Drywall Grid System.
 - c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, 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 indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- 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 tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating 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 runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - 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.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in accordance with referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

- C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: As required by Code.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09221

SECTION 09290 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 SUBMITTALS

- A. Product Data: For products indicated.

1.3 QUALITY ASSURANCE

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Protected Openings Identification: All corridor partitions, smokestop partitions, horizontal exit partitions, exit enclosures, and fire rated walls required to have protected openings shall be effectively and permanently identified with signs or stenciling as follows.
1. Locate identification above ceiling areas and in concealed spaces. Provide the following wording: "FIRE AND SMOKE BARRIER PROTECT ALL OPENINGS".
 - a. Letter Size: 2-inches high
 - b. Spacing: 4 feet on center, maximum.
 - c. Letter Font: Helvetica Regular
 - d. Letter Color: Red.
 2. Also provide a 3-inch wide painted red line below the identification signage to identify the direction and extent/length of the rated wall. Extend the painted line the full length of the wall; identify directional changes and where rated walls end.

1.4 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are 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.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.
 - 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. G-P Gypsum.
 - b. Lafarge North America Inc.
 - c. National Gypsum Company.
 - d. USG Corporation.
- B. Regular Type and Type X (fire rated):
 - 1. Thickness: 1/2 inch.
 - 2. Long Edges: Tapered.
- C. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
 - 1. Thickness: 1/2 inch, unless otherwise indicated.
 - 2. Long Edges: Tapered.

2.2 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Paper-faced galvanized steel sheet.
 - 2. Shapes: As indicated.

2.3 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Backer Board: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening backer board, use screws of type and size recommended by panel manufacturer.
- C. Aluminum Reveal:
 - 1. Product and Manufacturer – Basis of Design: 1/2" Aluminum Reveal DRM 625-50; Fry Reglet Corporation
 - a. Finish: To be selected by the Architect from manufacturer's standard finishes.
 - 2. Other Acceptable 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. Flannery Incorporated
 - b. Gordon Incorporated

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
- 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 APPLYING AND FINISHING PANELS

- A. General: Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. 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.
- D. Penetrations:
 - 1. Refer to Section 078413 Penetration Firestopping regarding sealing of wall and ceiling penetrations.
 - 2. Seal around all non-fire rated penetrations of gypsum panel walls and ceilings completely to minimum of Smoketight requirements.

3.3 INSTALLING TRIM ACCESSORIES

- A. General: Attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 in specific locations identified, where approved by Architect, as indicated on the Drawings, and as follows:
 - 1. Ceilings: Unless otherwise indicated install control joints as follows:
 - a. Install control joints in areas exceeding 2500 sq. ft.
 - b. Space control joints not more than 50 feet on center.
 - c. Install control joints where ceiling framing or furring changes direction.
 - 2. Partitions and Furring: Unless otherwise indicated install control joints as follows:
 - a. Install control joints in partitions and wall furring runs exceeding 30 feet.
 - b. Space control joints not more than 30 feet on center.
 - c. Install control joints in furred assemblies where control joints occur in base exterior wall.
- C. Reveals: Install as indicated on the Drawings and in accordance with manufacturer's instructions and recommendations.

3.4 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 3: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: All other locations, unless otherwise indicated.

3.5 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. 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 09290

SECTION 09310 - CERAMIC TILE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Tile.
2. Stone thresholds.
3. Waterproof membrane for thin-set tile installations.

1.2 SUBMITTALS

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

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Stone thresholds in 6-inch lengths.
3. Assembled samples with grouted joints for each type and composition of tile and for each color and finish required, at least 12 inches square and mounted on rigid panel. Use grout of type and in color or colors approved for completed work.

1.3 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.

1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for 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 one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:

1. Stone thresholds.
2. Joint sealants.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
 - 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

2.2 TILE PRODUCTS

- A. Products and Manufacturers: Refer to the Finish Material List.
- B. Trim Units: Matching characteristics of adjoining flat tile and coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes as follows, selected from manufacturer's standard shapes:

2.3 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 - 1. Bevel edges at 1:2 slope, aligning lower edge of bevel with adjacent floor finish. Limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.
- B. Marble Thresholds: ASTM C 503 with a minimum abrasion resistance in accordance with ASTM C 1353 or ASTM C 241 and with honed finish.
 - 1. Color: As indicated on the Drawings.

2.4 WATERPROOFING FOR THIN-SET TILE INSTALLATIONS

- A. Product and Manufacturer – Basis of Design: System consisting of liquid-latex rubber and fabric reinforcement.
 - 1. Mapelastic HPG; MAPEI Corporation
- B. Other Acceptable 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. Jamo Inc.
 - 2. LATICRETE International Inc.

2.5 SETTING AND GROUTING MATERIALS

- 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. Jamo Inc.
 - 2. LATICRETE International Inc.
 - 3. MAPEI Corporation.
 - 4. Summitville Tiles, Inc.
- B. Latex-Portland Cement Mortar:
 - 1. Product and Manufacturer – Basis of Design: Granirapid; MAPEI Corporation
 - 2. Other Acceptable 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. Jamo Inc.
 - b. LATICRETE International Inc.

C. Tile Grout:

1. Product and Manufacturer – Basis of Design: Kerapoxy CQ; MAPEI Corporation
 - a. Color: Refer to the Finish Materials List
2. Other Acceptable 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. Jamo Inc.
 - b. LATICRETE International Inc.

2.6 ELASTOMERIC SEALANTS

- A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."

2.7 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting 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.

2.8 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Interior Designer.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.
- B. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.
 - 1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
 - 2. Remove protrusions, bumps, and ridges by sanding or grinding.
- C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: Where recommended by the tile manufacturer or as needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.
- E. Install cement board and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.3 INSTALLATION, GENERAL

- A. Waterproofing: Apply waterproofing at all floor tile locations.
- B. Tile Workmanship and Visual Appearance: All tile shall be installed with zero-lippage, with straight and even joints, and smooth and flat. The intent is that all tile installations are to be installed using the best of techniques. Any tile that does not meet or exceed the requirements indicated shall be removed and replaced in accordance with specified requirements.
- C. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials indicated.
- D. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation."
- E. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- F. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- G. Jointing Pattern: As indicated or as directed by the Architect.
- H. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Locate joints in tile surfaces directly above joints in concrete substrates.
 - 2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."
- I. Grout tile to comply with requirements of the following tile installation standards:
 - 1. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

3.4 TILE INSTALLATION

- A. General: Install tile to comply with TCA installation methods and ANSI A108 Series of tile installation standards.
- B. Joint Widths: Install tile on floors and walls with joint widths as directed by the Architect.

- C. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
 - 1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

3.5 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove latex-portland cement grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
 - 3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.
- B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09310

SECTION 09511 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical ceiling tile and suspension systems.

1.2 SUBMITTALS

A. Product Data: For products indicated.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: 6-inch- square Samples of each indicated.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch-long Samples of each type, finish, and color.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

B. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-response tests are performed by a qualified testing and inspecting agency. Qualified testing and inspecting agencies include Underwriters Laboratories (UL), Warnock Hersey, or another agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
2. Surface-burning characteristics of acoustical panels comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
3. Acoustical panel ceilings indicated are identical in materials and construction to those tested for fire resistance per ASTM E 119.
4. Products are identified with appropriate markings of applicable testing and inspecting agency.

D. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.6 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CEILING SYSTEMS

- A. Products and Manufactures: Subject to compliance with requirements, available products and manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ceiling Type A: ACT: Armstrong, Optima, Fine Texture, Square Tegular, 4ft x 4ft x 1-inch; white.
 - a. Grid: Armstrong, Interlude XL, 9/16", white
 - b. Edge Trim: Armstrong, Axiom Knife Edge, 6" Length, 5" Height, white

2. Ceiling Type B: ACT: Armstrong, Optima, Fine Texture, Square Tegular, 4ft x 4ft x 1-inch; white.
 - a. Grid: Armstrong, Interlude XL, 9/16", white;
 - b. Edge Trim: Armstrong, Axiom Classic Trim, 4", white
 3. Ceiling Type C: Metal Panel: Armstrong, Metalworks, Torsion Spring, 2ft x 8ft, Sound Insulation, Micro perforations, Gun Metal Grey.
 - a. Edge Trim: Standard Torsion Spring Bulkhead, 4", Gun Metal Grey
 4. Ceiling Type G: ACT: Armstrong, Optima, Fine Texture, Square Tegular, 4ft x 4ft x 1-inch; white.
 - a. Grid: Armstrong, Interlude XL, 9/16", white
 - b. Edge Trim: Manufacturer's standard; white.
- B. Other Acceptable Manufactures: Subject to compliance with requirements, available products and manufacturers that may be incorporated into the Work include, but are not limited to, the following:
1. CertainTeed Corporation
 2. USG Corporation

2.2 GRID (METAL SUSPENSION SYSTEM)

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Grid System: Main and cross runners complying with ASTM A 653.
 1. Structural Classification - ASTM C 635: Intermediate-duty system.
- C. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung.

2.3 METAL EDGE MOLDINGS AND TRIM

- A. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips.
 1. Colors: To be selected by the Architect from manufacturer's full line.

2.4 ACOUSTICAL SEALANT

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Acoustical Sealant for Concealed Joints:
 - a. Pecora Corporation; BA-98.
 - b. Tremco, Inc.; Tremco Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with manufacturer's instructions and recommendations, publications referenced below and CISCA "Ceiling Systems Handbook."
 - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
 - 2. CISCA Recommendations for Acoustical Ceilings: Comply with CISCA "Recommendations for Direct-Hung Acoustical Tile and Lay-In Panel Ceilings."

- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
 - 1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 - 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 - 3. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 - 4. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
 - 5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 - 6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
 - 7. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
 - 8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.
- B. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- C. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09511

SECTION 09651 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl composition tile.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: Samples of each color and pattern of resilient floor tile required.

1.3 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 degrees F or more than 95 degrees F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 degrees F or more than 95 degrees F.
- C. Close spaces to traffic during floor covering installation.
- D. Close spaces to traffic for 48 hours after floor covering installation.
- E. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RESILIENT TILE FLOORING

- A. Vinyl Composition Tile:
 - 1. Products and Manufacturers: Refer to the Finish Material List.

B. Fire-Test-Response Characteristics:

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

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 manufacturer to suit resilient products and substrate conditions indicated.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 3. Moisture Testing:
 - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours or as required by the materials manufacturer.
 - b. Alkali Testing - Allowable PH Reading: 5-9 or as required by the materials manufacturer.
 - c. Perform additional tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- C. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

- E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are same temperature as space where they are to be installed.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
- B. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- C. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- D. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- H. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.

- I. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09651

SECTION 09653 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall base.
 - 2. Stair accessories.

1.2 SUBMITTALS

- A. Product Data: For each product indicated.
- B. Samples: For products indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.3 PROJECT CONDITIONS

- A. Maintain temperatures within range recommended by manufacturer, but not less than 70 degrees F or more than 95 degrees F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 degrees F or more than 95 degrees F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 WALL BASE

- A. Products and Manufacturers: Refer to the Finish Material List.
 - 1. Height: As indicated.
 - 2. Type: As indicated.

2.2 MISCELLANEOUS MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturers for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- C. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - 1. Do not install resilient products until they are the same temperature as the space where they are to be installed.

3.2 RESILIENT WALL BASE INSTALLATION

- A. General: Install resilient base in accordance with manufacturer's instructions and recommendations.
 - 1. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
 - 2. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 - 3. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 4. Do not stretch wall base during installation.
 - 5. On irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

3.3 ACCESSORY INSTALLATION

- A. General: Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
 - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
 - a. Do not wash surfaces until after time period recommended by manufacturer.
- B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09653

SECTION 09680 - CARPET

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Carpet.

1.2 SUBMITTALS

- A. Product Data: For each product indicated; include the following:
 - 1. Maintenance data.
- B. Shop Drawings: Include the following:
 - 1. Seam locations.
 - 2. Pattern type, repeat, location, direction, and starting point.
 - 3. Transition, and other accessory strips.
 - 4. Transition details to other flooring materials.
- C. Samples: For carpet.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104, Section "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. General: Comply with CRI 104, Section "Site Conditions; Temperature and Humidity."
- B. Environmental Limitations: Do not install carpet until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- C. Prepare existing surfaces as required by the carpet materials manufacturer for the installation of new work. Remove adhesives and other contaminants from substrates in accordance with carpet materials manufacturer's instructions and recommendations.
- D. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by manufacturer.

1.6 WARRANTY

- A. Carpet Warranty: Manufacturer's standard form in which manufacturer agrees to replace carpet that does not comply with requirements or that fails within 10 years from date of Substantial Completion. Warranty does not include deterioration or failure of carpet from unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

PART 2 - PRODUCTS

2.1 CARPET

- A. Products and Manufacturers: Refer to the Finish Material List.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 w/sq. cm per ASTM E 648.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the following:
- B. Seaming Cement: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.

- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by the following:
 - a. Carpet manufacturer.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section "Site Conditions; Floor Preparation," and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

3.3 INSTALLATION

- A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Do not bridge building expansion joints with carpet.
- D. Cut and fit carpet 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 by carpet manufacturer.
- E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.

2. Remove yarns that protrude from carpet surface.
 3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with CRI 104, Section, "Protecting Indoor Installations."
- C. Protect carpet 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 manufacturer.

END OF SECTION 09680

SECTION 09720 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall covering.

1.2 SUBMITTALS

- A. Product Data: For product indicated. Include data on physical characteristics and flame-resistance characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate seams and termination points.
- C. Samples: For each wall covering indicated.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.
- E. Maintenance Data: For wall coverings.

1.3 PROJECT CONDITIONS

- A. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures required by manufacturer's instructions.
- B. Maintain constant recommended temperature and humidity for at least seventy-two hours prior to and throughout the installation period, and for seventy-two hours after wallcovering installation completion.
- C. Provide not less than 80-foot-candles per square foot lighting level measured mid-height at substrate surfaces.

1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard warranty against manufacturing defects.

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 according to 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 E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Fire Rating: Class A
 - b. Flame-Spread Index: 15 or less.
 - c. Smoke-Developed Index: 120 or less.

2.2 WALL COVERINGS

- A. Products and Manufacturers: Refer to the Finish Material List.

2.3 ACCESSORIES

- A. Adhesives: Types recommended by the manufacturer for materials and substrates indicated.
- B. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 4 finish, per GA-214-M-97: Recommended Levels of Gypsum Board Finish; permanent lighting shall be installed and operational.
- B. Test substrate with suitable moisture meter and verify that moisture content does not exceed manufacturer's requirements for substrate conditions.
- C. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface.
- D. Evaluate all painted surfaces for the possibility of pigment bleed-through.
- E. Notify the Architect in writing of any conditions detrimental to the proper and timely completion of the installation.

- F. Proceed with installation only after unsatisfactory conditions have been corrected.
- G. Beginning of installation means acceptance of surface conditions.

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.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

3.3 INSTALLATION

- A. General: Comply with wall-covering manufacturer's written installation instructions applicable to products and applications indicated except where more stringent requirements apply.
- B. Acclimate wallcovering in the area of installation a minimum of twenty-four hours before installation.
- C. Do not install material that is questionable in appearance.
- D. Primer: Apply primer to substrates complying with manufacturer's instructions and recommendations for substrates indicated.
- E. Adhesive: Apply adhesive complying with manufacturer's instructions and recommendations.
 - 1. Remove excess adhesive immediately after the wallcovering is applied and clean entire surface.

3.4 CLEANING

- A. Remove excess adhesive at finished 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.
- E. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the wallcovering installation from the project site. Leave areas in neat, clean, and orderly condition.

END OF SECTION 09720

SECTION 09771 – FIBERGLASS REINFORCED PLASTIC PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fiberglass reinforced plastic panels.

1.2 SUBMITTALS

A. Product Data: Submit product data products specified.

B. Samples: Submit two samples of each type of panel, each type of trim and fastener.

1.3 QUALITY ASSURANCE:

A. Single Source Responsibility: Provide panels, and molding only from the manufacturer specified to ensure warranty and color harmonization of accessories.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Delivery of Materials: Package sheets for shipment to project site.

B. Storage of Materials: Store panels in a dry place at the project site.

C. Handling: Remove foreign matter from face of panel by use of a soft bristle brush, avoiding abrasive action.

1.5 PROJECT CONDITIONS:

A. Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or terrazzo work has dissipated.

B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Fiberglass Reinforced Plastic Panels:

1. Product and Manufacturer – Basis of Design: Fire-X Glasbord with Surfaseal; Crane Composites, Inc.
 - a. Finish: Pebble-like embossed surface finish.
 - b. Color: Black.
2. Thickness: 0.09" nominal.
3. UL Label: Material shall be Underwriters Laboratories (U.L.) Listed.
4. Surface Burning Characteristics: Class A per ASTM E-84.
5. FM Approval: FMRC (Factory Mutual Research Center) approved.

B. Division Bars, Corner Trim and Moldings: PVC; panel manufacturer's standard length extruded vinyl pieces.

1. Colors: Match panels.

C. Sealant: Type as recommended by the panel manufacturer for installation indicated.

D. Fasteners: Manufacturer's standard product for installation indicated.

1. Colors: Match panels.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
- B. Do not begin installation until backup surfaces are put into satisfactory condition.

3.2 APPLICATION:

- A. General: Install panels and accessories in accordance with manufacturer's instructions and recommendations and Installation Guide.
 1. Cut panel material with carbide tipped saw blades or drill bits, or cut with snips.
 2. Install panels with manufacturer's recommended gap for panel field and corner joints.

3.3 CLEANING:

- A. Remove adhesives or other contaminants from panel face and exposed accessory surfaces using solvent or cleaner recommended by panel manufacturer.

END OF SECTION 09771

SECTION 09775 – RESIN PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resin panels.

1.2 SUBMITTALS

- A. Product Data: Submit product data products specified.
- B. Samples: Submit two samples of resin panel.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Delivery of Materials: Package sheets for shipment to project site.
- B. Storage of Materials: Store panels in a dry place at the project site.
- C. Handling: Remove foreign matter from face of panel by use of a soft bristle brush, avoiding abrasive action.

1.4 PROJECT CONDITIONS

- A. Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from plaster, concrete or terrazzo work has dissipated.
- B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Resin Panels:
 - 1. Product and Manufacturer: Refer to the Material List.
- B. Sealant: Type as recommended by the panel manufacturer for installation indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
- B. Do not begin installation until backup surfaces are put into satisfactory condition.

3.2 APPLICATION

- A. General: Install panels and accessories in accordance with manufacturer's instructions and recommendations and Installation Guide.

3.3 CLEANING

- A. Remove adhesives or other contaminants from panel face and exposed accessory surfaces using solvent or cleaner recommended by panel manufacturer.

END OF SECTION 09775

SECTION 09910 - PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exposed interior items and surfaces.
2. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment installed and application of paint coats to all finish coated mechanical and electrical equipment in exterior locations, except as otherwise indicated.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

D. Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.2 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

1. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1. After color selection, the Architect will furnish color chips for surfaces to be coated.

- C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
 - 1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 - 2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
 - 3. On actual wall surfaces and other exterior and interior building components, duplicate painted finishes of prepared samples. On at least 100 square feet of surface, as directed, provide full-coat finish samples until required sheen level, color and texture is obtained; simulate finished lighting conditions for review of in-place work.

- D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and School Districts, and other information specified.

1.3 QUALITY ASSURANCE

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Contents by volume, for pigment and vehicle constituents.
 - 5. Thinning instructions.
 - 6. Application instructions.
 - 7. Color name and number.
 - 8. VOC content.

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products and Manufacturers: Subject to compliance with requirements, products and manufacturers specified include, but are not limited to, the following:
 - 1. The Sherwin-Williams Company
- B. Other Products and Manufacturers: Subject to compliance with requirements, available products and manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore & Company (Moore)
 - 2. PPG Industries, Inc. (PPG)

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- C. Colors: Refer to the Finish Material List; where colors are not indicated the Architect will select colors from manufacturer's full line.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
 - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 - 1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
 - 1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
- D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
- B. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- C. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 INTERIOR PAINT SCHEDULE

- A. Gypsum Drywall – Walls:
 - 1. Paint System, Application and Finish: Latex; two Finish Coats over Primer; refer to the Finish Identification list for gloss level (Finish).
 - a. Primer: Harmony Interior Primer Sealer; 1.3 mils DFT
 - b. Finish Coats: Harmony Interior Latex; 1.8 mils DFT per coat.

B. Gypsum Drywall – Ceilings:

1. Paint System, Application and Finish: Latex; two Finish Coats over Primer; refer to the Finish Identification list for gloss level (Finish).
 - a. Primer: Harmony Interior Primer Sealer; 1.3 mils DFT
 - b. Finish Coats: Harmony Interior Latex; 41.8 mils DFT per coat.

C. Ferrous Metal: Includes steel doors and frames, handrails and railings.

1. Paint System, Application and Finish: Alkyd/Latex; two finish coats over prime coat; semi-gloss finish. Pre-primed requires top finish only; prime coat damaged surfaces.
 - a. Primer: Pro Industrial Pro-Cryl Universal Primer; 2-4 mils DFT.
 - b. Finish Coats: Pro Industrial Pre-Catalyzed Waterbased Epoxy; 1.5 mils DFT per coat.

END OF SECTION 09910

SECTION 11900 – MISCELLANEOUS EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Beverage cooler.
 - 2. Wine cooler.

1.2 SUBMITTALS

- A. Product Data: For equipment indicated. Include operating characteristics, dimensions of individual equipment items, and finishes.
- B. Warranties: Sample of warranties.
- C. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wine Cooler:

1. Model and Manufacturer: KBU-50 Compressor Two-Temp Zone Wine Cellar; Kings Bottle BTO America Limited, Santa Fe Springs, CA, or approved equal.
 - a. Accommodation (Bottles): 50
 - b. Type of Cooling: Compressor with air-circulated fan cooling.
 - c. Nominal Voltage/Frequency: 1 10-115V/50-60HZ
 - d. Rated Voltage: 115V
 - e. Frequency: 60HZ
 - f. Rated Power Input: 130 watts

 - g. Temperature Range: Dual temperature zones.
 - 1) Upper Zone: 41-60 degrees F
 - 2) Lower Zone: 45-64 degrees F

 - h. Door Type: Glass door with stainless steel trim; Type 304 stainless steel brushed finish.
 - i. Finish: Type 304 stainless steel; brushed finis.

B. Beverage Cooler:

1. Model and Manufacturer: KBU-56 Beverage Cooler; Kings Bottle BTO America Limited, Santa Fe Springs, CA, or approved equal.
 - a. Description: 2-door front viewing full stainless steel bar fridge.
 - b. Volume: 210 Liter
 - c. Type of Cooling: Compressor with air-circulated fan cooling.
 - d. Rated Voltage: 115V
 - e. Frequency: 60HZ
 - f. Rated Power Input: 160 watts (heating glass OFF0; 210 (heating glass ON)
 - g. Temperature Range: 32-46 degrees F.
 - h. Range of Inside Cabinet Humidity: >50% RH
 - i. Finish: Type 304 stainless steel brushed finis.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. General: Comply with manufacturer's written instructions and recommendations.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Comply with plumbing and electrical requirements.

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. Perform visual, mechanical, and electrical inspection and testing according to manufacturers' written recommendations. Certify compliance with manufacturer's equipment 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.
- C. Equipment item will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.4 DEMONSTRATION

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

END OF SECTION 11900

SECTION 12492 - CURTAINS AND DRAPES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tracks.
 - 2. Draperies.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Tracks: Include maximum weights of draperies that can be supported.
 - 2. Fabric and textile treatments.
- B. Shop Drawings:
 - 1. Tracks: Show installation and anchorage details and locations of controls.
 - 2. Draperies: Show sizes, locations, and details of installation.
- C. Samples: For each exposed product and for each color and texture specified submit manufacturer's standard size.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificate for each fabric treated with flame retardant.

1.4 CLOSEOUT SUBMITTAL

- A. Maintenance data.

1.5 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions by field measurements before drapery fabrication, and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 DRAPERY TRACKS

- A. Manually Operated Track: Basis of Design: Automatic Devices Company, Flex-I-Trac, Series 132 (Walk Along Track System)
- B. Other Acceptable 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. Forest Group USA, Inc.
 - 2. Kirsch Window Fashions; a Newell Rubbermaid brand.
- C. Description:
 - 1. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches (610 mm) o.c.
 - a. Support Capability: Weight of drapery indicated
 - b. Finish: Black
 - 2. Mounting Brackets: Aluminum, of type suitable for fastening track to surface indicated and designed to support weight of track assembly and drapery plus force applied to operate track.
 - a. Mounting Surface: As indicated on Drawings.
 - b. Size: Field verify
 - 3. Installation Fasteners: Sized to support track assembly and drapery, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.
 - 4. Operation: Manually operated Baton
 - a. Draw: One way, stack as indicated on Drawings
 - b. Operating Hardware Location: As indicated on Drawings.
 - 5. Carriers: Model 1301, shall be spaced on 12" centers and shall be of stiff wire construction supported from two self-lubricating nylon wheels rolling on two parallel treads.
 - a. Master Carriers: Butt.
 - 6. End Stops: Manufacturer's standard with track end cap.

2.2 DRAPERIES

- A. Fire-Test-Response Characteristics: For fabrics treated with fire retardants, provide products that pass NFPA 701 as determined by testing of fabrics that were treated using treatment-application method intended for use for this Project by a testing and inspecting agency acceptable to authorities having jurisdiction.
- B. Products and Manufacturers: Refer to the Finish Material List. Subject to compliance requirements, Alternate manufacturer's:
 - 1. DesignTex.
 - 2. Fabricut.
- C. Source Limitations: Obtain each color and pattern of drapery fabric and trim from one dye lot.
- D. Drapery: As Indicated on Drawings.
 - 1. Over Drape:
 - a. Pinch (French) Pleats: 200 percent fullness; three fold (fingers) each pleat.
 - b. Dimension Between Pleats: 4"
 - c. Construction:
 - 1) Header: double 4" with buckram.
 - 2) Drapery construction to match mockup sample provided by interior designer. Subcontractor to submit a sample prior to fabrication for approval of fabrication details by interior designer.
 - d. Performance:
 - 1) Flame Resistance: Passes NFPA 701
 - 2) Wet and Dry Crocking: Passes AATCC 8 – Wet: Grade 5; Dry: Grade 5
 - 3) Colorfastness to Light: Passes AATCC 16 – Grade 5 @ 60 hrs.(Drapery)
 - e. Installation: Hang Drapery below rods and 1" above finish floor.
 - 2. Sheer: As indicated on Drawings
 - a. Pinch (French) Pleats: 250 percent fullness; three -fold (fingers) each pleat.
 - b. Dimension Between Pleats: 4"
 - c. Construction:
 - 1) Header: double 4" with buckram.
The sheer drapery treatment height exceeds the width of the fabric and will need to be seamed to maintain the vertical orientation of the threads (fabric is railroaded). The seam will align with the center horizontal mullion (see elevations on sheet A-721) and will be surged with matching thread turned down and stitched under a 7/16" matching grosgrain ribbon sewn straight across the back side of the treatment to finish the seam and promote a uniform appearance from both sides.
 - 2) Drapery construction to match mockup sample provided by interior designer. Subcontractor to submit a sample prior to fabrication for approval of fabrication details by interior designer.

- d. Performance:
 - 1) Flame Resistance: Passes NFPA 701
 - 2) Wet and Dry Crocking: Passes AATCC 8 – Wet: Grade 5; Dry: Grade 5
 - 3) Colorfastness to Light: Passes AATCC 16 – Grade 5 @ 60 hrs.(Drapery)
- e. Installation: Hang Drapery below rods and 1” above finish floor.

2.3 DRAPERY FABRICATION

- A. Fabricate draperies in heading styles and fullnesses indicated. Fabricate headings to stand erect. If less than a full width of fabric is required to produce panel of specified fullness, use equal widths of not less than one-half width of fabric located at ends of panel.
 - 1. One-Way-Stacking Draperies: Add 5 inches to overall width for returns.
- B. Seams: Sew vertical seams with twin-needle sewing machine with selvage trimmed and triple overlocked. Join widths so that patterns match and vertical seams lay flat and straight without puckering. Horizontal seams are not acceptable.
- C. Side Hems: Double-turned, 1-1/2-inch- (38-mm-) wide hems consisting of three layers of fabric, and blindstitched so that stitches are not visible on face of drapery.
- D. Bottom Hems: Double-turned, 4-inch- (102-mm-) wide hems consisting of three layers of fabric, and weighted at seams and corners and blindstitched so that weights and stitches are not visible on face of drapery.
- E. Linings: Equal to widths of drapery fabric and joined to drapery fabric at top by inside invisible seam, and hand stitched at side hems and shadowed with 1-1/2-inch (38-mm) return of face fabric. Self lined with matching face to inside and outside of space.
 - 1. Bottom Hem: Blind stitch to drapery fabric.
- F. All above criteria applies to sheer with exception of lining.

PART 3 - EXECUTION

3.1 DRAPERY TRACK INSTALLATION

- A. Install track systems according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.
- B. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use tape or another method recommended in writing by track manufacturer.
- C. All blocking shall be installed by Contractor with the ability to support specified drapery system.

3.2 DRAPERY INSTALLATION

- A. Where draperies abut overhead construction, hang draperies so that clearance between headings and overhead construction is 1/4 inch (6.4 mm).
- B. Where draperies extend to floor, install so that bottom hems clear finished floor by not more than 1 inch (25 mm) and not less than 1 inch (25 mm).
- C. After hanging draperies, test and adjust each track to produce unencumbered, smooth operation.
- D. Steam and dress down draperies as required to produce crease- and wrinkle-free installation.
- E. Remove, replace, clean draperies that are stained or soiled.

END OF SECTION 122200

SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Concrete bases.
9. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 1. Finish: Polished chrome-plated
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. 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.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic 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.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 15050

SECTION 15060 - HANGERS & SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Equipment supports.

B. See Division 15 Section(s) "Metal Ducts" and "Nonmetal Ducts for additional duct hangers and supports.

1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
1. AAA Technology & Specialties Co., Inc.
 2. Bergen-Power Pipe Supports.
 3. B-Line Systems, Inc.; a division of Cooper Industries.
 4. Carpenter & Paterson, Inc.
 5. Empire Industries, Inc.
 6. ERICO/Michigan Hanger Co.
 7. Globe Pipe Hanger Products, Inc.
 8. Grinnell Corp.
 9. GS Metals Corp.
 10. National Pipe Hanger Corporation.
 11. PHD Manufacturing, Inc.
 12. PHS Industries, Inc.
 13. Piping Technology & Products, Inc.
 14. Tolco Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.6 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:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, 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:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, 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 (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- H. 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 (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).

2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install powder-actuated fasteners 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.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 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 smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 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 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 contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

SECTION 15075 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Equipment signs.
 - 4. Access panel and door markers.
 - 5. Pipe markers.
 - 6. Duct markers.
 - 7. Valve tags.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
 - 1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 - 2. Location: Accessible and visible.
 - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches (64 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Data: Instructions for operation of equipment and for safety procedures.
 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
 3. Thickness: 1/16 inch (1.6 mm) thick, unless otherwise indicated.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch (1.6-mm) thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch (3.2-mm) center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils (0.08 mm) thick with pressure-sensitive, permanent-type, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): 3/4 inch (19 mm) minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches (150 mm) or Larger: 1-1/2 inches (38 mm) minimum.

2.3 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers, with numbering scheme. Provide 5/32-inch (4-mm) hole for fastener.
 - 1. Material: 0.032-inch- (0.8-mm-) thick brass.
 - 2. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.

2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
1. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Meters, gages, thermometers, and similar units.
 - c. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - d. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - e. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - f. Fans, blowers, primary balancing dampers, and mixing boxes.
 - g. Packaged HVAC central-station and zone-type units.
 - h. Tanks and pressure vessels.
 - i. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
 - a. Green: For cooling equipment and components.
 - b. Yellow: For heating equipment and components.
 2. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 4. Include signs for the following general categories of equipment:
 - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 - e. Fans, blowers, primary balancing dampers, and mixing boxes.
 - f. Packaged HVAC central-station and zone-type units.
 - g. Tanks and pressure vessels.
 - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Pretensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches (150 mm): Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch (19 mm) wide, lapped at least 1-1/2 inches (38 mm) at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches (150 mm) and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches (38 mm) wide, lapped at least 3 inches (75 mm) at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
 1. Green: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. Letter Size: Minimum 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- B. Locate markers near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
 1. Valve-Tag Size and Shape:
 - a. 1-1/2 inches square
 2. Valve-Tag Color:
 - a. Yellow
 3. Letter Color:
 - a. Black

3.6 ADJUSTING AND CLEANING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.
- B. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 15075

SECTION 15080 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:
 - 1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Sealants.
 - 6. Factory-applied jackets.
 - 7. Field-applied jackets.
 - 8. Tapes.
 - 9. Securements.
 - 10. Corner angles.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control inspection reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas Super K.
 2. Block Insulation: ASTM C 552, Type I.
 3. Special-Shaped Insulation: ASTM C 552, Type III.
 4. Board Insulation: ASTM C 552, Type IV.
 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.

7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 1. Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 1. Products:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 1. Products:
 - a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 1. Products:
 - a. Fibrex Insulations Inc.; FBX.
 - b. Johns Manville; 1000 Series Spin-Glas.
 - c. Owens Corning; High Temperature Industrial Board Insulations.

- d. Rock Wool Manufacturing Company; Delta Board.
- e. Roxul Inc.; Roxul RW.
- f. Thermafiber; Thermafiber Industrial Felt.

K. Mineral-Fiber, Preformed Pipe Insulation:

1. Products:

- a. Fibrex Insulations Inc.; Coreplus 1200.
- b. Johns Manville; Micro-Lok.
- c. Knauf Insulation; 1000 Pipe Insulation.
- d. Manson Insulation Inc.; Alley-K.
- e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

L. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.

1.]Products:

- a. Knauf Insulation; Permawick Pipe Insulation.
- b. Owens Corning; VaporWick Pipe Insulation.

M. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

- a. CertainTeed Corp.; CrimpWrap.
- b. Johns Manville; MicroFlex.
- c. Knauf Insulation; Pipe and Tank Insulation.
- d. Manson Insulation Inc.; AK Flex.
- e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.3 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products:

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

2.4 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. Cellular-Glass: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. Products:

- a. Childers Products, Division of ITW; CP-96.
- b. Foster Products Corporation, H. B. Fuller Company; 81-33.

- C. Flexible Elastomeric: Comply with MIL-A-24179A, Type II, Class I.

1. Products:

- a. Aeroflex USA Inc.; Aero seal.
- b. Armacell LCC; 520 Adhesive.
- c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- d. RBX Corporation; Rubatex Contact Adhesive.

- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

- E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products:

- a. Dow Chemical Company (The); 739, Dow Silicone.
- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates: Comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:

- a. Childers Products, Division of ITW; CP-35.
- b. Foster Products Corporation, H. B. Fuller Company; 30-90.
- c. ITW TACC, Division of Illinois Tool Works; CB-50.
- d. Marathon Industries, Inc.; 590.
- e. Mon-Eco Industries, Inc.; 55-40.
- f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products:

- a. Childers Products, Division of ITW; CP-76.
- b. Foster Products Corporation, H. B. Fuller Company; 30-45.

- c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
2. Joint Sealants for Polystyrene Products:
 - a. Childers Products, Division of ITW; CP-70.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 3. Materials shall be compatible with insulation materials, jackets, and substrates.
 4. Permanently flexible, elastomeric sealant.
 5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
 6. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
1. Products:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products:
 - a. Childers Products, Division of ITW; CP-76.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 5. Color: White.

2.7 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - 1. Products:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - 2. Sheet and roll stock ready for shop or field sizing.
 - 3. Finish and thickness are indicated in field-applied jacket schedules.
 - 4. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - 5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
 - 6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union covers.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
 - 1. Width: 3 inches (75 mm).
 - 2. Thickness: 11.5 mils (0.29 mm).

3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 6. 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 and UL listed.
1. Width: 3 inches (75 mm).
 2. Thickness: 6.5 mils (0.16 mm).
 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
1. Width: 2 inches (50 mm).
 2. Thickness: 3.7 mils (0.093 mm).
 3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 4. Elongation: 5 percent.
 5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal.
- B. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
1. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Aluminum, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 3. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- C. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
1. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 2. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).

3. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- D. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 1. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 2. Spindle: Aluminum, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 3. Adhesive-backed base with a peel-off protective cover.
- E. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- F. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- G. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- H. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.11 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation with tightly butted joints free of voids and gaps. Vapor barriers shall be continuous. Before installing jacket material, install vapor-barrier system.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- 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. Hangers and Anchors: 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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 (100 mm) 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. Manholes.
 5. Handholes.
 6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.

- B. Insulation Installation at Below-Grade 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 (50 mm).
 - 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. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
 - 1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."
- F. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies according to Division 7 Section "Through-Penetration Firestop Systems."

3.4 DUCT AND PLENUM INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
 5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (50 mm) o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.5 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. Secure single-layer insulation with bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
- C. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with bands at 12-inch (300-mm) intervals.
- D. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- E. Cover segmented insulated surfaces with a layer of insulating 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.
- F. 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.
- G. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- H. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of preformed insulation to pipe with wire or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
 - 4. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
 - 5. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- I. Insulation Installation on Pipe Flanges:
 - 1. Install preformed pipe insulation to outer diameter of pipe flange.
 - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of same insulation material and thickness as pipe insulation.
 - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

5. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- J. Insulation Installation on Pipe Fittings and Elbows:
1. 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.
 2. 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.
- K. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. 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.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. 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.
 5. Install insulation to flanges as specified for flange insulation application.
- L. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. 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.
- M. 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 (50 mm) 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.

N. Special Installation Requirements for Flexible Elastomeric and Polyolefin Insulation:

1. 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.
2. Insulation Installation on Pipe Flanges:
 - a. Install pipe insulation to outer diameter of pipe flange.
 - b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 - c. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
 - d. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
3. Insulation Installation on Pipe Fittings and Elbows:
 - a. Install mitered sections of pipe insulation.
 - b. 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.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.

B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.7 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket as specified in Division 9 painting Sections.

1. Apply two finish coats of interior, flat, latex-emulsion size over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum jackets.

3.8 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

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(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe,

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Remove defective Work.

C. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Metal ducts exposed within an air conditioned storage space.
4. Double wall preinsulated metal ducts.
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.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Supply, Return-Air Duct and Plenum Insulation (non mechanical room): Mineral-fiber blanket, 2.2 inches 0.75-lb/cu. Ft (R=6 minimum) nominal density.
- B. Exposed, Supply, Return-Air Duct and Plenum Insulation: Mineral-fiber board, 3.0 inches 0.75-lb/cu. Ft (R=6 minimum) nominal density. Provide metal jacket suitable for field painting in open areas.

3.11 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

3.12 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. Fire-suppression piping.
2. Drainage piping located in crawl spaces.
3. Below-grade piping.
4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR & OUTDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Mineral-fiber pipe insulation, Type I, 1 inch (25 mm) thick. In exposed areas provide jacket suitable for field painting.
- B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Flexible elastomeric 1/2 inch thick.

3.14 FIELD-APPLIED JACKET SCHEDULE

- A. Ductwork and Piping, Exposed in open lounge area:
 1. Provide a Metal jacket suitable for field painting.

END OF SECTION 15080

SECTION 15140 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Flexible connectors.
4. Escutcheons.
5. Sleeves and sleeve seals.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 3. Copper Pressure-Seal-Joint Fittings:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
- b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; 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. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: Minimum 200 psig.
 - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- C. Install domestic water piping level and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- E. 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.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

- M. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valves as indicated on contract drawings. Use ball valves.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2-1/2 and smaller. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Aboveground Domestic Water Piping NPS 2-1/2 and Smaller: Plastic-to-metal transition fittings.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
- 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: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches 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.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. 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 required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection.

3.9 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. Seal space outside of sleeves in concrete slabs and walls with grout.
- I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- J. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel.
2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
- K. 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 in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

- b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Piping Tests:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 6. Prepare reports for tests and for corrective action required.
- D. Domestic water piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.14 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. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.15 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Aboveground domestic water piping, NPS 2-1/2 and smaller, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper solder-joint fittings; and brazed or soldered joints.
 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.16 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 1. Shutoff Duty: Use ball valves for piping NPS 2-1/2 and smaller.
 2. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 15140

SECTION 15145 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Balancing valves.
 - 3. Temperature-actuated water mixing valves.
 - 4. Strainers.
 - 5. Hose bibbs.
 - 6. Wall hydrants.
 - 7. Drain valves.
 - 8. Water hammer arresters.
 - 9. Trap-seal primer valves.
- B. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
 - 1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Rough bronze.

2.2 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.

4. Pressure Rating: 400-psig minimum CWP.
5. Size: NPS 2 or smaller.
6. Body: Copper alloy.
7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a Watts Industries Co.
 - h. Symmons Industries, Inc.
 - i. Taco, Inc.
 - j. Watts Industries, Inc.; Water Products Div.
 - k. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1017.
4. Pressure Rating: 125 psig.
5. Type: Thermostatically controlled water mixing valve.
6. Material: Bronze body with corrosion-resistant interior components.
7. Connections: Threaded inlets and outlet.
8. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
9. Tempered-Water Setting: as indicated.
10. Tempered-Water Design Flow Rate: as indicated.
11. Valve Finish: Chrome plated.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2-1/2 and smaller

3. End Connections: Threaded for NPS 2-1/2 and smaller.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2-1/2 and Smaller: 0.020 inch.
6. Drain: Pipe plug.

2.5 HOSE BIBBS

A. Hose Bibbs:

1. Refer to plumbing fixture schedule on contract drawings.

2.6 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Refer to plumbing fixture schedule on contract drawings:

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Refer to plumbing fixture schedule on contract drawings:

2.9 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Refer to plumbing fixture schedule on contract drawings:

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install thermometers and water regulators if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- D. Install Y-pattern strainers for water on supply side of each pump.
- E. Install water hammer arresters in water piping according to PDI-WH 201.
- F. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- G. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.2 FIELD QUALITY CONTROL

- A. Remove and replace malfunctioning domestic water piping specialties.

3.3 ADJUSTING

- A. Set field-adjustable flow of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 15145

SECTION 15150 - SANITARY WASTE & VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

- b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- B. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste and vent patterns.
 2. Solvent Cement and Adhesive Primer:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Aboveground, soil, waste and vent piping NPS 4 and smaller shall be any of the following:
1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 22 Section "Common Work Results for Plumbing."
- E. 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."

- F. 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 2 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.
- G. 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.
- H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Use full-port ball valve for piping NPS 2 and smaller.
- C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. 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. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. 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. Refer to Division 22 Section "Sanitary Waste Piping Specialties."

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. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection.

3.7 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.
 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 2. Prepare reports for tests and required corrective action.

3.8 CLEANING

- 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.

END OF SECTION 15150

SECTION 15155 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Roof flashing assemblies.
4. Miscellaneous sanitary drainage piping specialties.
5. Flashing materials.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Cast-Iron Cleanouts :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Raised-head, cast-iron plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Refer to plumbing fixture schedule on contract drawings.

C. Cast-Iron Exterior Cleanouts:

1. Refer to plumbing fixture schedule on contract drawings.

D. Cast-Iron Floor Cleanouts:

1. Refer to plumbing fixture schedule on contract drawings.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Refer to plumbing fixture schedule on contract drawings.

B. Cast-Iron Floor Sinks:

1. Refer to plumbing fixture schedule on contract drawings.

C. Cast-Iron Hub Drains:

1. Refer to plumbing fixture schedule on contract drawings.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Acorn Engineering Company; Elmdor/Stoneman Div.
- b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., thick, lead flashing collar and skirt extending at least 6 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

2.5 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.

2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- H. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- I. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
- J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- K. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- L. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 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.
- 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 Division 07 Section "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.

3.4 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 15155

SECTION 15410 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Faucets for lavatories showers and sinks.
 - 2. Protective shielding guards.
 - 3. Fixture supports.
 - 4. Disposers.
 - 5. Lavatories.
 - 6. Sinks.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities "Public Law 90-480, "Architectural Barriers Act"; and

Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 2. Vitreous-China Fixtures: ASME A112.19.2M.
 - 3. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 4. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 2. Faucets: ASME A112.18.1.
 - 3. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 4. Hose-Coupling Threads: ASME B1.20.7.
 - 5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 6. NSF Potable-Water Materials: NSF 61.
 - 7. Pipe Threads: ASME B1.20.1.
 - 8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 9. Supply Fittings: ASME A112.18.1.
 - 10. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 3. Faucets: ASME A112.18.1.
 - 4. Hand-Held Showers: ASSE 1014.
 - 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Pipe Threads: ASME B1.20.1.
 - 8. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Hose-Coupling Threads: ASME B1.20.7.
 5. Off-Floor Fixture Supports: ASME A112.6.1M.
 6. Pipe Threads: ASME B1.20.1.
 7. Plastic Toilet Seats: ANSI Z124.5.
 8. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Refer to plumbing fixture schedule on contract drawings.

2.2 SINK FAUCETS

A. Sink Faucets:

1. Refer to plumbing fixture schedule on contract drawings.

2.3 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.

- g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.4 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Lavatory Supports:
 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.

2.5 LAVATORIES

- A. Lavatories:
 1. Refer to plumbing fixture schedule on contract drawings.

2.6 SINKS

- A. Sinks:
 1. Refer to plumbing fixture schedule on contract drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.

2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
 - D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
 - E. Install wall-mounting fixtures with tubular waste piping attached to supports.
 - F. Install fixtures level and plumb according to roughing-in drawings.
 - G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
 - I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
 - J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
 - K. Install toilet seats on water closets.
 - L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
 - M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
 - N. 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.
 - O. Install shower flow-control fittings with specified maximum flow rates in shower arms.
 - P. Install traps on fixture outlets.
 1. Exception: Omit trap on fixtures with integral traps.
 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
 - Q. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

- R. Connect inlet hose to dishwasher and outlet hose to disposer.
- S. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- T. Set showers in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."
- U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.

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- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15410

SECTION 15815 - METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes metal, rectangular ducts and fittings for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa).
- B. See Division 15 Section "Nonmetal Ducts" for fibrous-glass ducts.
- C. See Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details for metal ducts.
 - 1. Penetrations through fire-rated and other partitions.
 - 2. Duct accessories, including access doors and panels.

1.3 QUALITY ASSURANCE

- A. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 SEALANT MATERIALS

- A. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.
- B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Galvanized-steel shapes and plates complying with ASTM A 36/A 36M.

2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Lockformer.
 2. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
 3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Ductwork:

1. Supply Ducts: 2-inch wg (500 Pa)
2. Return Ducts (Negative Pressure): 1-inch wg (250 Pa)

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.
- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.
- E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).

- M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."
- N. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
 - 1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.
- B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- D. Install concrete inserts before placing concrete.
- E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION 15815

SECTION 15820 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
1. Backdraft dampers.
 2. Volume dampers.
 3. Fire dampers.
 4. Combination fire and smoke dampers.
 5. Turning vanes.
 6. Duct-mounting access doors.
 7. Flexible connectors.
 8. Flexible ducts.
 9. Duct accessory hardware.
 10. Duct Silencers

1.2 SUBMITTALS

- A. Product Data: For the following:
1. Backdraft dampers.
 2. Volume dampers.
 3. Fire dampers.
 4. Combination fire and smoke dampers.
 5. Turning vanes.
 6. Duct-mounting access doors.
 7. Flexible connectors.
 8. Flexible ducts.

1.3 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.
- D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT DAMPERS

- A. Manufacturers:
 1. Greenheck.
 2. Penn Ventilation Company, Inc.
 3. Ruskin Company.
- B. Description: Multiple-blade, parallel action gravity balanced, with[center-pivoted] blades of maximum 6-inch (150-mm) width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Frame: 0.052-inch-1.3-mm- thick, galvanized sheet steel, with welded corners and mounting flange.
- D. Blades: 0.050-inch- (1.2-mm-) thick aluminum sheet.

- E. Blade Seals: Neoprene.
- F. Blade Axles: Galvanized steel.
- G. Tie Bars and Brackets: Galvanized steel.
- H. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Flexmaster U.S.A., Inc.
4. McGill AirFlow Corporation.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized sheet steel.
3. Blade Axles: Galvanized steel.
4. Bearings: [Oil-impregnated bronze] [Molded synthetic] [Stainless-steel sleeve].
5. Tie Bars and Brackets: Galvanized steel.

D. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include

center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 FIRE DAMPERS

- A. Manufacturers:
 - 1. Greenheck.
 - 2. McGill AirFlow Corporation.
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company.
- B. Fire dampers shall be labeled according to UL 555.
- C. Fire Rating: See Architectural Plans.
- D. Frame: Curtain type with blades inside airstream fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick as indicated and of length to suit application.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- I. Fusible Links: Replaceable, 165 deg F (74 deg C) rated.

2.6 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, [single] [double]-vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.
 - 1. Manufacturers:

- a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. METALAIRE, Inc.
 - d. Ward Industries, Inc.
- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.7 DUCT-MOUNTING ACCESS DOORS

- A. General Description: Fabricate doors airtight and suitable for duct pressure class.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

1. Manufacturers:

- a. American Warming and Ventilating.
- b. CESCO Products.
- c. Ductmate Industries, Inc.
- d. Flexmaster U.S.A., Inc.
- e. Greenheck.
- f. McGill AirFlow Corporation.
- g. Nailor Industries Inc.
- h. Ventfabrics, Inc.
- i. Ward Industries, Inc.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Provide number of hinges and locks as follows:

- a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
- b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
- c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches [with outside and inside handles].
- d. Sizes 24 by 48 Inches (600 by 1200 mm) and Larger: One additional hinge.

- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch (25-mm) thickness. Include cam latches.

1. Manufacturers:

- a. Ductmate Industries, Inc.
- b. Flexmaster U.S.A., Inc.

2. Frame: Galvanized sheet steel, with spin-in notched frame.

- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.8 FLEXIBLE CONNECTORS

- A. Manufacturers:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Corp.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.9 FLEXIBLE DUCTS

- A. Manufacturers:
 - 1. Flexmaster U.S.A., Inc.
 - 2. Hart & Cooley, Inc.
 - 3. McGill AirFlow Corporation.
- B. Noninsulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg 250 Pa negative.
 - 2. Maximum Air Velocity: 4000 fpm (20.3 m/s).
 - 3. Temperature Range: Minus 20 to plus 210 deg F (Minus 28 to plus 99 deg C).
- C. Insulated-Duct Connectors: 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 (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20.3 m/s).
 - 3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

- D. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches (75 to 450 mm) to suit duct size.

2.10 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 APPLICATION AND 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. Provide 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 backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- D. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Provide test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers, with fusible links, according to manufacturer's UL-approved written instructions.
- H. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
 - 1. On both sides of duct coils.
 - 2. Downstream from volume dampers[, turning vanes,] and equipment.
 - 3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.

4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
 5. On sides of ducts where adequate clearance is available.
- I. Install the following sizes for duct-mounting, rectangular access doors:
 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 5. Body Access: 25 by 14 inches (635 by 355 mm).
 6. Body Plus Ladder Access: 25 by 17 inches (635 by 430 mm).
 - J. Label access doors according to Division 15 Section "Mechanical Identification."
 - K. Install flexible connectors for metal ducts connecting to grilles at all walls penetrating into auditorium area from mechanical rooms. Provide additional wrap insulation over flexible connector.
 - L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
 - M. For fans developing static pressures of 5-inch wg (1250 Pa) and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
 - N. Connect terminal units to supply ducts[directly or] with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.
 - O. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.
 - P. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
 - Q. Install duct test holes where indicated and required for testing and balancing purposes.
- 3.2 ADJUSTING
- A. Adjust duct accessories for proper settings.
 - B. Adjust fire and smoke dampers for proper action.
 - C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15820

SECTION 15950 - TESTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - c. Multizone systems.
 2. Hydronic Piping Systems:
 - a. Constant-flow systems.
 - b. Variable-flow systems.
 3. HVAC equipment quantitative-performance settings.
 4. Kitchen hood airflow balancing.
 5. Existing systems TAB.
 6. Verifying that automatic control devices are functioning properly.
 7. Reporting results of activities and procedures specified in this Section.

1.2 SUBMITTALS

- A. Strategies and Procedures Plan: Within [30] [60] [90] days from Contractor's Notice to Proceed, submit [2] [4] [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.
- B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- C. Warranties specified in this Section.

1.3 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

- C. TAB Report Forms: Use standard forms from [AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."] [NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."] [SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing."] [TAB firm's forms approved by Architect.]

1.4 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. 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.

1.5 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.6 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
- B. 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.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."
- 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 equipment performance data including fan and pump curves. 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. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- P. Examine system pumps to ensure absence of entrained air in the suction piping.
- Q. Examine equipment for installation and for properly operating safety interlocks and controls.
- R. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- S. 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.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in [AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems"] [NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems"] [SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing"] and this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.4 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' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.
- 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS
- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum and return-air and exhaust-air dampers at a position that simulates full-cooling load.
 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 3. Measure total system airflow. Adjust to within indicated airflow.
 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance systems similar to constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.

8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at full flow through the cooling coil if coil has that capacity.
- B. Adjust each zone damper to indicated airflow.

3.8 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at indicated flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.9 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.10 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.11 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator and condenser to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
 - 1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 - 2. If water-cooled chillers, condenser-water entering and leaving temperatures, pressure drop, and water flow.
 - 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.
 - 4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
 - 5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
 - 6. Capacity: Calculate in tons of cooling.

7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.13 PROCEDURES FOR COOLING TOWERS

- A. Shut off makeup water for the duration of the test, and verify that makeup and blowdown systems are fully operational after tests and before leaving the equipment. Perform the following tests and record the results:
 1. Measure condenser-water flow to each cell of the cooling tower.
 2. Measure entering- and leaving-water temperatures.
 3. Measure wet- and dry-bulb temperatures of entering air.
 4. Measure wet- and dry-bulb temperatures of leaving air.
 5. Measure condenser-water flow rate recirculating through the cooling tower.
 6. Measure cooling tower pump discharge pressure.
 7. Adjust water level and feed rate of makeup-water system.

3.14 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.15 PROCEDURES FOR BOILERS

- A. If hydronic, measure entering- and leaving-water temperatures and water flow.
- B. If steam, measure entering-water temperature and flow and leaving steam pressure, temperature, and flow.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Water Coils: Measure the following data for each coil:
 1. Entering- and leaving-water temperature.
 2. Water flow rate.
 3. Water pressure drop.
 4. Dry-bulb temperature of entering and leaving air.
 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 6. Airflow.
 7. Air pressure drop.
- B. Electric-Heating Coils: Measure the following data for each coil:
 1. Nameplate data.

2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.17 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.18 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
 1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- B. After balancing is complete, do the following:
 1. Measure and record the static pressure at the hood exhaust-duct connection.
 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches (300 mm) between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.

3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
1. Check duct slopes as required.
 2. Verify that duct access is installed as required.
 3. Verify that point of termination is as required.
 4. Verify that duct air velocity is within the range required.
 5. Verify that duct is within a fire-rated enclosure.
- D. Report deficiencies.
- 3.19 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS
- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
4. Air balance each air outlet.

3.20 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.21 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
 2. Air Outlets and Inlets: 0 to minus 10 percent.
 3. Heating-Water Flow Rate: 0 to minus 10 percent.

4. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.22 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:

- a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.

3.23 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950

SECTION 16050 - BASIC ELECTRICAL MATERIALS & METHODS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Common electrical installation requirements.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.4 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
5. So that underground raceways that extend under the building grade slab are routed clear of footings, grade beams and similar including drainage provisions and the work of other trades. Where the number of sweeps or bends exceeds practical limits, furnish and install hand holes, manholes and similar appurtenances to facilitate the pulling in of cables.
6. So that raceways run "overhead" are located at elevations and in such a manner that does not interfere with the work of other trades or restrict proper use and access of the area or space in which the raceway is located. In particular locate circuitry to Connector Strips at a suitable elevation above the catwalks.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."
- C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

- M. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

END OF SECTION 16050

SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 3/0 stranded.
 - 5. Bonding Conductor: No. 4, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: copper-clad steel $\frac{3}{4}$ " x 20'.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for #10 AWG and smaller, and stranded conductors for #8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum. Bury at least 24 inches (600 mm) below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors 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 EQUIPMENT GROUNDING

- A. 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. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch (6-by-50-by-300-mm) grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. Metal or Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least 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.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 2 Section "Underground Ducts and Utility Structures," and shall be at least 12 inches (300 mm) deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- 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.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
 - a. Measure ground resistance not less 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.
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 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).
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

SECTION 16072 - ELECTRICAL SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 SUBMITTALS

A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of component used.

1.3 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed under this Project, with a minimum structural safety factor of 5 times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-3, factory-fabricated components for field assembly, and provide finish suitable for the environment in which installed.

1. Manufacturers:

- a. Cooper B-Line; a division of Cooper Industries.
 - b. ERICO International Corporation.
 - c. Allied Support Systems; Power-Strut Unit.
 - d. GS Metals Corp.
 - e. Michigan Hanger Co., Inc.; O-Strut Div.
 - f. National Pipe Hanger Corp.
 - g. Thomas & Betts Corporation.
 - h. Unistrut; Tyco International, Ltd.
 - i. Wesanco, Inc.
2. Channel Dimensions: Selected for structural loading
- C. Raceway and Cable Supports: As described in NECA 1.
- D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers:
 - 1) Cooper B-Line; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Construction Products.
 - 5) MKT Fastening, LLC.
 - 6) Powers Fasteners.
 2. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 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, high strength. Comply with ASTM A 325.
 5. Toggle Bolts: All-steel springhead type.
 6. Hanger Rods: Threaded steel.

2.3 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 5 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 for application of hangers and supports for electrical equipment and systems, unless requirements in this Section or applicable Code are stricter.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 for installation requirements, except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods, unless otherwise indicated by Code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel:
 - a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
 - b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - c. Spring-tension clamps.
 - 6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 5 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.

3.4 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
- B. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so expansion anchors will be a minimum of 10 bolt diameters from edge of the base.
 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of the base.
 2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 3. Place and secure anchorage devices. Use supported equipment manufacturer's 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. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 6. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 3 Section "Cast-in-Place Concrete (Limited Applications)."

END OF SECTION 16072

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Identification for conductors and communication and control cable.
2. Warning labels and signs.
3. Equipment identification labels.

1.2 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Marker Tape: Vinyl or vinyl -cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 WARNING LABELS AND SIGNS

A. Comply with NFPA 70, NFPA 70 E and 29 CFR 1910.145.

- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).
- D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 10 by 14 inches (250 by 360 mm).
- E. Fasteners for Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
- F. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 mm)."
 - 3. PPE Personnel protection equipment labels identifying level of hazard and the required protective items as prescribed by NEC 70 E.

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

PART 3 - EXECUTION

3.1 APPLICATION

- A. Auxiliary Electrical Systems Conductor and Cable Identification: Use marker tape to identify field-installed alarm, control, signal, sound, intercommunications, voice, and data wiring connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals and cable pull points. Identify by system and circuit designation.
 2. Use system of designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
- B. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply [self-adhesive warning labels]. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- C. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: [Self-adhesive, engraved, laminated acrylic or melamine label]. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, drilled for screw attachment.
 - c. Elevated Components: Increase sizes of labels and legend to those appropriate for viewing from the floor.
 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Electrical switchgear and switchboards.
 - c. Transformers.
 - d. Motor-control centers.
 - e. Disconnect switches.
 - f. Enclosed circuit breakers.
 - g. Motor starters.
 - h. Push-button stations.

- i. Power transfer equipment.
- j. Contactors.

3.2 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.

END OF SECTION 16075

SECTION 16120 - CONDUCTORS & CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Aluminum and Copper Conductors: Comply with NEMA WC 70.
- B. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, THHW and other insulation types as required based on the environment to which the conductor will be subjected.

2.2 CONNECTORS AND SPLICES

- 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:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Hubbell Power Systems, Inc.
 - 3. O-Z/Gedney; EGS Electrical Group LLC.
 - 4. 3M; Electrical Products Division.
 - 5. Tyco Electronics Corp.
 - 6. IlSCO
 - 7. NSI Industries – “Polaris Taps”
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
- D. Where required due to limitations on the “approved termination devices” provided with equipment (approved for use by the AHJ, the contractor shall provide “transition boxes” and connectors to allow for the reduction of conductor size (oversized to account for voltage drop) to occur without voiding warranties or violating code limitations on wire bending space, clearance or cross sectional area limits.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.4 SLEEVE SEALS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.

- D. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic, include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHW or THHN-THWN, single conductors in raceway.
- B. Exposed Branch Circuits and Feeders: Type THHW or THHN-THWN, single conductors in EMT raceway
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHW or THHN-THWN, single conductors in raceway or Metal-clad cable, Type MC.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHW or THHN-THWN, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 16 Section "Electrical Supports".
- F. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."
- G. 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 and UL 486B.
- H. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- I. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.4 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- D. Cut sleeves to length for mounting flush with both wall surfaces.
- E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 7 Section "Joint Sealants."

- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 7 Section "Through-Penetration Firestop Systems."
- J. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- L. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.5 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 7 Section "Through-Penetration Firestop Systems."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test [service entrance and feeder conductors and conductors feeding the following critical equipment and services] for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- C. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 16120

SECTION 16130 - RACEWAYS & BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. EMT: ANSI C80.3.
- C. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Fittings for EMT: Steel, set-screw or compression type.

2.2 METAL WIREWAYS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: As indicated.
- F. Finish: Manufacturer's standard enamel finish.

2.3 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Butler Manufacturing Company; Walker Division.
- b. Enduro Systems, Inc.; Composite Products Division.
- c. Hubbell Incorporated; Wiring Device-Kellems Division.
- d. Lamson & Sessions; Carlon Electrical Products.
- e. Panduit Corp.
- f. Walker Systems, Inc.; Wiremold Company (The).
- g. Wiremold Company (The); Electrical Sales Division.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- C. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic finished inside with radio-frequency-resistant paint.
- G. Cabinets:
 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed and above ceilings: EMT suitable for field painting.
 2. Concealed in Interior Walls and Partitions: EMT .
 3. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- B. Minimum Raceway Size: 3/4-inch (16-mm) trade size.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 16 Section "Electrical Supports and Seismic Restraints."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.
- K. Raceways for Optical Fiber and Communications Cable: Install as follows:
 - 1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
 - 2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
 - 3. Install with a maximum of four 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- M. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- N. 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.
- O. Set metal floor boxes level and flush with finished floor surface.
- P. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

DESTINATION LOUNGE
ORANGE COUNTY CONVENTION CENTER

RACEWAYS & BOXES
SECTION 16130

END OF SECTION 16130

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
 3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

B. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.
3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

C. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

D. Long-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. (111 sq. m).

E. Wide-Range Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

- a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

2.5 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic [0.035-inch- (1-mm-)
 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant die-cast aluminum with lockable cover.

2.6 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

2.7 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices – below elevation noted on architectural documents as not to be painted black: White.
 2. Wiring Devices – above elevation noted on architectural documents as to be painted black: Black.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. 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.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION 16140

SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Indoor occupancy sensors.
 - 2. Lighting Control Panel
- B. The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. Contractor shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system. All Labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section.
- C. Lighting Control panel is listed as "basis of design" only. Other equal products as noted on drawings will be acceptable for submission and review.

1.2 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.3 COORDINATION

- A. Coordinate placement of daylight and occupancy sensors to achieve optimum performance. Proper sensor placement should be coordinated with others in order to avoid obstructions that would interfere with maintaining prescribed light levels
- B. Coordinate the work to provide luminaires and lamps that are compatible with the lighting controls to be installed
- C. Coordinate location of touch panels and keypad stations with finish work that is to be installed by others
- D. Notify architect of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work
- E. Pre-installation meeting: Conduct on-site meeting with lighting control representative prior to starting work as part of manufacturer's standard startup service. Representative to review with the installer:
 - 1. Low voltage wiring requirements
 - 2. Line voltage and low voltage separation requirements
 - 3. Lighting management panel locations

4. Sensor locations
5. Touch Panel locations
6. Keypad locations
7. Wall station locations
8. Networked luminaire wiring requirements
9. Connections to other equipment

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 1. Lighting plan showing location, orientation, and coverage area of each sensor.
 2. Interconnection diagrams showing field-installed wiring.
- C. Submittal Data for Lighting Control Panels
 1. Shop Drawings: Submit dimensioned drawings of lighting control system and accessories including, but not necessarily limited to, relay panels, switches, DTC, photocells and other interfaces. Shop drawings shall indicate exact location of each device or a RFI to confirm location. Plans are diagrammatical. EC to verify all lighting control material requirements from approved shop drawings. "Cut Sheet" submittal not acceptable.
 2. Product Data: Submit for approval manufacturer's data on the specific lighting control system and components. Submittal shall be electronic format with hard copy available. To prevent departures from approved system operation, electronic files submitted shall be able to be directly downloaded to the specified system at manufacturer facility. Submit a complete bill of materials with part numbers, description and voltage specifications.
 3. Manufacturer shall provide free software that can be used to specify the system, detail all programming and generate a single line in a format that can be dropped into industry standard CAD packages.
 4. One Line Diagram: Submit a one-line diagram of the system configuration indicating the type, size and number of conductors between each component if it differs from that illustrated in the riser diagram in these specifications. Submittals that show typical riser diagrams are not acceptable.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. Lighting Control Panel:
1. Manufacturer: Minimum 10 years of experience designing and assembling architectural lighting controls
 2. All devices are 100% factory function tested prior to delivery
 3. Compliant with the requirements of NFPA 70
 4. All power components UL listed for required loads

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.3 SWITCH-BOX OCCUPANCY SENSORS

- A. Manufacturers:
1. Bryant Electric; a Hubbell Company.
 2. Hubbell Lighting Inc.
 3. Leviton Mfg. Company Inc.
 4. Lightolier Controls; a Genlyte Company.
 5. Lithonia Lighting.
 6. MYTECH Corporation.
 7. Novitas, Inc.
 8. RAB Electric Manufacturing, Inc.
 9. Sensor Switch, Inc.
 10. TORK.
 11. Unenco Electronics; a Hubbell Company.
 12. Watt Stopper (The).

- B. Description: PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; and rated for 1000 W at 277-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/3-hp motors, minimum.
1. Include ground wire.
 2. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present.

2.4 INDOOR OCCUPANCY SENSORS

A. Manufacturers:

1. Hubbell Lighting Inc.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting.
4. MYTECH Corporation.
5. Novitas, Inc.
6. RAB Electric Manufacturing, Inc.
7. Sensor Switch, Inc.
8. TORK.
9. Unenco Electronics; a Hubbell Company.
10. Watt Stopper (The).

B. Description: Wall- or ceiling-mounting, solid-state, PIR-type units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted though a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (215 to 2150 lx); keeps lighting off when selected lighting level is present.

8. Detector Sensitivity: Detect occurrences of 6-inch (150-mm) minimum movement of any portion of a human body that presents a target of at least 36 sq. in. (232 sq. cm).
9. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
10. Detection Coverage (Corridor): Detect occupancy within 90 feet (27 m) when mounted on a 10-foot- (3-m-) high ceiling.

2.5 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG, complying with Division 16 Section "Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG, complying with Division 16 Section "Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 14 AWG, complying with Division 16 Section "Conductors and Cables."
- D. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Division 16 Section "Voice and Data Communication Cabling."

2.6 LIGHTING CONTROL PANEL

- A. Basis of controls design Manufacturer: Acuity Brands, One Lithonia Way, Conyers GA 30012 Jim Phelan, Business Development Manager, phone 847-848-0014. Other acceptable manufacturers are – HUBBEL, LEVITON, LEHIGH DIMMING, PHILLIPS.
- B. General:
 1. Provide system hardware that is designed, tested, manufactured, warranted by a single manufacturer
 2. Operational Life: At least 10 years expected life while operating within the specified ambient temperature and humidity range
 3. Standard Compliance & Compatibility: Provide architectural control product with native DMX512-A control
 4. Luminaire Compatibility: Supports RGB luminaires in 8 bit and/or 16 bit configurations also supporting MSB or LSB first luminaire settings.
 5. Design and test equipment to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2
 6. Power Failure Memory: automatically store system settings and recover from a power failure without requiring user input
 7. Wireless devices:
 - a. Automatically sync for system operation without addressing
 - b. Send and receive messages for real-time operation and feedback
 - c. Use industry standard RF protocols
 - d. Be in compliance with FCC and IEE standards
 8. Time Clock: automatically adjust for daylight savings time and leap year
- C. Dimming and Switching Performance Requirements:

1. Electrolytic capacitors operate at least 36 degrees F (20 degrees C) below the capacitor's maximum temperature rating when the device is under full load
2. Inrush tolerance: Use MOSFET that has a maximum rating of six times the operating current of the dimmer/relay
3. Acuity Controls
4. Fresco™ Network Lighting Controls 260943 - 4 3.27.2014
5. Surge tolerance: Panels are designed and tested to withstand surges of 6,000V, 3,000amps according to IEEE C62.41.2 and IEC 61000-4-5 without impairment to performance
6. Power failure recovery: When power is interrupted and subsequently restored, within 3 seconds lighting to automatically return to same levels prior to power failure
7. Utilize half cycle to half cycle zero cross movement to allow for voltage compensation in order to overcome line noise and lamp flickering
8. Incorporate electronic soft start default at initial turn-on that smoothly ramps lights to appropriate levels within 0.5 seconds
9. Utilize air gap off to disconnect the load line from the line supply
10. Control all light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable
11. Assign load type to each dimmer that will provide proper dimming curve for the specific light source to be controlled
12. Minimum and maximum light levels are user adjustable on a circuit by circuit basis

D. Touch Panel Controls

1. Product: Fresco Touch Screen (7TSN)
2. Preset lighting scene controller
 - a. General Requirements:
 - 1) 7" full color multi-touch capacitive touchscreen for controlling lighting and system components
 - 2) Control up to 36 dynamic lighting zones/scenes per touch screen
 - 3) Link up to 8 touch screens for a possibility of 288 lighting zones/scenes
 - 4) Connect up to 128 network devices per touch screen
 - 5) On screen lighting design
 - 6) Lighting zones/scenes can be comprised of lighting intensity, color, color temperature, and luminaire position
 - 7) Modify color and color temperature using a digital color palette and UV rating scale
 - 8) Proximity screen sensor for auto "wake-up"
 - 9) Auto dimming and user adjustable backlight
 - 10) User programmable screen lock limiting access to all feature control and programming
 - 11) Full alpha-numeric scene and zone naming
 - 12) Configurable interface to reflect project requirements
 - 13) Lighting zones/scenes support control of forward/reverse phase dimming, 0-10v, RGB, nLight® enabled luminaires, nLight® power packs, DALI, tunable white and moving fixtures
 - 14) Integral astronomical time clock enables lighting scenes

- 15) Partition status control and visualization
 - 16) Direct DMX control for a single universe (512 slots)
 - 17) Connect up to 128 nLight® enabled devices
 - 18) Digital motion sensor control
 - 19) Digital daylight harvesting response
 - 20) RS-232/contact closure capable for 3rd party integration
 - 21) Local wireless Bluetooth connectivity with mobile app
 - 22) Compatible with Fresco Lighting Management Panels (LMP)
 - 23) Frame Color: Black
3. Electrical:
 - a. Input: 24VDC
 - b. Power Supply: 120/277V AC
 - c. RS-485 network terminal
 - d. nLight enabled RJ-45 ports (in/out)
 4. Mounting:
 - a. Installs in a standard triple gang US back box
 - b. Remote mounted power supply
 - c. Plug in wire harness for RS-485 and DMX connections
 5. Protocols:
 - a. RS-485
 - b. IEEE 802.15 Bluetooth® compliant
 - c. nLight Digital communication
- E. Lighting Management Panels
- a. Product: Fresco Lighting Management Panel (FCS LMP)
 - b. General Requirements:
 - 1) Comply with UL508
 - 2) Universal voltage operation 120V-277V (MVOLT)
 - 3) Available as Factory-assembled
 - 4) Available as 4-wire Main Lug
 - 5) Configurable for site conditions with certain modules and circuit breakers small
 - 6) Oversized field wiring channel to separate line voltage and low voltage
 - 7) Available voltage barrier
 - 8) Locking breaker cover
 - 9) Convection cooled, no fans required
 - 10) Available with UL924 listed phase loss sensor device (FCS LMPE)
 - c. Factory installed bypass circuit jumpers on each dimming circuit
 - d. Provide main lugs and branch circuit protection for each power module unless panel is dedicated as feed-through type
 - e. Branch circuit rating
 - 1) 120V: 2,000W (20A)
 - f. Branch circuit breakers (when supplied) UL listed thermal magnetic
 - 1) 120V: 14kAIC
 - g. Integrated LCD push button controller for addressing panels, system override, modules and systems diagnostics
 - h. Integral USB port for PC based panel programming which is accessible behind locking door

- i. Mounting: Surface mounted NEMA type 1 enclosure
- F. Panel Installed Lighting Management Modules
- 1. Provide by manufacturer.
- 2.7 Low Voltage Wall Stations
- A. Product: nPOD (nLight®)
 - B. Push button lighting scene controller
 - C. General Requirements:
 - 1. Use Cat5 wiring with RJ45 adapters for connection between devices
 - 2. Recess into single gang junction box
 - 3. Allows control of any lighting fixtures part of the lighting control system
 - 4. Upon button press, LED to immediately illuminate
 - 5. Controller can be setup as scene recall, toggle, or raise/lower
 - 6. Controller station LED's track system status logic
 - 7. Replacement of unit does not require reprogramming
 - 8. Allows connection to additional stations, sensors, or power packs
 - 9. Custom button engraving
 - 10. Colors {White}{Almond}{Lt Almond}{Gray}{Black}
- 2.8 Remote Mounted Power Modules
- A. A. Networked relay and dimming power packs
 - B. Products: (nLight®)
 - 1. nPP16 (Power pack with 16A relay)
 - 2. nEPP5D (Power pack with 5A relay and 0-10VDC output)
 - 3. nSP16 (Secondary power pack with 16A relay)
 - 4. nSP52P (Secondary power pack with 2 5A relays)
 - 5. nSP5D (Secondary power pack with 5A relay and 0-10VDC dimming output)
 - 6. nPP16ER (UL924 listed secondary power pack with 16A relay for switching emergency lighting circuit)
 - 7. nSP5PCD2W (Secondary power pack with 5A relay and incandescent dimming or 2-wire fluorescent dimming output)
 - 8. nSP5PCD3W (Secondary power pack with 5A relay and 3-wire fluorescent dimming output)
 - 9. nSP5PCDMLV (Secondary power pack with 5A relay and magnetic low voltage dimming output)
 - 10. nSP5PCDELV (Secondary power pack with 5A relay and electronic low voltage dimming output)
 - C. General requirements
 - 1. Power pack will incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system

2. Secondary power packs incorporate the relay(s), 0-10VDC dimming output, or line voltage dimming output
3. Accept 120/277VAC and plenum rated
4. All devices have two RJ-45 ports
5. Parameters available and configurable remotely from software and locally via device push-button
6. Power pack to be securely mounted to junction box with ½ inch threaded chase nipple or mounted within luminaire ballast channel
7. Power (secondary) packs that provide up to 16A switching of all load types
8. Power (secondary) packs that provide up to 5A switching of all load types as well as 0-10VDC dimming or fluorescent ballasts/LED drivers
9. Specific secondary packs provide up to 5A of switching and can dim 120VAC incandescent or 120/277VAC line voltage dimmable fluorescent (2-wire and 3-wire versions)
10. Specific secondary packs provide up to 5A of switching and can dim 120/277VAC magnetic low voltage transformers
11. Specific secondary packs provide up to 5A of switching and can dim 120VAC electronic low voltage
12. Specific power/secondary are UL924 listed for switching of emergency power circuits

2.9 Digital Sensors

A. Wired Networked Occupancy/Vacancy Sensors/Photocells

B. Products: Network Wall Switch Sensors

1. nWSD or nWSX (PIR, 1 Relay)
2. nWSD PDT or nWSX PDT (Dual Tech, 1 Relay)
3. nWSD NL (PIR w/Night Light, 1 Relay)
4. nWSD PDT NL (Dual Tech w/Night Light, 1 Relay)
5. nWSX NL LV (PIR w/Night Light, No Relay)
6. nWSD PDT NL LV (Dual Tech w/Night Light, No Relay)
7. nWSD LV or nWSX LV (PIR, No Relay, Raise/Lower Dim Control)
8. nWSD PDT LV or nWSX PDT LV (Dual Tech w/Night Light, No Relay, Raise/Lower Dim Control)

C. Products: Network Fixture Embedded Sensors

1. nES 7 (PIR, No Relay)
2. nES 7 ADCX (PIR w/Photocell, No Relay)
3. nES PDT 7 (Dual Tech, No Relay)
4. nES PDT 7 ADCX (Dual Tech w/Photocell, No Relay)
5. nES ADCX (Dimming photocell)

D. Products: Network Standard Range 360° Ceiling Mount Sensors

1. nCMPDT9 (Low Voltage, Dual Tech)
2. nCMRPDT9 (Line Voltage, Dual Tech)
3. nCMR92P (Line Voltage, PIR, 2-Pole)
4. nCMRPDT92p (Line Voltage, Dual Tech, 2-Pole)
5. nCM92P (Low Voltage, PIR, 2 Channels)

6. nCMR9 (Line Voltage, PIR)
 7. nCM9 (Low Voltage, PIR)
 8. nCMPDT92P (Low Voltage, Dual Tech, 2 Channels)
- E. E. Products: Network Standard Range 360° Recessed Mount Sensors
1. nRMR92P (Line Voltage, PIR, 2-Pole)
 2. nRMRPDT9 (Line Voltage, Dual Tech)
 3. nRMR9 (Line Voltage, PIR)
 4. nRM9 (Low Voltage, PIR)
 5. nRMPDT9 (Low Voltage, Dual Tech)
 6. nRM92P (Low Voltage, 2 Channels)
 7. nRMPDT92P (Low Voltage, Dual Tech, 2 Channels)
- F. F. Products: Network Standard Range 360° Fixture Mount Sensors
1. nCMRB9 (Line Voltage, PIR)
 2. nCMBPDT92P (Low Voltage, Dual Tech, 2 Channels)
 3. nCMB9 (Low Voltage, PIR)
 4. nCMRBPDT9 (Line Voltage, Dual Tech)
 5. nCMRBPDT92P (Line Voltage, Dual Tech, 2-Pole)
 6. nCMRB92P (Line Voltage, PIR, 2-Pole)
 7. nCMB92P (Low Voltage, PIR, 2 Channels)
 8. nCMBPDT (Low Voltage, Dual Tech)
- G. G. General requirements
1. Occupancy sensors sense presence of human activity within the desired space and control on/off function of the lights
 2. Utilize passive infrared (PIR) technology which detects occupant motion
 3. Sensors are available for ceiling, wall, corner, recessed, and fixture mounting conditions
 4. Dual technology sensors utilize PIR/Microphonics (also known as Passive Dual Technology or PDT)
 5. Sensors utilizing Microwave or Ultrasonic technology will not be accepted
 6. Sensors are available with zero, one, or two Class 1 switching relays, and up to one 0-10VDC dimming output.
 7. Provide multiple lens options which are interchangeable for specific applications
 8. Communication and Class 2 low voltage power is delivered to each device with CAT-5 cabling and terminate with RJ-45 connectors
 9. All sensors have two RJ-45 ports for purpose of daisy chain wiring method
 10. Sensors are equipped with automatic override for 100 burn-in of lamps
 11. Wall switch sensors have optional features for photocell/daylight override, vandal resistant, and low temperature/high humidity option
 12. Sensors capable of being embedded into luminaire
 13. Photocells provide on/off set-point and deadband to prevent artificial light from cycling
 14. Photocell and dimming sensor set-point is automatically calibrated using sensor microprocessor
 15. Photocell min/max thresholds may be manually configured
 16. Dimming sensors control 0-10VDC dimmable ballasts by sinking up to 20mA of Class 2 current

2.10 2.11 Device Quality

- A. Perform 100% function testing of all devices

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 LIGHTING RELAY PANEL INSTALLATION

- A. Mount relay control cabinets adjacent to respective lighting panel board. Cabinet shall be surface or flush mount, per plans. Wiring between relay control cabinets and panel boards shall be in accordance with local codes and acceptable industry standards. Under no circumstances will any extra payment be authorized for the EC or GC due to the EC's lack of knowledge or understanding of any and all prevailing codes or specified manufacturer's installation requirements. Neatly lace and rack wiring in cabinets. During construction process, protect all interior components of each relay panel and each digital switch from dust and debris. Any damage done to electronic components due to failure to protect them shall be the sole responsibility of the installing contractor.
- B. Switches: Provide outlet boxes, single or multi-gang, as shown on the plans for the low voltage digital switches. Mount switches as per plans. Supply faceplates per plans and specifications. EC is specifically responsible to supply and install the required low voltage cable, Category 5, 4 twisted pair, with RJ45 connectors (commonly referred to as Cat 5 patch cable) between all switches and panels. Field-test all Cat 5 patch cable with a recognized cable tester. All low voltage wire to be run in conduit, per local codes.
- C. Manufacturer to provide on all systems of more than 2 panels a crimping kit with sufficient approved EZ Brand RJ 45 connectors to populate the whole system. A simple manual that shows all the pitfalls of crimping RJ 45s and how to do it right must be both provided and read by the installing contractor.
- D. Wiring
 1. Do not mix low voltage and high voltage conductors in the same conduit. No exceptions.
 2. Ensure low voltage conduits or control wires do not run parallel to current carrying conduits.
 3. Place manufacturer supplied "terminators" at each end of the system bus per manufacturer's instructions.
 4. Plug in Category 5 patch cable with RJ45 end connector that has been field-tested with a recognized cable tester, at the indicated RJ45 connector provided at each lighting control device, per manufacturer's instructions.

5. Use Category 5 patch cable for all system low voltage connections. Additional conductors may be required to compensate for voltage drop with specific system designs. Contact LC&D or refer to the GR2400 manual for further information. Use shielded cable for dry contact inputs on runs over 200ft.
 6. Do not exceed 4000ft-wire length for the system bus.
- E. All items on the bus shall be connected in sequence (daisy chained). Star and spur topologies are not acceptable.
- F. The specified lighting control system shall be installed by the electrical contractor who shall make all necessary wiring connections to external devices and equipment, to include photocell. EC to wire per manufacturer instructions.

3.3 INSTALLATION AND SET-UP

- A. Verify that conduit for line voltage wires enters panel in line voltage areas and conduit for low-voltage control wires enters panel in low-voltage areas. Refer to manufacturer's plans and approved shop drawings for location of line and low-voltage areas. This is especially applicable in jobs where back boxes are sipped in advance. It is the responsibility of the contractor to verify with lighting control manufacturer all catalog information and specific product acceptability.
- B. For approved contact closure switches, use #18 AWG stranded conductors. For all other digital switches, provide wiring required by system manufacturer.
- C. For classroom digital switches provide wiring required by system manufacturer
- D. Contractor to test all low voltage cable for integrity and proper operation prior to turn over. Verify with system manufacturer all wiring and testing requirements.
- E. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, commissioning of the lighting control system and Owner instruction includes:
1. Confirmation of entire system operation and communication to each device.
 2. Confirmation of operation of individual relays, switches, occupancy sensors and daylight sensors
 3. Confirmation of system Programming, photocell settings, override settings, etc.
 4. Provide training to cover installation, maintenance, troubleshooting, programming, and repair and operation of the lighting control system.
- F. Panels shall be located so that they are readily accessible and not exposed to physical damage.
- G. Panel locations shall be furnished with sufficient working space around panels to comply with the National Electric Electrical Code.
- H. Panels shall be securely fastened to the mounting surface by at least 4 points.
- I. Unused openings in the cabinet shall be effectively closed.

- J. Cabinets shall be grounded as specified in the National Electrical Code.
- K. Lugs shall be suitable and listed for installation with the conductor being connected.
- L. Conductor lengths shall be maintained to a minimum within the wiring gutter space. Conductors shall be long enough to reach the terminal location in a manner that avoids strain on the connecting lugs.
- M. Maintain the required bending radius of conductors inside cabinets.
- N. Clean cabinets of foreign material such as cement, plaster and paint.
- O. Distribute and arrange conductors neatly in the wiring gutters.
- P. Follow the manufacturer's torque values to tighten lugs.
- Q. Before energizing the panelboard, the following steps shall be taken:
 - 1. Retighten relay connections to the manufacturer's torque specifications. Verify that required connections have been furnished.
 - 2. Remove shipping blocks from component devices and the panel interior.
 - 3. Remove debris from panelboard interior.
- R. Follow manufacturers' instructions for installation and all low voltage wiring.
- S. Service and Operation Manuals:
 - 1. Submit operation and service manuals. Complete manuals shall be bound in flexible binders and data shall be typewritten or drafted.
 - 2. Manuals shall include instructions necessary for proper operation and servicing of system and shall include complete wiring circuit diagrams of system, wiring destination schedules for circuits and replacement part numbers. Manuals shall include as-built cable Project site plot plans and floor plans indicating cables, both underground and in each building with conduit, and as-built coding used on cables. Programming forms of systems shall be submitted with complete information.
 - 3. Comply with energy code lighting control system "Acceptance Requirements". Acceptance tests are used to verify that lighting controls were installed and calibrated correctly. These tests may require that a responsible party certify that controls are installed and calibrated properly. This is the installing contractor's responsibility. Verify requirements with building authority.
- T. DOCUMENTATION

1. Each relay shall have an identification label indicating the originating branch circuit number and panelboard name as indicated on the drawings. Each line side branch circuit conductor shall have an identification tag indicating the branch circuit number.
2. Provide a point-to-point wiring diagram for the entire lighting control system. Diagram must indicate exact mounting location of each system device. This accurate "as built" shall indicate the loads controlled by each relay and the identification number for that relay, placement of switches and location of photocell. Original to be given to owner, copies placed inside the door of each LCP.

U. SERVICE AND SUPPORT

1. Start Up: EC shall contact LC&D at least 7 days before turnover of project. LC&D will remotely dial into the lighting control system, run diagnostics and confirm system programming. EC shall be available at the time of dial in to perform any corrections required by LC&D. EC is responsible for coordinating with GC and the owner the installation of a dedicated telephone line or a shared phone line with an automatic Fax/Modem switch. Phone jack to be mounted within 12" of Master LCP. Label jack with phone number. EC to connect phone line from jack to Master LCP.
2. Telephone factory support shall be available at no additional cost to the EC or Owner both during and after the warranty period. Factory to pre-program the lighting control system per plans and approved submittal, to the extent data is available. The specified manufacturer, at no added cost, shall provide additional remote programming via modem as required by the EC or Owner for as long as a phone line is available for the life of the system. Upon request manufacturer to provide remote dial up software at no added cost to system owner. No exceptions.
3. Provide a factory technician for on-site training of the owners' representatives and maintenance personnel. Coordinate timing with General Contractor. Provide 1 day of factory on-site training.

V. CLEANING

1. Division 1 - Execution Requirements: Final cleaning.
2. Clean photocell lens as recommended by manufacturer.
3. Clean all switch faceplates.

3.4 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 16 Section "Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 16145

SECTION 16289 - TRANSIENT VOLTAGE SUPPRESSION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes TVSSs for low-voltage power equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."
- D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."
- E. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449, "Transient Voltage Surge Suppressors."

1.4 PROJECT CONDITIONS

- A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
 - 2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 4. Altitude: Less than 20,000 feet (6090 m) above sea level.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies, Inc.
 - 2. Atlantic Scientific.
 - 3. Current Technology, Inc.
 - 4. Cutler-Hammer, Inc.; Eaton Corporation.
 - 5. Entelec International.
 - 6. General Electric Company.
 - 7. Innovative Technology, Inc.
 - 8. Intermatic, Inc.
 - 9. LEA International.
 - 10. Leviton Mfg. Company Inc.
 - 11. Liebert Corporation; a division of Emerson.
 - 12. Northern Technologies, Inc.
 - 13. Siemens Energy & Automation, Inc.
 - 14. Square D; Schneider Electric.
 - 15. Surge Suppression Incorporated.
 - 16. Sutton Designs Inc.
 - 17. Transtector Systems, Inc.
 - 18. Tycor; Cutler-Hammer, Inc.
 - 19. United Power Corporation.
 - 20. Zero Surge Inc.

2.2 PANELBOARD SUPPRESSORS

- A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:
 - 1. LED indicator lights for power and protection status.
 - 2. Audible alarm, with silencing switch, to indicate when protection has failed.
 - 3. Fuses, rated at 200-kA interrupting capacity.
 - 4. Integral disconnect switch.
 - 5. Redundant suppression circuits.
 - 6. Surge-event operations counter.
- B. Peak Single-Impulse Surge Current Rating: 160 kA per phase.
- C. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of 480Y/277, 208Y/120, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277, 400 V for 208Y/120.
 2. Line to Ground: 800 V for 480Y/277, 400 V for 208Y/120
 3. Neutral to Ground: 800 V for 480Y/277, 400 V for 208Y/120
- D. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
1. Line to Neutral: 400 V.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
1. Line to Neutral: 400 V, 800 V from high leg.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.
- F. Protection modes and UL 1449 suppressed voltage rating for voltages of 240 or 480, 3-phase, 3-wire, delta circuits shall be as follows:
1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
 2. Line to Ground: 1500 V for 480 V, 800 V for 240 V.

2.3 SUPPRESSORS FOR ELECTRONIC-GRADE PANELBOARDS

- A. Surge Protection Device Description: Sine-wave-tracking type, panel-mounted design with the following features and accessories:
1. LED indicator lights for power and protection status.
 2. Audible alarm, with silencing switch, to indicate when protection has failed.
 3. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
- B. Peak Single-Impulse Surge Current Rating: 160kA per phase.
- C. Protection modes and UL 1449 suppressed voltage rating for grounded wye circuits with voltages of 480Y/277, 208Y/120, 3-phase, 4-wire circuits shall be as follows:
1. Line to Neutral: 800 V for 480Y/277, 400 V for 208Y/120
 2. Line to Ground: 800 V for 480Y/277, 400 V for 208Y/120
 3. Neutral to Ground: 800 V for 480Y/277, 400 V for 208Y/120
- D. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, single-phase, 3-wire circuits shall be as follows:
1. Line to Neutral: 400 V.
 2. Line to Ground: 400 V.
 3. Neutral to Ground: 400 V.

- E. Protection modes and UL 1449 suppressed voltage rating for 240/120-V, 3-phase, 4-wire circuits with high leg shall be as follows:
 - 1. Line to Neutral: 400 V, 800 V from high leg.
 - 2. Line to Ground: 400 V.
 - 3. Neutral to Ground: 400 V.

- F. Protection modes and UL 1449 suppressed voltage rating for voltages of 240, 480, or 600, 3-phase, 3-wire, delta circuits shall be as follows:
 - 1. Line to Line: 2000 V for 480 V, 1000 V for 240 V.
 - 2. Line to Ground: 1500 V for 480 V, 800 V for 240 V.

2.4 ENCLOSURES

- A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

- A. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
 - 1. Provide multipole, 30, 60 or 100-A circuit breaker as a dedicated disconnect for suppressor, unless otherwise indicated.

3.2 FIELD QUALITY CONTROL

- A. Testing: [Owner will engage] [Engage] a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports:

- B. Testing: Perform the following field tests and inspections and prepare test reports:
 - 1. Complete startup checks according to manufacturer's written instructions.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

END OF SECTION 16289

SECTION 16410 - ENCLOSED SWITCHES & CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Enclosures.

1.2 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Energy & Automation, Inc.
4. Square D/Group Schneider.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Moeller Electric Corporation.
4. Siemens Energy & Automation, Inc.
5. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
4. GFCI Circuit Breakers: Single- and two-pole configurations with [5]-mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
5. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.4 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 1. Outdoor Locations: NEMA 250, Type 3R.
 2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.
- B. Concrete base is specified in Division 16 Section "Basic Electrical Materials and Methods Electrical Supports and Seismic Restraints," and concrete materials and installation requirements are specified in Division 3.
- C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- D. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- E. Comply with mounting and anchoring requirements specified in Division 16 Section "Seismic Controls for Electrical Work Electrical Supports and Seismic Restraints."
- F. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- G. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

3.2 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

END OF SECTION 16410

SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. UL listing for series rating of installed devices.
 - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
 - 3. Field quality-control test reports.
 - 4. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Eaton Corporation; Cutler-Hammer Products.
 - b. General Electric Co.; Electrical Distribution & Protection Div.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D.

2.2 MANUFACTURED UNITS

- A. Enclosures: Flush- and surface mounted cabinets. NEMA PB 1, Type 1.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Locations: NEMA 250, Type 1.
 - b. Other Wet or Damp Indoor Locations: NEMA 250, Type 3R
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
- B. Phase and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- C. Conductor Connectors: Suitable for use with conductor material.
 - 1. Ground Lugs and Bus Configured Terminators: Compression type.
- D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Rating:

1. UL label indicating series-connected rating with integral or remote upstream overcurrent protective devices. Include size and type of upstream device allowable, branch devices allowable, and UL series-connected short-circuit rating.

2.3 DISTRIBUTION PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.
- B. Main Overcurrent Protective Devices: Circuit breaker or Fused switch.
- C. Branch Overcurrent Protective Devices:
 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 3. Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- C. Non-Dimmed Panels "ND" as defined in the DSL documents are to be equipped with micro-processor based programmable logic controllers as manufactured by Eaton and of the "Power Command" style or "Lyn Tec" style.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with series-connected rating to meet available fault currents.
 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
 3. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - a. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.

- b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- C. Fuses are specified in Division 16 Section "Fuses."

2.6 CONTROLLERS

- A. Motor Controllers: NEMA ICS 2, Class A, combination controller equipped for panelboard mounting and including the following accessories:
- 1. Individual control-power transformers.
 - 2. Fuses for control-power transformers.
 - 3. Bimetallic-element overload relay.
 - 4. Indicating lights.
 - 5. Seal-in contact.
 - 6. 2 convertible auxiliary contacts.
 - 7. Push buttons.
 - 8. Selector switches.
- B. Contactors: NEMA ICS 2, Class A, combination controller equipped for panelboard mounting and including the following accessories:
- 1. Individual control-power transformers.
 - 2. Fuses for control-power transformers.
 - 3. Indicating lights.
 - 4. Seal-in contact.
 - 5. 2 convertible auxiliary contacts.
 - 6. Push buttons.
 - 7. Selector switches.
- C. Controller Disconnect Switches: Fused switch mounted adjacent to and interlocked with controller.
- 1. Auxiliary Contacts: Integral with disconnect switches to de-energize external control-power source.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held general-purpose controller.
- 1. Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. Control-Power Source: 120-V branch circuit.

2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Furnish portable test set to test functions of solid-state trip devices without removal from panelboard.
- C. Fungus Proofing: Permanent fungicidal treatment for panelboard interior, including overcurrent protective devices and other components.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 16 Section " r Electrical Work Electrical Supports."
- C. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Install overcurrent protective devices and controllers.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- I. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
- J. Ground equipment according to Division 16 Section "Grounding and Bonding."
- K. Connect wiring according to Division 16 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.

- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. 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.

END OF SECTION 16442

SECTION 16511 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
 - 5. Retrofit kits for fluorescent lighting fixtures.
- B. See Division 16 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
- C. See Division 16 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multiple lighting relays and contactors.
- D. See DSL documents for theatrical "Stage Lighting" fixtures and their controls.
- E. See Division 16 Section "Dimming Controls" for other dimming systems, as applicable.

1.2 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- D. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- I. Plastic Diffusers, Covers, 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 (3.175 mm)] minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.

2.2 BALLASTS

- A. Electronic Ballasts for Linear Fluorescent Lamps: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps

served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.

1. Sound Rating: A.
 2. Total Harmonic Distortion Rating: Less than 10 percent.
 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 4. Operating Frequency: 20 kHz or higher.
 5. Lamp Current Crest Factor: 1.7 or less.
 6. BF: 0.85 or higher.
 7. Power Factor: 0.95 or higher.
- B. Electromagnetic Ballasts for Linear Fluorescent Lamps: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
1. Ballast Manufacturer Certification: Indicated by label.
- C. Ballasts for Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher for Linear Fluorescent Lamps: Electromagnetic type designed for use with indicated lamp types.
- D. Ballasts for Dimmer-Controlled Lighting Fixtures with Linear Fluorescent Lamps: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
- E. Ballasts for Bi-Level Controlled Lighting Fixtures with Linear Fluorescent Lamps: Electronic type.
1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
 2. Ballast shall provide equal current to each lamp in each operating mode.
 3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.
- F. Ballasts for Compact Fluorescent Lamps: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: A.
 4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41, Category A or better.

6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher, unless otherwise indicated.
 9. Power Factor: 0.95 or higher.
 10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 11. Ballast Case Temperature: 75 deg C, maximum.
- G. Ballasts for Dimmer-Controlled Lighting Fixtures with Compact Fluorescent Lamps: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
- H. Internal-Type Emergency Fluorescent Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
1. Emergency Connection: Operate 1 fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Night-Light Connection: Operate one fluorescent lamp continuously.
 3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
- I. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
 3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).
 4. Open-circuit operation that will not reduce average life.
 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- J. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Lamp end-of-life detection and shutdown circuit.
 2. Sound Rating: A.
 3. Total Harmonic Distortion Rating: Less than 15 percent.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp Current Crest Factor: 1.5 or less.
 6. Power Factor: .90 or higher.
 7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 8. Protection: Class P thermal cutout.
- K. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter-starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
 2. Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).
 3. Open-circuit operation shall not reduce average lamp life.

2.3 EXIT SIGNS

- A. Internally Lighted Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
1. Lamps for AC Operation: Fluorescent, 2 for each fixture, 20,000 hours of rated lamp life.
 2. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.4 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type.
 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 LAMPS

- A. Low-Mercury Fluorescent Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 Rapid-Start low-mercury Fluorescent Lamps: Rated 32 W maximum, nominal length 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.
- C. T8 Rapid-Start low-mercury Fluorescent Lamps: Rated 17 W maximum, nominal length of 24 inches (610 mm), 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500K, and average rated life of 20,000 hours, unless otherwise indicated.
- D. Compact Fluorescent Lamps: 4-Pin, low mercury CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start.
 - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 - 6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).
- E. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65 , and color temperature 4000K.
- F. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000K.
- G. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80 , and color temperature 4000K.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 16 Section "Electrical Supports and Seismic Restraints" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, [12 gage (2.68 mm)].
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, [12 gage (2.68 mm)].

- F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Adjust aimable lighting fixtures to provide required light intensities.
- E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 16511

SECTION 16701–COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 GENERAL

- A. The work described herein and on the drawings consists of labor, materials, equipment, programming, testing, and other services necessary to provide and install the systems called for within Division 16701. Any labor, material, programming, testing, etc. not specifically mentioned within these specifications or not shown on the drawings but required for proper performance of the system and completion of the work of this project shall be provided and installed by the Contractor.
- B. It is understood that the Contractor may employ Installers to accomplish the actual installation of the systems outlined herein. Use of the term “Installer” shall not relieve the Contractor from responsibility to complete the work in accordance with the intent of the contract documents.
- C. Where conflicts exist the most stringent requirement shall apply.

1.2 RELATED DOCUMENTS

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

1.3 RELATED SECTIONS

- A. Comply with applicable requirements of the following divisions and sections, including additional information outlined within this section and other Division 16701 sections:
 - 1. Division 01 Section “Project Management and Coordination”
 - 2. Division 01 Section “Submittal Procedures”
 - 3. Division 01 Section “Product Requirements”
 - 4. Division 01 Section “Closeout Procedures”
 - 5. Division 07 Section "Penetration Firestopping"
 - 6. Division 08 Section "Access Doors and Frames."
 - 7. Division 09 Section "Painting"
 - 8. Division 16
 - 9. Division 16701
- B. The requirements outlined within this section shall apply to all other Division 16701 sections. Refer to individual Division 16701 sections for requirements in addition to those outlined herein.

1.4 DEFINITIONS

- A. NEC: National Electric Code, NFPA 70

1.5 SUMMARY

A. Section Includes:

1. General

- a. Standards, Codes, References and Regulatory Requirements
- b. Quality Assurance
- c. Submittals
- d. Requests for Substitution
- e. Requests for Information
- f. Project Conditions
- g. Delivery, Storage and Handling
- h. Coordination
- i. Closeout Documents
- j. Warranty
- k. Maintenance Service
- l. Spare Capacity
- m. Extra Materials
- n. Testing
- o. Owner's Training

2. Products

- a. General
- b. General Pathway Requirements
- c. Service Entrance Pathways
- d. Terminal Cabinets
- e. Sleeves for Pathways and Cables
- f. Grout
- g. Conduit Bushings
- h. Pull Strings
- i. Surge Suppression Equipment
- j. Labels
- k. Magnetic Tape

3. Execution

- a. General
- b. Sleeve Installation For Communications Penetrations
- c. Pathways
- d. Grounding
- e. Terminal Boxes, Junction Boxes, and Cabinets
- f. Cables/Wires
- g. Surge Suppression
- h. Outlets
- i. Raceway Identification
- j. Labels
- k. Protection And Cleaning
- l. Testing
- m. Demonstration

1.6 STANDARDS, CODES, REFERENCES AND REGULATORY REQUIREMENTS

- A. The requirements for the Division 16701 systems outlined in the drawings and these specifications comply, to the best of the Designer's knowledge, with applicable codes at the time of design. However, it is the Contractor's responsibility to coordinate and verify the requirements of the Authority Having Jurisdiction over this project. The Contractor shall submit in writing any discrepancies to the Designer immediately upon discovery.
 - B. The Contractor shall comply with applicable Standards, Codes, References, and Regulatory Requirements outlined below as well as those additional requirements outlined in individual Division 16701 sections.
 - C. The equipment and installation shall comply with the current and applicable provisions of the following standards, codes, references, and regulatory requirements including all ratified addenda:
 - 1. American Society for Testing and Materials (ASTM)
 - 2. FCC: Federal Communication Commission Part 68 as modified by Wiring Docket 88-57.
 - 3. NFPC 70 - National Electrical Code (NEC), 2008 Edition
 - 4. NFPA 262-1985 - National Fire Prevention Association, 1470 Atlantic Avenue, Boston, MA 02210.
 - 5. UL 444 – Communications Cables
 - 6. UL 497 – Protectors for Paired Conductor Communications Circuits
 - 7. UL 497A – Secondary Protectors for Communications Circuits
 - 8. UL 497B – Protectors for Data Communication and Fire Alarm Cables
 - 9. UL 1449– Standard for Safety, Transient Voltage Surge Suppressors.
 - D. The equipment and installation shall comply with the latest adopted provisions of the following codes and laws:
 - 1. Americans with Disabilities Act (ADA): Where applicable, the system shall comply with ADA, Public Law 101-336, 1990 and with the ADA Accessibility Guidelines (ADAAG).
 - 2. Local and State Building Codes.
 - a. Florida Building Code: 2010 edition including references and revisions.
 - b. Florida Fire Prevention Code: 2010 edition including references and revisions
 - c. Authority Having Jurisdiction: The systems shall comply with applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
 - E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by Underwriters Laboratory, and marked for intended location and application.
- 1.7 QUALITY ASSURANCE
- A. All quality assurance requirements shall be as of the date the project bid. Failure of the Manufacturer or Installer to meet the quality assurance requirements on or before the

date of the project bid shall render the Manufacturer or Installer unacceptable for this project.

- B. Manufacturer: Company specializing in manufacturing the products specified with a minimum 5 years documented experience.
- C. Installer - General:
 - 1. Company or person installing system must specialize in and have been actively engaged in the business of selling, installing, and servicing the system with minimum five (5) years documented experience going back from the date the project bid.
 - 2. The Installer shall maintain an office within fifty (50) miles of the project with capability to provide emergency service 7-days-a-week, 24 hours a day.
 - 3. The Installer shall be a direct sales division of, or the authorized and designated distributor for, the equipment manufacturer whose product he intends to install.
 - 4. The Installer shall own and maintain tools and equipment necessary for successful installation and testing of the system and have personnel who are adequately trained in the use of such tools and equipment.
 - 5. The Installer shall be currently licensed by the Electrical Contractors' Licensing Board as a Statewide Low Voltage System Specialty Contractor (ES-069) unless specifically noted otherwise within an individual Division 16701 section.
 - 6. The Installer's technical staff shall be certified by the equipment manufacturer as qualified to install, program, test, adjust, and service the equipment to be installed.
- D. Cabling
 - 1. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less for all cables
 - b. Smoke-Developed Index: 50 or less for Category 6 cables; 450 or less for other cables.
- E. Contractor Responsibilities: In addition to other requirements outlined within the contract documents, the Contractor shall be responsible for the following:
 - 1. Where the Contractor has questions or there are inconsistencies between Divisions or Sections or where information appears to be incomplete or incorrect, it shall be the Contractor's responsibility to confirm the requirements in writing prior to submission of a bid.
 - 2. Unspecified Equipment and Materials: Any item of equipment or material not specifically addressed within the contract documents and required to provide a complete and functional system shall be provided by the Contractor at a level of quality consistent with other specified items.
 - 3. The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including patching and painting, shall be included as necessary.

- F. Where devices, cable terminations, or boxes are installed above inaccessible ceilings or behind walls, the Contractor shall provide and install an appropriately sized access panel matching the fire rating of the ceiling or wall where installed.

1.8 SUBMITTALS

A. General

1. Submit in accordance with Division 01 Section "Submittals" and specific requirements outlined in individual Division 16701 sections. The Contractor shall provide submittals as outlined herein to the Designer for review. Failure of the Contractor to provide submittals for review in timely manner shall result in the Contractor being solely responsible for any remedial work necessary to meet the intent or requirements of the contract documents.
2. The Contractor shall assemble submittal requirements for each individual section as a single package. This package shall include all Qualifications data, Product data, and Shop Drawings as outlined below. Partial submittals shall not be reviewed and shall be returned to the Contractor for completion. Individual section submittal packages shall not be combined with submittals for other specification sections. Individual section submittal packages shall be tailored to the specific requirements of the individual section.
3. The Contractor shall provide submittals in electronic format for review. Submittals shall be in PDF format. The use of other electronic formats shall not be acceptable.
 - a. Where the Authority Having Jurisdiction requires approved Shop Drawings to be provided with the permit application in a format other than PDF (e.g. DWF), the Contractor, upon receipt of approved Shop Drawings (i.e. those that are stamped as "Reviewed" by the Designer with no outstanding comments), shall provide the Designer with a copy in the AHJ's preferred format for the Designer to stamp.
4. Electronic submittals shall comply with the following:
 - a. Two files shall be provided. One file shall contain Qualifications data and Product data (e.g. all cutsheets and documentation that are typically 8-1/2 x 11" in size). One file shall include Shop Drawings of the same size as the contract drawings.
 - b. The Qualifications and Product data file shall be in full color and shall include fully legible literature as provided by the equipment manufacturers.
 - c. The Shop Drawings file shall be in black and white. The use of colors (e.g. layer colors resulting from AutoCAD) shall not be acceptable. Including multiple systems in a single Shop Drawing file shall not be acceptable.
5. The Contractor shall provide submittals based on the requirements of the contract documents. Requests for Information (RFI), suggestions for design changes, or other issues pertaining to equipment or installation of the system shall not delay the Contractor's timely submission of submittal data. Issues identified by the Contractor, Installer, or Designer shall be addressed separate from the submittals and the submittal process.

6. The Contractor shall submit Shop Drawings prepared by the Installer to demonstrate the Installer understands the scope of work and project requirements. Submission of the contract drawings in an attempt to meet the requirement for submittal shop drawings shall not be acceptable.
7. Basic electrical materials shall be as specified in Division 16. Submittals for Division 16701 systems are not required to include information on materials specified in Division 16. However, any basic electrical materials required for Division 16701 systems and not specifically called out in Division 16 or where specifically called out in Division 16701 sections shall be included with the submittals for the individual Division 16701 system.
8. The Contractor shall refer to the individual Division 16701 sections for additional submittal requirements.

B. Electronic Submittals Formatting

1. Electronic submittals shall comply with the following:
 - a. Two files shall be provided. One file shall contain Qualifications data and Product data (e.g. all cutsheets and documentation that are typically 8-1/2 x 11" in size). One file shall include Shop Drawings of the same size as the contract drawings.
 - b. The Qualifications and Product data file shall be in full color and shall include fully legible literature as provided by the equipment manufacturers.
 - c. The Shop Drawings file shall be created in AutoCAD (hand-drawn Shop Drawings shall not be acceptable) and shall be in black and white. The use of colors (e.g. layer colors resulting from AutoCAD) shall not be acceptable. Including multiple systems in a single Shop Drawing file shall not be acceptable.
2. Revisions
 - a. Where the initial submission of Submittals by the Contractor does not result in a "Reviewed" stamp from the Designer, the Contractor shall resolve all outstanding items and comments from the Designer and resubmit the Submittals for further review. Revisions to the Submittals shall be clouded to identify changes made by the Contractor (or Installer). Revision clouds shall be such that they are easily and clearly identifiable and include all changes to the documents. Revisions to the Submittals that are not clearly identified shall not be considered valid revisions and corrections at a later date necessary to resolve the unidentified issues shall be the sole responsibility of the Contractor.
 - b. The Contractor shall resubmit as necessary to address and clear all comments from the Designer.

C. Qualifications

1. Submit a notarized letter signed by an officer of the installing company that includes the following statements (do not change wording except to insert information noted in brackets):
 - a. As of the time of bid and currently:

- 1) [Company Name] did and does specialize in and has been actively engaged in the business of selling, installing, and servicing [System Name] systems with a minimum of five (5) years documented experience going back from the date the project bid.
 - 2) [Company Name] did and does maintain an office within fifty (50) miles of the project with capability to provide emergency service 7-days-a-week, 24 hour days. [Company Name]'s office is located at [Company Office Address].
 - 3) [Company Name] was and is the authorized distributor for the equipment submitted.
 - 4) [Company Name] did and does own all necessary test equipment required to test the system at the completion of the installation.
2. Submit a letter from the major equipment manufacturers confirming the Installer is currently an authorized distributor in good standing with the ability to provide sales and service.
 3. Submit a list of all test equipment owned including the manufacturer, model number, serial number, and last calibration date that will be used to test the system.
 4. Submit a copy of the Installer's current Florida Statewide Low Voltage System Specialty Contractor (ES-069) license or other license specifically called for within individual Division 16701 sections.
 5. Submit a technical resume of experience for the Installer's Field Supervisor who will be assigned to this project. Resume shall be clearly marked as "Field Supervisor"
 6. Submit a list of at least three (3) system projects completed within the last two (2) years of similar type and size with contact names and telephone numbers of the Owner's Project Manager for each.
 7. Submit one (1) copy of each manufacturer's certification of successful completion of factory training for each member of the Installer's staff who will install, program, test, or adjust the system to be installed.
 8. The use of Sub-Installers (i.e. Installers two levels removed from the Electrical Sub-Contractor) shall not be allowed.

D. Product Data

1. Submit a narrative for each system outlining the sequence of operation.
2. Submit original cutsheets, as provided by the manufacturer, for each piece of equipment, material, cable, etc. to be provided and installed as part of the system.
 - a. Cutsheets shall provide full technical specifications for each piece of equipment being submitted on.
 - b. Scanned documents that are faded, skewed or illegible shall not be acceptable.
 - c. Copies of non-technical information, cutsheets from distributor's catalogs, or screen prints from web site pages, etc. shall not be acceptable.
 - d. The first page of each product cutsheet shall identify the specification section and paragraph in the upper right hand corner of the page for which the Contractor is submitting (e.g. Place "Section 27 10 00, Paragraph 2.1" or similar)

- e. Each cutsheet shall clearly identify, either through highlighting or a stamped arrow, the exact model number of each piece of equipment or material to be provided and installed.
 - f. Each cutsheet shall clearly identify the specification section number and associated paragraph number that the individual piece of equipment is being submitted for.
3. In addition to the above, the Contractor shall, prior to submitting, verify the following are included:
- a. Flush grade pull boxes.
 - b. Specialty terminal cabinets.
 - c. Each type of wire and cable to be installed as part of the system. Cable cutsheets shall be labeled with the same identifier used in the Matrix to be included in the Shop Drawings to ensure clarity in regard to which cable(s) is required for each device.
 - d. Connectors and required tooling.
 - e. Terminations system components for each cable type.
 - f. Cable suspension J-hooks, cable fasteners, etc.
 - g. Grounding and surge suppression system components for the system portion of the project.
 - h. Installation manuals for each active (i.e. powered) piece of equipment or software application to be installed as part of the system.
 - i. Operations manuals for each active piece of equipment or software application to be installed as part of the system.

E. Shop Drawings

1. Submit complete shop drawings showing how the Contractor intends to install the system. Shop drawings shall, as a minimum, include the following:
 - a. Symbol Legend showing:
 - 1) Unique symbols for all system racks, cabinets, panels, equipment, and devices to be installed.
 - b. Cable matrix showing:
 - 1) All system cables to be installed as part of the system.
 - 2) A unique identifier for each cable type
 - 3) Each cable's type, manufacturer, and model number.
 - c. Site Plans showing:
 - 1) Backbone conduits with quantity and sizes shown for each run.
 - 2) Pull boxes (i.e. Flush Grade, Rack Mounted, Wall Mounted, etc.) with dimensions
 - 3) Backbone cables (either in conduit or direct buried) with cable type and quantities.
 - d. Phasing Plan showing:

- 1) The order in which work will be accomplished. Identify phases as planned for construction. Where the Contractor determines phasing is not required for a system the requirement for the Phasing Plan may be omitted but the submitted Site Plan (or Floor Plans where the project includes no site work) shall include the statement "No phasing of work sequences required".
 - 2) Temporary infrastructure (conduit and cabling sizes and quantities) for each system affected. Clearly note how the Contractor plans on maintaining existing systems in a functional condition in areas that the Owner will continue to occupy during construction.
- e. Floor Plans showing:
- 1) System equipment racks, cabinets, panels, terminal cabinets, and major pull boxes.
 - 2) System devices
 - 3) Conduit or J-Hook runs connecting devices to termination equipment. Contractor shall accomplish preliminary coordination with other trades and shall show conduit and J-hook runs as he intends on installing them, including cables by identifier and quantity.
 - 4) Conduit sleeves including quantities and sizes.
 - 5) Required interconnections to other systems.
 - a) Enlarged Plans:
 - (1) Show all major equipment (i.e. equipment racks, equipment cabinets, equipment panels, terminal cabinets, etc. as shown on the floor plans).
 - 6) Whether in Communications Rooms or other building spaces the Contractor's Shop Drawings shall show each piece of equipment as he intends to install it. Any conflicts with other building systems shall be identified and resolved prior to the starting the submittal process.
- f. Elevations showing:
- 1) All four walls of each Communication Room showing the coordination of all wall and floor mounted equipment for all systems in the space. Submittals for each system shall show all equipment regardless of system with the equipment for the system being submitted on printing in black and all other systems equipment printing 50% screened.
- g. Details showing:
- 1) System Point-to-Point Wiring Diagram: The Contractor shall include in his Shop Drawings a Point-to-Point Wiring Diagram that includes all equipment, devices, cabling, signal types, and interconnections to other systems or equipment as necessary to show a logical diagram of how the system's parts and pieces are interconnected. The Block Diagram shall identify all system cables identified by quantity and type outlined in the Cable Matrix noted above.

- 2) Terminal Cabinet Layouts
 - 3) Front Elevations: of system equipment racks and cabinets showing all equipment, shelves, wire management, etc. as the Installer intends on assembling the cabinets.
 - 4) Rear Elevations: of system equipment rack and cabinets showing any system equipment not shown on the front elevations.
 - 5) Details of any special or field fabricated assemblies to be installed as part of the system.
 - 6) Submit calculations in table format for sizing of UPS's including:
 - a) A matrix showing a line item for each piece of equipment to be powered by the UPS. This shall include manufacturer, model number, quantity and description in separate columns.
 - b) The primary side voltage for each piece of equipment
 - c) The current requirements for each piece of equipment
 - d) The extended total current requirements for each line item
 - e) The total current requirements for all equipment.
 - f) The total power capacity of each UPS showing a minimum of twenty (20) minutes of full load run time for the total calculated wattage plus fifty percent spare capacity.
2. Prior to submitting Shop Drawings, the Contractor shall coordinate the termination equipment for each system such that there are no conflicts between building systems.

1.9 REQUESTS FOR SUBSTITUTION

- A. Submit requests for substitution in accordance with Division 01 Section "Product Requirements".
- A. Requests for Substitution shall be submitted not less than ten (10) days prior to the project's bid date. Requests for Substitution shall be submitted in writing explaining why the substitution is being requested and how the proposed item(s) will meet or exceed the specifications. Submitted information shall be adequate information to support the Request for Substitution or it shall be rejected. The Designer reserves the right to be the sole judge of whether or not a requested substitution is acceptable. If approved by the Designer, acceptance of the substitution must be issued in a written addendum not later than seven (7) days prior to bid-opening date.
 - B. Requests for Substitution after the project bid-opening date will only be accepted for review where 1) the equipment manufacturer either no longer manufacturer's a specified piece of equipment or has replaced a specified piece of equipment with another piece of equipment and 2) there is no other acceptable manufacturer listed in the specifications. In this case, the Contractor shall submit a Request for Substitution with documentation necessary to support the substitution request and confirm that the proposed substitution meets or exceeds the specified equipment in all respects. Requests for Substitution shall not result in additional cost to the Owner.

- C. Where the Contractor proposes to substitute the specified cable (either copper or fiber optic) he shall provide to the Designer a complete copy of the U.L. Test report for that product. Proposed cable substitutions that are not accompanied by the appropriate U.L. test report shall be rejected.
- D. The Contractor, if requested to do so by the Designer, shall be prepared to show by "proof-of-performance" test that the equipment being furnished on the job is equal to or better than the equipment specifications listed herein. This proof shall be shown by actual tests and not by printed sales literature. To this end, the Contractor shall provide qualified technicians and such test equipment as required to perform this function.

1.10 REQUESTS FOR INFORMATION

- A. Due to the complexity of the system it is understood that the Contractor may need to submit Requests for Information (RFI) to the Designer in order to obtain clarifications of project requirements, advise the Designer of potential problems, or suggest methods to improve the installed system. In any instance where the Contractor feels it is necessary to submit an RFI he shall do so in a manner that allows the Designer to review and comment on the issue identified within the RFI in a timely manner. The Contractor shall include in his RFI the following information:
 - 1. A reference to the specific drawing number and note number or specification section and paragraph number, and
 - 2. A narrative that clearly identifies the potential issue, and
 - 3. The Contractor's proposed solution, and
 - 4. Costs, if any, associated with implementing the Contractor's proposed solution. If an indication of cost is not included it will be assumed no cost is associated with the Contractor's proposed solution.
- B. It shall be incumbent upon the Contractor when submitting an RFI to provide any additional information (equipment cutsheets, sketches, etc.) as necessary to ensure that the Designer fully understands the issue and the proposed solution.
- C. Submitted RFI's that do not include the information outlined above shall not be reviewed and shall be returned to the Contractor for correction.
- D. The Contractor shall submit RFI's in a timely manner, after discovery of the issue, which allows the Designer adequate time to review and comment on the issue identified.

1.11 OBSOLESCENCE OF EQUIPMENT

- A. Where a manufacturer makes a specified piece of equipment obsolete or supersedes it with a newer model, the Contractor shall provide replacement equipment that meets or exceeds the technical specifications of the original piece of equipment -- by the original equipment manufacturer or one of the listed Acceptable Substitution manufacturers or another manufacturer if no equipment is available from the Basis of Design manufacturer or no Acceptable Substitution manufacturers are listed -- at no additional cost to the Owner. Replacement of the specified equipment under these conditions shall not

delay the Contractor's timely submission of submittals as outlined elsewhere in this section.

1.12 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Do not deliver or install equipment, frames, cabinets, etc. until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
- B. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight.
- C. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
- D. Test each pair of UTP, STP, or multi-conductor cable for open and short circuits.
- E. Document in spreadsheet format the date, time, name of Installer personnel accomplishing test, tests accomplished, and initials of Installer's Supervisor confirming testing was completed. Maintain electronic and hard copy of documentation on site.

1.14 COORDINATION

- A. Comply with the requirements of Division 01 Section "Project Management and Coordination".
- B. Coordinate arrangement, mounting, and support of communications materials and equipment:
 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 2. To provide code required clearances and working room in front of and around equipment, cabinets, and racks. Exceed code requirements where noted within contract documents.
 3. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 4. To allow right of way for piping and conduit installed at required slope.
 5. So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

- C. Coordinate layout and installation of equipment, pathways, and cabling. Coordinate service entrance arrangement with local utilities.
 - 1. Adjust arrangements and locations of equipment with equipment and materials of other communications, electronic safety and security, and related systems that share space.
 - 2. Modify as-built drawings to reflect adjustments.
 - 3. Coordinate location of power raceways, circuits and receptacles with locations of equipment requiring electrical power to operate.
- D. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- E. Coordinate location of access panels and doors for equipment that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- F. Coordinate work with other trades as necessary.
- G. Coordinate work associated with Owner provided equipment as necessary.

1.15 CLOSE-OUT DOCUMENTS

- A. Submit close-out documents in accordance with Division 01 Section "Closeout Procedures" and specific requirements outlined in individual Division 16701 sections.
- B. In addition to requirements outlined in Division 01 Section "Closeout Procedures" comply with the following:
 - 1. Submit cable routings for backbone, tie, and riser cable terminations.
 - 2. Submit an original copy, on CD, as provided by the original manufacturer, of each software program provided as part of the system.
 - 3. Submit a hard copy and an electronic copy of the final system programming as accomplished by the Installer. The hard copy shall be a printout of the software programming code accomplished by the Installer.
 - 4. Submit a documented list of all system passwords. The Contractor shall provide the Owner with all system passwords. The use of master or backdoor passwords known only to the Contractor or Installer shall not be acceptable.
 - 5. Submit a "Sequence of Operation" for each system.
 - 6. For those systems with active controls or equipment with functions and features that can be adjusted as part of the normal operation, submit detailed, written documentation of all system settings and adjustments at the time of project completion including but not limited to:
 - a. Level settings for all potentiometers, switches, and other settings on all system equipment.
 - b. Photographs of all equipment knob, button, rheostat, slider control, switch, and other settings necessary to document the original system configuration and settings at the completion of construction. Photographs shall clearly indicate the equipment and settings. The Contractor may utilize digital photography for documentation purposes. In the event that digital photography

is used, the Contractor shall provide one (1) electronic copy and one (1) color hard copy of all photographs.

- c. Other applicable equipment settings as may be required by the Owner.
- d. The documentation shall be formatted and presented in a manner that will allow the Owner to return the system to its original settings without assistance.

- 7. The Contractor shall submit a draft copy of Close-Out documentation to the Designer seven (7) days prior to requesting Substantial Completion and a final copy of Close-Out documentation to the Designer no less than seven (7) days prior to requesting Final Completion of the project. Both draft and final copies shall be submitted on a properly labeled DVD.

1.16 WARRANTY

- A. Submit warranties in accordance with Division 01 Section "Warranties" and specific requirements outlined in individual Division 16701 sections.
- B. Where a manufacturer's stated warranty exceeds that called for in these specifications, the Contractor shall honor the manufacturer's warranty as if it had been specified herein.

1.17 MAINTENANCE SERVICE

- A. Comply with the requirements of individual Division 16701 sections

1.18 SPARE CAPACITY

- A. Comply with requirements of individual Division 16701 sections

1.19 EXTRA MATERIALS

- A. Comply with requirements of individual Division 16701 sections.
- B. Keys: Provide a minimum of three (3) sets of keys, identified by system and lock, for each different type of lock installed for each system. Keys sets shall be on individual key rings with permanent plastic or metal tag identifying the system, lock location, and key number.

1.20 TESTING

- A. Accomplishing system testing as called for herein. Comply with additional requirements where called for in an individual Division 16701 section.

1.21 OWNER'S TRAINING

- A. The Contractor shall, after Substantial Completion but prior to Final Completion, provide the Owner with training on the systems within in Division 16701. Individual training sessions shall be provided for each system. Combining training systems into a single training session shall not be acceptable.
- B. Training shall be comprised of:

1. A walk-through of the facility to identify all system equipment and equipment locations.
2. A review of:
 - a. The system's Close-Out documents
 - b. The system's final documented test results
 - c. The system's Manufacturer's warranties
 - d. The system's software, programming, and passwords
 - e. The system's equipment settings and adjustments

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Contractor shall provide and install all equipment and materials necessary for complete, operational systems whether or not specifically shown on the drawings or specified herein.
- B. The Contractor shall provide all labor, programming, and testing necessary to complete the work related to the Division 16701 systems and provide the Owner, at the completion of the project, with fully functional and properly operating systems in accordance with the manufacturer's recommendations, the requirements of the contract documents, and applicable industry standards.
- C. The Contractor shall install, program, and test Owner furnished equipment where required by the contract documents.
- D. Equipment and components shall be new, and the manufacturer's current model. All equipment and materials shall be suitable for use intended, and meet all stated performance requirements for the system configurations specified herein.
- E. Equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- F. Unless specifically noted otherwise, equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.

2.2 GENERAL PATHWAY REQUIREMENTS

- A. General:
 1. Pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of Division 16.
- B. Conduit:

1. EMT fittings shall be steel, compression type connectors, with insulated bushings and separate lock nuts on conduits entering panel cabinets.
2. Bushings: Provide insulated bushings on ends of all raceway. All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
3. Pull cords: Install pull cords in all raceway runs that are installed without cable.
4. Size:
 - a. Minimum size shall be as shown on the drawings.
 - b. The Contractor shall size raceways in accordance with the NEC for the quantity of cables to be installed unless noted otherwise.

C. Boxes:

1. Boxes shall be sized as required by NEC for cables, conduit and device installed unless noted otherwise.

2.3 TERMINAL CABINETS

A. Comply with applicable requirements of Division 16 unless noted otherwise.

1. Provide and install terminal cabinets where shown on the drawings. Size either as shown on the drawings or as required by the National Electric Code (NEC).
2. Provide terminal cabinets for all surge suppression equipment and associated terminations including 120VAC power surge suppressor as required in Division 26.
3. Terminal cabinets in exterior applications or in non-conditioned spaces shall be weatherproof.

B. Support: Provide and install two (2) sections of 8'0", 1 5/8" x 1 5/8", 16 ga., hot dipped galvanized, structural channel, green, w/slotted holes positioned approximately 24" away from the Portable for support of the junction box. Supports shall be buried a minimum of 3'0" in the ground vertically and spaced a minimum of 12" apart or as required to match selected junction box mounting needs. Box is to be secured to the support struts with stainless steel hardware.

C. Manufacturers

1. Interior
 - a. Basis of Design
 - 1) Square "D".
 - b. Acceptable Substitutions
 - 1) Hoffman
 - 2) Bud

2.4 SLEEVES FOR PATHWAYS AND CABLES

- A. Provide and install sleeves for penetrations through exterior walls above and below grade.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 CONDUIT BUSHINGS

- A. Grounding Bushings: All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
- B. Insulation Bushings: Provide insulated bushings on ends of all raceway.
- C. Manufacturers
 - 1. Basis of Design
 - a. Arlington EMT Series Insulating Bushings or acceptable substitution

2.7 PULL STRINGS

- A. Install pull cords in all raceway runs that are installed without cable.
- B. Manufacturers
 - 1. Basis of Design
 - a. Jet Line #232 or acceptable substitution

2.8 SURGE SUPPRESSION EQUIPMENT

- A. For Power Circuits (120 volt):
 - 1. UL 1449 listed.
 - 2. 15 amp, 120V rated.

3. Suppressors shall be tested per IEEE, C62.41-1991 for Categories A and B.
4. Normal mode (L-N), and common mode (L+N-G) protection.
5. Internal fusing.
6. Hybrid design.
7. Indicators for normal operation and failure indication.
8. Enclosure:
 - a. Fire retardant high impact, phenolic or plastic housing or metal enclosure.
9. Clamping voltage UL 1449, Line to Neutral, Category B Impulse At (3KA, 8 x 20 μ s): 385V @ 120V.
10. Maximum Surge Capacity: 20,000 amps.
11. Maximum Continuous Operating Voltage: 115% of line voltage.
12. Provide hardwire connection or add 15 amp receptacle device to hardwired devices to match equipment being protected and maintain UL listing.
13. Provide additional 15 amp in-line fusing as required to comply with UL and the NEC when connected to a 20 amp, 120V circuit.
14. Manufacturers
 - a. Basis of Design
 - 1) Leviton #51020-WM (hardwired).
 - b. Acceptable Substitution
 - 1) EDCO #HSP-121BL2.

2.9 LABELS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 16 Section "Identification for Electrical Systems."
- C. Manufacturers
 1. Basis of Design
 - a. Brady Corporation
 2. Acceptable Substitution
 - a. HellermannTyton.
 - b. Kroy LLC.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with NECA 1.

- B. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The Contractor shall provide and install raceways, wiring and cabling required for complete and fully functional systems as intended by these specifications.
- C. The Contractor shall provide and install a properly sized, flush mounted outlet box for every floor, wall, and ceiling mounted device.
- D. In locations where pathways are not accessible after completion of the project, raceway shall be extended from device to device or fire rated access panels shall be installed to provide access to pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device.
- E. Contractor shall properly terminate each device according to the manufacturer's recommendations. Unless specifically noted otherwise, the Contractor shall provide and install cabling to connect all circuitry associated with a device.
- F. Equipment shall be installed in accordance with manufacturer's instructions.
- G. Install electrical basic materials per applicable sections of these specifications.
- H. Equipment, other than portable equipment, shall be held firmly in place. The exception shall be when the Contractor is required to use resilient shock mounting to decouple equipment from the structure it is being mounted to.
- I. Support raceways, backboards, and cabinets per applicable sections of these specifications, as shown on the drawings, and as recommended by the manufacturer. Fastenings and supports shall be adequate to support their loads with a safety factor of five (5).
- J. Switches, connectors, outlets, etc., shall be clearly, logically, and permanently marked during installation. Where the equipment manufacturer does not provide markings or for fabricated and installed equipment the Contractor shall provide and install permanent, engraved labels for proper identification.
- K. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- L. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- M. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- N. Right of Way: Give to piping systems installed at a required slope.

3.2 FIRESTOPPING

- A. Contractor shall provide and install firestopping on all penetrations through rated walls and floors to match the rating of the wall or floor assembly. Refer to Division 7 for additional information.

3.3 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors a minimum of 2 inches above finished floor level.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- I. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work. The use of pitch pockets is not acceptable.
- J. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- K. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing mechanical sleeve seals.

3.4 CONDUIT

- A. Conduit systems for individual systems shall not be shared by power or any other electrical wiring that is not part of the system.
- B. Backbone cables shall be in a complete conduit system. Refer to the drawings for additional information.

- C. Conduits run underground shall be installed a minimum of 24" below grade. Provide and install magnetic tape above underground runs to allow the Owner to easily locate in the future.
- D. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
- E. Bend conduits with minimum inside radius of 6 times the internal diameter. Increase bend radius to 10 times for conduit larger than 2 inch size. Provide proper bend for all changes of direction. Pull and splice boxes shall not be used in lieu of a bend.
- F. Install conduits so no more than two 90o bends are in any conduit section without a pullbox. Install additional pullboxes as required to maintain maximum of two 90o bends between pullboxes and/or termination points.
- G. Install interior conduits so no more than one hundred (100) feet of conduit are in any conduit section without a pullbox. Install additional pullboxes as required to maintain a maximum of one hundred (100) feet between pullboxes and termination points.
- H. In installations where the electrical contractor does not provide a counterpoise system in conjunction with the underground conduit system, the Contractor shall provide a coupling conductor within the underground conduit system to run alongside copper conductors. Coupling conductors shall be sized according to applicable codes and standards.
- I. Label conduits at both ends to indicate destination and source. Also indicate length of conduit. This labeling/identification shall be fully documented in as-built (record) drawings.
- J. Install pull string in each empty conduit over 10 feet in length or containing a bend.
- K. Properly support cables/wire not installed in conduits.
- L. Special Conduit Systems: Special conduit systems may be specified for some portions of the system. Refer to the drawings and other sections of these specifications to determine where or if such systems are used.
- M. Use of ceiling tiles, grid or hanger wires for the support cables shall be prohibited.
- N. Comply with requirements in Division 16 Section "Conduit and Boxes for Electrical Systems" for installation of conduits and wireways.

3.5 RACEWAY IDENTIFICATION

- A. All conduit system junction boxes (except those subject to view in public areas) for Division 16701 systems shall be color coded as listed below utilizing the Krylon colors noted:
 - 1. Fire Alarm – Safety Orange 2410
 - 2. Fiber Optics - Safety Purple 1929

3. Sound System - Safety Yellow 1813
4. Intercom - True Blue K1910
5. Computer/Data - Bright Gold K1701
6. TV - Glossy White K1501
7. Security/CCTV - John Deer Green K1817
8. Telephone - Safety Green 2012

B. Refer to Section 26 05 53 for additional information

3.6 GROUNDING

- A. Provide and install complete grounding system as required to comply with the drawings, other Division 16701 sections, Division 16, and applicable codes.
- B. Communications bonding and grounding shall be in accordance with the National Electrical Code (NEC), NFPA and EIA/TIA grounding and bonding standards.
- C. A 2/0 AWG stranded copper wire cable in PVC conduit shall be extended between new ground bars located at each communications room (or other location shown on drawings) and the building main electrical service ground point or secondary transformer ground point. Building steel, equipment racks and cabinets, cable tray, and surge suppressor devices shall be bonded to the ground bar via a #6 AWG stranded copper cable and UL approved connecting hardware.
- D. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- E. Comply with ANSI-J-STD-607-A.
- F. Locate ground bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar.
- G. Connect cable shields to ground bus bar in an industry approved manner. Connections shall be soldered or crimped.
- H. The Contractor shall take such precautions as are necessary to guard against electromagnetic and electrostatic hum, and to install all equipment so as to provide maximum safety to the person who operates it.

3.7 SURGE SUPPRESSION

- A. Provide and install surge suppression devices on:
 1. Each copper cable (unshielded twisted pair, shielded twisted pair, coaxial, etc.) entering or leaving a building. Install surge suppression devices at system terminal board or in a cabinet.
 2. In other locations where required by the manufacturer or required to properly protect the equipment and the system.
- B. Install surge suppression device on all 120 volt power sources to equipment. Surge suppression on 120 VAC circuits shall be provided and installed by the electrical sub-

contractor. Coordinate with Division 16 to ensure that surge suppression for 120 VAC power circuit and surge suppression required by this section for each system are installed in same terminal cabinet and bonded together.

- C. Bond surge and suppression device to building ground system as called for in Division 16.
- D. Contractor shall take extreme care to ensure a properly surge protected system.
- E. Surge protection equipment must be selected by contractor to match the equipment being protected including wire sizes, operating volts, amps, and circuit impedance.
- F. Installation of surge protection equipment and its grounding shall be per manufacturer's recommendations to assure short and proper ground paths.
- G. Terminal Cabinets
 - 1. Surge suppression devices shall be installed in terminal cabinets whether or not shown on the drawings. Where required, install surge suppression terminal cabinet in termination area of individual system being protected.
 - 2. Size terminal cabinets as required to facilitate installation of terminations and surge suppression in a neat and workmanlike manner.
 - 3. Coordinate location of terminal cabinets with adjacent equipment and materials.
- H. Equipment Installation
 - 1. Install surge suppression equipment per manufacturer's recommendation
 - 2. Install surge suppression equipment terminal cabinets, etc. as required to facilitate installation of surge protection equipment and terminal points. Size terminal cabinets as required to facilitate installation of surge suppression equipment and terminal blocks.
- I. Ground Installation
 - 1. Ground Bus Connections
 - a. Provide "local" ground bus in each terminal cabinet housing surge protection equipment (with lugs, etc. as required).
 - b. Bond "local" ground bus to terminal cabinet with minimum #6 copper wire.
 - c. Connect terminal cabinet "local" ground bus to "systems" ground bus installed per with minimum #6 copper insulated wire (unless otherwise noted) in conduit.
 - d. Note that "systems" ground bar is also to be used for power transformation ground (480V to 208V) where applicable.
 - 2. Surge suppression equipment grounding
 - a. Connect each surge suppressor to local ground bus in terminal cabinet with wire sized as recommended by manufacturer.

- b. Coordinate with Division 16 to ensure that 120 VAC power source/supply surge suppressor is also grounded to same local ground bus as surge suppressors provided in these criteria.
 - 3. Conductors
 - a. Bends in excess of 90 degrees in any grounding conductor shall not be permitted.
 - b. Do not bundle unprotected conductors with protected conductors.
 - c. Conductors shall be kept as short as possible.
 - d. Conductors shall be secured at 12" intervals with an accepted copper clamp
 - e. Grounding conductors shall be properly connected to the building service ground by accepted clamps.
 - 4. Grounding Connectors
 - a. Connectors, splicers, and other fittings used to interconnect grounding conductors, bond to equipment or grounding bars, shall be UL Listed for the purpose.
 - b. All connectors and fittings are to be of the Nicopress crimp or compression set screw type.
 - c. Special treatment to fittings lugs, or other connectors of dissimilar materials are to be applied to prevent electro-galvanic action.
 - J. Isolation of cable shields
 - 1. Cable shields shall be suitably protected at each termination point to avoid incidental contact with grounded elements of the building structure. Shield continuity shall be maintained throughout the entire cabling system. Ground reference of the building ground system shall be matched at the Communications Rooms Ground Bus Bar.
 - 2. Isolation of the shields shall be individually verified by resistance measurements as connections are made.
- 3.8 TERMINAL BOXES, JUNCTION BOXES AND CABINETS
- A. Boxes and cabinets shall be UL listed for their use and purpose.
 - B. Install boxes and cabinets plumb and square with wall. Where flush mounted boxes and cabinets shall be flush with wall surface.
- 3.9 CABLES/WIRES
- A. The Contractor shall provide and install all copper and fiber optic cable required to complete the scope of work of this project. Refer to individual Division 16701 sections for specific cabling requirements.
 - B. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

- C. Cables shall not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
- D. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
- E. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
- F. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
- G. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- H. All cable and wire shall be new.
- I. Install cables/wires in accordance with manufacturer's instructions.
- J. Cables shall be installed as illustrated on the drawings except where necessary to avoid EMI sources or other obstacles. Major deviations from the illustrated path must be accepted in advance by the Designer. Where illustrated path is not show on the drawings, Contractor shall include intended, general routing path within his submittals.
- K. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- L. Install cables in raceways (refer to drawings) and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 16 Section "Raceway and Boxes for Electrical Systems."
- M. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
- N. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.
- O. All cable terminations and testing of cable installed under this project shall be accomplished by the Contractor unless specifically noted otherwise.
- P. Cable runs shall include a service slack prior to the termination point. Provide for a 12-inch service slack in the ceiling above each outlet. Service slack in Communications Rooms shall consist of a 10-foot slack section for all station cables located and placed neatly in the cable tray above the equipment rack or cabinet.
- Q. Cables placed under ground, below slab on grade, in slab on grade, or in other wet locations, whether in conduit or direct buried, shall be gel-filled or water blocking type.

- R. Interior backbone cables shall be Riser rated unless otherwise stated or required by code.
- S. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- T. Install system wiring and/or raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
- U. Maintain proper separation between system cables and all power and/or unshielded cables, as required to prevent noise, crosstalk, etc.
 - 1. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in the National Electric Code (NEC). Increase separation if so required to comply with referenced standards.
 - 2. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors.
 - 3. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).
 - 4. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).
 - 5. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

6. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
 7. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).
- V. The majority of the system wiring will be installed above ceilings. Cabling used throughout this project shall comply with the requirements outlined in the National Electric Code (NEC) Article 760. Cabling shall bear CMP and/or appropriate markings for the environment in which they are installed.
- W. Provide a minimum of two cable support hangers at corners and 90 degree turns. Attachment shall be to the building structure and framework at a maximum of five (5) foot intervals. Where cable is routed above the ceiling in areas where there are no walls, all-thread shall be used (minimum 1/4"; sized to support the intended weight) with the appropriate hanger for cross-room support. Support rods shall be level and plumb after cable installation. Requirements for bending radius and pulling tension of cables shall be adhered to.
- X. Above suspended ceilings and below raised floor areas where duct, cable trays, or conduits are not available, cables shall be bundled in groups of 40 or less. Secure loosely with cable ties. Cables shall be loose enough to be rotated easily by hand. Cable ties used in plenum areas shall be plenum rated.
- Y. Provide protection for exposed cables.
- 3.10 OUTLETS
- A. The Contractor shall provide and install an outlet plate with appropriate connectors for each device whether or not shown on the drawings.
 - B. Install devices/inserts in outlets so that same orientation is used throughout project.
 - C. Install wall plates with all inserts required to properly connect all equipment circuits and complete the installation in a professional manner.
- 3.11 LABELS
- A. The Contractor shall provide and install permanent, engraved labels on all equipment where the original manufacturer has not already provided labels.
 - B. Custom, fabricated, or field assembled assemblies and equipment shall be provided with permanent engraved or non-removable silk-screened labels. The Contractor shall provide samples of labels to Designer for review and approval prior to fabrication or final installation. The Contractor shall modify labeling as required by the Designer.
 - C. The Contractor shall provide and install a permanent, machine printed, protected label on both ends of each system cable. The label at each end of the cable shall provide the following information:
 1. System identifier
 2. Room number where other end of cable is terminated

- a. Where system cables are routed between buildings the Contractor shall preface the Room Number with a Building Number
 - b. Room numbers shall coincide with numbering scheme included in contract documents.
3. Device identifier where other end of cable is terminated
 - a. Device identifier shall provide a clear indication of device connected to.
 4. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 5. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 6. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).
 7. 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.
 8. 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.
- D. Equipment, control, and system cabling shall be provided with permanent descriptive labels.
- E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
1. Cables shall use flexible vinyl or polyester that flexes as cables are bent.

3.12 PROTECTION AND CLEANING

- A. The Contractor shall ensure that all system equipment is fully protected from damage, work of other trades, construction material, dirt, and dust to the point that upon occupancy by the Owner the equipment shall appear new and as if it had just been removed from the manufacturer's original packing.
- B. The Contractor shall be responsible for ensuring that all system enclosures and equipment is clean and in like new condition prior to requesting Substantial Completion. As a minimum, this shall include:

1. The interior of equipment cabinets, terminal cabinets, and all other system enclosures shall be free of installation remnants, construction materials, dust, dirt, and other evidence of construction.
 2. The exterior of equipment cabinets, terminal cabinets, and all other system enclosures shall be free of scrapes, nicks, dents, discoloration, abrasions, excess construction materials, or other evidence of damage.
 3. System equipment backboxes, outlet boxes shall be free of damage and excess construction materials that hinder the installation of equipment or reduce the interior volume of the box.
 4. Equipment exteriors shall be clean and free of fingerprints, dust, stains, scratches, abrasions, marks, excess construction materials, or other contaminants.
 5. All system devices shall be clean and free of damage or visible markings.
- C. Field touch-up painting of racks, cabinets, and system enclosures to hide the evidence of damage shall not be acceptable. The Contractor shall replace racks, cabinets, or system enclosures that have visible exterior damage.
- D. In the event that the Designer determines that the equipment has not been protected properly, evidence of damage is visible, or the degree of installation remnants, construction material intrusion, dust, dirt, or other evidence of construction appears excessive, the Contractor shall clean the equipment and enclosures to the satisfaction of the Designer or shall, at the direction of the Designer, replace the equipment with new.

3.13 TESTING

- A. Perform testing as necessary or specified to verify fully functional systems with no visual, audible, or operational degradation. Replace and/or repair and retest components that fail performance standards. Test cables, outlets, devices, and equipment in accordance with industry acceptable practices for each individual system.
- B. Provide factory trained personnel to perform the tests and adjust the system.
- C. Test Equipment
1. Provide all required test equipment and associated apparatus necessary to successfully complete the system testing.
 2. Kits, home-built, and other nonprofessional test equipment shall not be acceptable.
 3. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- D. Cable
1. General

- a. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 - b. Visually inspect cable placement, cable termination, equipment and patch cords, and labeling of all components.
 - c. Visually confirm cables and outlets have been properly labeled.
 - d. Visually inspect grounding and bonding for completeness and termination tightness.
 - e. Test operation of shorting bars in connection blocks.
2. UTP and Multi-Conductor Cable
- a. Test each cable. Perform the following tests:
 - b. DC loop resistance
 - c. Shorts
 - d. Opens
 - e. Intermittent faults
 - f. Polarity between conductors.

E. Corrective Action

1. The Contractor shall submit to the Designer, within five (5) business days of accomplishing the initial testing, a list identifying cables that do not meet the testing requirements. The Designer shall review the documentation and determine corrective action to be taken. This may include replacement of defective materials at no additional expense to the Owner.
2. The Contractor shall be responsible for repairing or replacement of defective equipment, materials, and cable as necessary to provide 100% satisfactory testing.
3. Remove and replace cabling where test results indicate that they do not comply with specified requirements. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Documentation of Tests, Measurements, and Adjustments Performed:

1. Provide system verification and acceptance documentation signed and dated by the Contractor at the completion of testing. Document the following:
 - a. List of personnel in attendance during testing including the name of the Technician who performed each individual test.
 - b. List of certified test equipment used with serial numbers
 - c. List date of last calibration for each piece of test equipment
 - d. Date of each test
 - e. List reference settings of test equipment used for tests
 - f. Submit testing results in hard copy and native electronic format.
2. System verification and acceptance documentation shall be provided with the Contractor's request for Substantial Completion.

3.14 DEMONSTRATION

- A. Demonstrate system to designated Owner personnel as required by applicable sections of these specifications. Accomplish Owner's training as described in Part 1.
- B. Complete operation of the system shall be demonstrated. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.
- C. The Contractor shall provide a typewritten "Sequence of Operation" for each system.

END OF SECTION 16701

SECTION 16710 – VOICE-DATA CABLE INFRASTRUCTURE

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 “Common Work Results for Communications”
- B. In addition to the requirements of Section 16701 comply with the following requirements:
 - 1. Definitions
 - a. BICSI: Building Industry Consulting Service International.
 - b. RCDD: Registered Communications Distribution Designer.
 - c. PoE: Power over Ethernet
 - d. VoIP: Voice over Internet Protocol
 - 2. Standards, Codes, References And Regulatory Requirements
 - a. The equipment and installation shall comply with the current and applicable provisions of the following standards, codes, references, and regulatory requirements including all ratified addenda:
 - 1) American Society for Testing and Materials (ASTM)
 - a) ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
 - b) ANSI/TIA/EIA-568-C.1, Commercial Building Telecommunications Cabling Standard
 - c) ANSI/TIA/EIA-568-C.2, Balanced Twisted Pair Telecommunications Cabling and Components Standard
 - d) ANSI/EIA/TIA-569-B, Commercial Building Standard for Telecommunication Pathways and Spaces
 - e) ANSI/TIA/EIA-606-A, Administration Standard for The Telecommunications Infrastructure of Commercial Buildings
 - f) ANSI/TIA/EIA-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications
 - g) ANSI/TIA/EIA-758-A, Customer-Owned Outside Plant Telecommunications Cabling Standard
 - h) ASTM D 4566-94, Standard Test Methods for Electrical Performance Properties of Insulations and Jackets of Telecommunications Wire and Cable
 - i) IEC 60603-7, Connectors for frequencies below 3 MHz for use with printed boards – Part 7: Detail specification for connectors, 8-way, including fixed and free

connectors with common mating features, with assessed quality

- 2) IEC 61935-1, Generic Specification for the Testing of Balanced Communications Cabling in Accordance with ISO/IEC 11801
 - 3) Building Industry Consulting Service International (BICSI), Telecommunications Distribution Methods Manual, (Latest Revision)
 - 4) Building Industry Consulting Service International (BICSI), Customer-Owned Outside Plant Design Manual, (Latest Revision)
 - 5) Building Industry Consulting Service International (BICSI), Telecommunications Cabling Installation Manual, (Latest Revision)
 - 6) Building Industry Consulting Service International (BICSI), LAN and Internetworking Design Manual, (Latest Revision)
3. Quality Assurance
- a. Installer – Category 6:
 - 1) Cabling Installer must have personnel certified by BICSI on staff.
 - 2) Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD. Shop Drawings shall be stamped by the RCDD with direct supervision responsibility.
 - 3) Installation Supervision: Installation shall be under the direct supervision of a BICSI certified Level 2 Installer or higher who shall be present at all times when work the work of this section is performed at the project site.
 - 4) Field Inspector: Currently registered by BICSI as an RCDD to perform the on-site inspection.
4. Warranty
- a. The Structured Cabling System shall be provided with a 25 Year Manufacturer's Warranty that covers the entire system (i.e. jacks, patch panels, patch cords, and cable). The warranty program shall include coverage for both Link and Channel configuration.
5. Spare Capacity
- a. Contractor shall provide and install system equipment and materials in quantities that will provide the Owner with twenty percent (20%) spare capacity (e.g. termination points, jacks, ports, etc.) after connection of all circuits as required by the contract documents. Equipment and materials where spare capacity shall be provided include:
 - 1) Termination Blocks
 - 2) Patch Panels
6. Extra Materials

- a. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1) Termination Blocks: One of each type.
 - 2) Patch-Panel Units: One of each type.
 - 3) Device Plates: Three of each type.

1.2 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete Voice/Data Cable Infrastructure System, as described herein and shown on the drawings, providing the following:
 - 1. Transport of voice, data, and video signals.
- B. Section Includes:
 - 1. Wall Mounted Equipment Racks
 - 2. Rack and Frame Equipment
 - 3. Cable Support Systems
 - 4. Copper Termination Equipment
 - 5. Fiber Optic Patch Panels
 - 6. Horizontal Copper Cable
 - 7. Copper Patch Panels
 - 8. Workstation Outlets
 - 9. Copper Patch Cords
 - 10. Surge Suppression Equipment
 - 11. Labels

1.3 SPECIAL REQUIREMENTS

- A. Not used.

1.4 FUNCTIONS AND OBJECTIVES

- A. Installation of a complete Structured Cabling System throughout the facility as described herein and shown on the drawings. The Structured Cabling System is used to transport voice, data, and video signals from various sources to end-points, devices, and other systems. The requirements called for herein apply to each other section where required to accomplish the work of this project. The Contractor shall coordinate the requirements to provide a complete and fully functional Structured Cabling System ready to accept interconnection to equipment and systems that will use the Structured Cabling System as their means of transporting signals. This coordination shall include materials (terminal blocks, patch cords, etc.) as necessary to complete the interconnection requirements.
- B. Provide and install equipment and materials to support the termination and interconnection of copper cables for Horizontal portions of the Structured Cabling System.

- C. Provide and install cabling, termination equipment and associated materials to support interconnection to the Horizontal portion of the Structured Cabling System.
 - D. Provide and install horizontal cabling, termination equipment and associated materials to support interconnection field devices and equipment with circuits from primary system equipment of the Structured Cabling System. Horizontal cabling shall be installed in raceway where shown on the drawings.
 - 1. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) in the horizontal cross-connect. The Contractor shall coordinate the installation of the horizontal cabling such that no individual cable shall exceed the maximum allowable horizontal cable length of 295 feet (90 m).
 - 2. Provide termination of the horizontal cabling at project Distribution Frames (DF) as shown on the drawings. Organization of the cabling system shall be such that it will be possible, through a series of patch panels, to route any voice or data circuit to any workstation outlet jack through the use of patch cords.
 - 3. Route horizontal cabling from Distribution Frames to Workstation Outlets utilizing approved cabling pathways.
 - 4. Terminate horizontal cabling at the workstation locations in an organized manner that allows access to the voice and data jacks for connection of terminal equipment through the use of patch cords.
 - E. Provide and install all copper cables, patch panels and communication outlets and other materials necessary to provide a complete, installed system for transmission of voice, data and video signals.
 - F. Patch panels, workstation outlets and other associated materials shall be provided by a single manufacturer.
 - G. The system, as provided and installed, shall be provided with a minimum twenty-five (25) year link and channel warranty for the entire installed system from the original manufacturer.
- 1.5 ALTERNATES
- A. Additive Alternate #2: All work associated with Conference Center (S222A).

PART 2 - PRODUCTS

2.1 GENERAL

- A. The Contractor shall provide and install all equipment and materials necessary for complete, operational systems whether or not specifically shown on the drawings or specified herein.
- B. The Contractor shall provide all labor, programming, and testing necessary to complete the work and provide the Owner, at the completion of the project, with fully functional

and properly operating systems in accordance with the manufacturer's recommendations, the requirements of the contract documents, and applicable industry standards.

- C. The Contractor shall install, program, and test Owner furnished equipment where required by the contract documents.
- D. Equipment and components shall be new, and the manufacturer's current model. All equipment and materials shall be suitable for use intended, and meet all stated performance requirements for the system configurations specified herein.
- E. Equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- F. Unless specifically noted otherwise, equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.

2.2 GENERAL PATHWAY REQUIREMENTS

- A. General:
 - 1. Comply with Section 16701
 - 2. Pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of Division 26.

2.3 RACK AND FRAME EQUIPMENT

- A. Network Electronics:
 - 1. Existing to remain or provided and installed by Owner

2.4 CABLE SUPPORT SYSTEM

- A. UL listed and labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
- B. Horizontal cables shall be suspended by pre-manufactured CAT 6 rated cable hangers in closets where J-hooks, ladder tray or rack management is not available. All supports shall be permanently attached to the structure using all-thread suspension, beam clamps, or wall mount to the structural metal or wooden members. The J-hooks shall feature a wide base loop with smooth curves to eliminate snag potential and cable deformation.
- C. J-hooks are to be in accordance with the NEC, EIA/TIA requirements for structured cabling systems.
- D. Manufacturers
 - 1. Basis of Design

- a. Erico Caddy CAT12, CAT21, CAT32
2. Acceptable Substitution
 - a. B-Line Series BCH 64, BCH 32, BCH 21

2.5 COPPER TERMINATION EQUIPMENT

A. General:

1. Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
2. The 110 or equivalent type cable termination components shall meet EIA/TIA 568-B Category 6 specification on all pins for connecting hardware.
3. Provide 110 support brackets and termination strip mounting hardware to mount onto terminal backboard. Include necessary grounding termination lugs and legs.
4. Include designation strips and termination tools.
5. Unit shall be fire retardant.
6. Shall be UL Listed.
7. In 100 pair multiples
8. For terminating 20-AWG through 26 AWG cable.
9. Provide with legs.
10. Provided with 110B1 type wire management above and below each 110 block.
11. Manufacturers
 - a. Basis of Design
 - 1) Panduit
 - b. Acceptable Substitutions
 - 1) Siemon
 - 2) Ortronics
 - 3) Amp

B. 110 Cross Connect System Terminal Block (Without Surge Protection):

1. Input and output to be via 110 wiring block.
2. Number of pairs to match number of connected voice pairs (25, 50 or 100).
3. Size unit as required for number of connected voice pairs (25, 50 or 100 pair).
4. Manufacturers
 - a. Basis of Design
 - 1) Panduit
 - b. Acceptable Substitutions
 - 1) Siemon
 - 2) Ortronics

3) Amp

2.6 FIBER OPTIC PATCH PANELS

- A. Modular panels housing multiple-numbered, duplex cable connectors.
- B. Number of Connectors per Field: As shown on the drawings. Include quantity necessary for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Shall be loaded with a minimum of twenty-four (24) SC connectors.
- D. Durable metal construction with mounting for standard EIA 19" equipment racks/cabinets.
- E. Shall include cable entry holes on top, bottom and sides
- F. Shall include removable hinged front and rear doors.
- G. Provide rack mounted or wall mounted as shown on the drawings.
- H. Manufacturers
 - 1. Basis of Design
 - a. Panduit #FRME2U with FAP Connector Modules and Blanks
 - 2. Acceptable Substitutions
 - a. Amp
 - b. Leviton

2.7 HORIZONTAL COPPER CABLE

- A. 100 Ohm, 23 gauge copper, four (4) pair, Category 6 "voice/data" copper unshielded twisted pair cable.
- B. Technical
 - 1. Minimum NEXT (dB): 41.3 dB
 - 2. Minimum PSNEXT (dB): 39.3 dB
 - 3. Minimum ELFEXT: 19.8 dB
 - 4. Minimum PSELGEXT: 16.8 dB
 - 5. Minimum ACR: 8.5 dB
 - 6. Minimum PSACR: 6.5 dB
 - 7. Minimum Return Loss: 17.3 dB
 - 8. Maximum Delay Skew (ns): 45 ns
- C. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70.
 - 1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
- D. The cable shall have surface markings: Verified UL Category 6
- E. Plenum rating: Cable shall be plenum rated and marked CMP or Plenum (UL). Cable may be non-plenum rated where installed in non-plenum spaces/areas.
- F. The cable shall be certified by the manufacturer as meeting requirements for a 25 year structured cabling system warranty. The cable shall be approved by the manufacturer for use in a warranted system from the connectivity manufacturer (e.g. patch panels, outlets, etc.) installed as part of this project.
- G. Manufacturers
1. Basis of Design
 - a. Panduit PUR6Co4bU-UY (Riser)
 - b. Panduit PUP6Co4bU-UY (Plenum)
 2. Acceptable Substitutions
 - a. Siemon
 - b. Ortronics
 - c. Amp

2.8 COPPER PATCH PANELS

- A. Configuration: UL Listed and labeled, Category 6, angled, modular RJ-45 non-keyed 8-position jacks.
- B. Wire Plan: EIA/TIA T568B.
- C. Active Pins: 1 through 8.
- D. Number of Ports: Configurations as called for on drawings.
- E. Each port/jack to have dust cover.
- F. Technical
1. NEXT (dB) @ 250MHz: 46.0 dB minimum
 2. Insertion Loss (dB) # 250 MHz: 0.32 dB maximum
 3. FEXT (dB) @ 250 MHz: 35.1 dB minimum
- G. Manufacturers
1. Basis of Design
 - a. Panduit Mini-Com #CPPL48WBLY 48 Port Category 6 patch Panels
 2. Acceptable Substitutions

- a. Siemon
- b. Ortronics
- c. Amp

2.9 WORKSTATION OUTLETS

- A. Install and configure as shown on the drawings.
- B. Workstation outlets shall be provided with ANSI/TIA/EIA-568-B.2-1 Category 6, 8-position modular jacks (RJ45 type) utilizing T568A wiring for voice and data connections. Jacks shall be certified to operate at 1000 Mbps data speed with twisted pair horizontal cabling as verified by ETL or UL. Faceplates shall be capable of accommodating up to 6, 8-position modular jacks each.
- C. Wall Outlets: Wall outlets shall consist of a single gang wall plate, office white in color, with quantity of jacks as shown on the drawings, and blank module inserts for all unused module locations.
 1. Plastic Faceplate: High-impact plastic.
 2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
 3. Blank Modules: Office White in color
 4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.
- D. Wireless Access Point (AP) Outlets shall consist of the same materials as wall mounted outlets but shall be flush ceiling mounted and centered near the middle of the room where shown on drawings.
- E. Modular Furniture Outlets: Furniture outlets shall consist of a modular furniture faceplate capable of housing up to four (4) 8-position modular connectors with quantity of jacks as shown on the drawings, and blank module inserts for all unused module locations.
- F. House Wall Phone: Wall phone outlets shall consist of a SE630 type wall plate with one (1) Category 6 terminating in an 8-position modular jack.
- G. 8-position Modular Jack: Shall be Category 6 jacks meeting or exceeding the following electrical, mechanical and performance specifications:
 1. Electrical Specifications:
 - a. Insulation Resistance: 500 M Ω minimum
 - b. Dielectric withstand voltage 1000 VAC RMS, 60 Hz minimum, contact-to-contact and 1500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface
 - c. Contact Resistance: 20 m Ω maximum
 - d. Current Rating: 1.5 A at 68 °F (20 °C) per IEC Publication 512-3, Test 5b
 - e. ISO 9001 Certified Manufacturer
 - f. UL Verified for EIA/TIA electrical performance
 - g. Comply with FCC Part 68

- h. Terminate jacks in TIA T568A pin assignment configuration.
 - i. Mechanical Performance:
 - j. Plug Insertion Life: 750 insertions
 - k. Contact Force: 3.5 oz (99.2 g) minimum using FCC Approved modular plug
 - l. Plug Retention Force: 30 lb (133 N) minimum between modular plug and jack
 - m. Temperature Range: -40 °F to 150 °F (-40 °C to 66 °C).
2. Channel Performance: Category 6 jacks shall be utilized in a channel configuration meeting or exceeding the following specifications at 250 MHz:
- a. NEXT (dB): 46.0 dB
 - b. Insertion Loss (dB): 0.32 dB or less
 - c. FEXT (dB): 35.1 dB
 - d. Return Loss (dB): 16.0 dB
3. Contractor shall provide and install white jacks for voice circuits and orange for data. Each multi-jack outlet shall have one (1) voice jack.
4. Manufacturers
- a. Basis of Design
 - 1) Panduit CFPSL2IWY 2-Port, CFPSL4IWY 4-Port, and CFPSL6IWY 6-Port Faceplates with CJ688TGIW Jacks
 - b. Acceptable Substitutions
 - 1) Siemon
 - 2) Ortronics
 - 3) Amp

2.10 COPPER PATCH CORDS

A. Provided and installed by Contractor.

- 1. Provided and install copper patch cords in quantities and lengths necessary to patch all installed patch panel jacks.
- 2. Provide and install one (1) patch cord of minimum six foot length for each workstation outlet installed. Patch cords shall be by the same manufacturer as the horizontal cable or copper patchpanels.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the requirements of Section 16701.

3.2 PATHWAYS

- A. Comply with requirements for pathways as specified herein. Drawings indicate general arrangement of pathways and fittings.

3.3 CABLES/WIRES

- A. Use of plastic or nylon cable ties within Communications rooms is strictly prohibited. Velcro cable ties or Velcro wraps shall be used instead of cable ties in all rooms where Category 6 cable is terminated.

3.4 LABELS

- A. Each jack on patch panels shall be identified with permanent machine generated labels, meeting the EIA/TIA 606 requirements and matching the OCPS numbering plan as shown on the faceplate. Labeling shall be permanent. Labeling shall be 12 point in size.
- B. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 - 1. Administration Class: 2
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- C. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration, including optional identification requirements of this standard.
- D. 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.
- E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

3.5 IDENTIFICATION

- A. Category 6 cable and Category 6 patch cords for data shall have a jacket that is purple in color.
- B. Category 6 patch cords for voice shall have a jacket that is white in color.
- C. Category 6 jacks (patch panels and workstation outlets) shall be purple in color.
- D. Workstation outlets shall be labeled as shown on the drawings.

3.6 TESTING

A. Test Equipment

1. Acceptable testing equipment: Subject to compliance with requirements:
 - a. Agilent (HP) Wireshope
 - b. Fluke
2. Test equipment shall be 100% Level III compliant with TIA/EIS 568.2-1 specifications for testing of CAT 6 cabling. No testers will be approved without meeting these requirements.
3. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel and link test configurations. Use of patch cords shall not be allowed.
4. The correct cable NVP shall be entered into test equipment to assure proper length and attenuation readings.

B. Cable

1. Category 6 Cable and Outlets
 - a. Test each cable, Workstation Outlet jack, and Patch Panel jack in accordance with requirements for UTP Cable. In addition, perform the following tests in accordance with TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map
 - 2) Length (physical vs. electrical, and length requirements)
 - 3) Attenuation
 - 4) Insertion loss
 - 5) Near-end crosstalk (NEXT) loss
 - 6) Power sum near-end crosstalk (PSNEXT) loss
 - 7) Equal-level far-end crosstalk (ELFEXT)
 - 8) Power sum equal-level far-end crosstalk (PSELFEXT)
 - 9) ACR
 - 10) PSACR
 - 11) Return loss.
 - 12) Propagation delay
 - 13) Delay skew
 - b. Testing shall include:
 - 1) The "basic link" and "channel".
 - 2) 100% passive testing of the cable system.

C. Documentation of Tests, Measurements, and Adjustments Performed:

1. Provide system verification and acceptance documentation signed and dated by the Contractor at the completion of testing. Document the following:

- a. List of personnel in attendance during testing including the name of the Technician who performed each individual test.
 - b. List of certified test equipment used with serial numbers
 - c. List date of last calibration for each piece of test equipment
 - d. Date of each test
 - e. List reference settings of test equipment used for tests
 - f. Cable NVP used for testing
 - g. Submit testing results in hard copy and native electronic format.
2. System verification and acceptance documentation shall be provided with the Contractor's request for Substantial Completion.

END OF SECTION 16710

SECTION 16741 – SOUND SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 “Common Work Results for Communications”

1.2 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete system as described herein and on the drawings.
- B. System to include but not be limited to:
 - 1. All sound reinforcement system equipment as outlined herein and as required for a complete and fully functional system.
 - 2. Support
 - a. Raceways, outlet boxes, cabinets, identification, etc. Conform to applicable sections in these specifications. Provide/install complete with all required basic materials.
 - b. Power: Refer to Division 16
 - c. Grounding: Refer to Division 16
- C. All cable shall be installed in complete raceway system as shown on the drawings.

1.3 SPECIAL REQUIREMENTS

- A. The Contractor shall provide and install all equipment, materials, programming, testing, and labor necessary to provide and install a complete and fully functional system whether or not specifically shown on the drawings or called out herein. Claims for additional equipment and materials not called out in the contract document shall not be allowed.
- B. The equipment cabinets specified herein are for both the Sound System and the Video System as called out in Section 16751. The Contractor shall coordinate installation of equipment and materials for both systems as shown on the drawings.

1.4 FUNCTIONS AND OBJECTIVES

- A. Provide and install a complete and fully functional Sound Reinforcement system providing pickup, amplification, distribution, and reproduction of voice and/or other audio program material from various sources such as microphones (hard-wired and wireless), CD Players, Computer audio, etc. as shown on the drawings and described herein.
- B. Provide integration between the Sound Reinforcement Systems and other related systems as required by Code and the Contract Documents.

- C. The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.
- D. Coordinate all work with other trades and Owner provided equipment as necessary.

1.5 ALTERNATES

- A. Additive Alternate #2: All work associated with Conference Center (S222A).

PART 2 - PRODUCTS

A. FLOOR MOUNT EQUIPMENT CABINET

1. Base shall be constructed of double formed front and rear sections; MIG welded and reinforced with 11 gauge CRS corner caster gussets. Vertical columns shall interlock with frame top and base.
2. Base shall include four (4) 3/8-16 threaded sockets for installation of levelers. Base shall also have provisions to be permanently secured to the floor.
3. Mounting rail channel support members shall be multi-formed and MIG welded for interlocking support.
4. Panel mounting rails shall be fully adjustable front to rear. Rails shall be formed from 14 gauge CRS, zinc plated and punched on EIA pattern with .281 diameter holes on 5/8" - 5/8" - 1/2" continuous centers (2 pair supplied).
5. Manufactured to EIA standards.
6. 22.31" Width by 25" Depth by 83.125" Height with 61.25" panel mounting space.
7. Front and rear access to equipment.
8. Shall include side panels.
9. Shall include metal louvered rear door.
10. Shall include surface mount plexi-glass front door.
11. Door shall include cylinder lock, lift-pull handle, and quick release hinges.
12. Color shall be black.
13. Provide all panels as required to mount equipment, including panel for power strip and filler panels. Filler panels shall be installed to allow future addition of equipment without the need for the Owner to maintain a stock of filler panels in a separate location. Filler panels larger than three (3) racks spaces shall not be acceptable.
14. Top and bottom rack units shall be vent panels. Other spaces shall be provided with blank or vent panels as shown on the drawings.
15. Provide, in each equipment cabinet, one (1) fan tray assembly with two (2) 115 CFM fans.
16. Provide ground bus full height minus six (6) inches. Mount to back of equipment cabinet. Connect to Systems ground bus bar.
17. Provide all brackets to mount non-rack mountable equipment.
18. Provide all hardware, supports, etc. as required to mount/house all equipment called for and/or shown at each location.
19. Provide additional shelves as required for each piece of equipment mounted in cabinet that requires a shelf.
20. Cabinet to include two (2) multi-outlet power strips.

- a. Comply with UL 1363.
 - b. Rack mounting.
 - c. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - d. LED indicator lights for power and protection status.
 - e. LED indicator lights for reverse polarity and open outlet ground.
 - f. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 - g. Cord connected with 15-foot (4.5-m) line cord.
 - h. Rocker-type on-off switch, illuminated when in on position.
 - i. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
 - j. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.
21. Provide casters to allow equipment cabinets to be moved out of installation space far enough to gain access to rear of cabinets with adequate working space. Contractor shall provide cabling to cabinets with enough slack to allow cabinets to be properly moved.
22. Equipment Cabinets shall have 44 Rack Units (RU) of usable space.
23. Manufacturers
- a. Basis of Design
 - 1) Atlas Soundolier #544-25 equipment cabinet with top panel, side panels, plexiglass front door, rear doors, SVP19 Series Vent Panels, S19 Series Filler Panels, CFT-0 Fan Tray and CFM-2-120 Fan Assembly; Leviton #5500-192 Power Strips
 - b. Acceptable Substitutions
 - 1) Newton
 - 2) Chatsworth
 - 3) Middle Atlantic

2.2 Power Sequencer

- A. The Power Sequencer shall be a series multi-stage surge protected device with linear filtering and automatic voltage shutdown used to power up and power down audio equipment in a logical sequence that prevents damage to audio components such as amplifiers.
- B. The Power Sequencer shall have six sequenced rear panel outlets in three groups of two with two additional switched rear panel outlets, and one front panel unswitched outlet.
- C. The power Sequencer shall be provided with a momentary remote control plate to allow power up or power down of the sound system without having to enter the sound system equipment cabinet. The momentary remote control plate shall be installed where shown on the drawings.
- D. Technical

1. Current Rating: 15 amps
2. Operating Voltage: 90 to 140 VAC
3. Over Voltage Shutdown: 140 VAC
4. Spike Protection Modes: Line to neutral, zero ground leakage
5. Spike Clamping Voltage: 188 Vpk @ 3,0000 amps, 133 VAC RMS
6. Response Time: 1 nanosecond
7. Maximum Surge Current: 6,500 amps
8. Noise Attenuation: 10 dB @ 10 kHz; 40 dB @ 100 kHz; 100 dB @ 10 MHz
9. Safety Agency Listings: CE, NRTL-C
10. Shall be provided with a three year warranty

E. Manufacturers

1. Basis of Design
 - a. Furman Sound PS-8R II Power Conditioner/Sequencer with an RS-2 Remote System Control Panel or acceptable substitution

2.3 WIRELESS MICROPHONE SYSTEM

- A. Will be provided and installed by Owner's Vendor as portable equipment after completion of the project.

2.4 HANDHELD MICROPHONES

- A. Will be provided and installed by Owner's Vendor as portable equipment after completion of the project.

2.5 MICROPHONE FLOOR STANDS:

- A. Will be provided and installed by Owner's Vendor as portable equipment after completion of the project.

2.6 MICROPHONE DESK STANDS:

- A. Will be provided and installed by Owner's Vendor as portable equipment after completion of the project.

2.7 MICROPHONE AND LINE LEVEL INPUT PLATES

- A. Stainless steel single-gang faceplates with quantity and type of XLR connectors as shown on the drawings.
- B. Provide one (1) 25 foot microphone cable for each jack type.
- C. Manufacturers:
 1. Basis of Design
 - a. Atlas Soundolier
 2. Acceptable Substitutions

- a. Pro Co Sound
- b. Whirlwind

2.8 LINE LEVEL MIXER

- A. The Line Level Mixer shall be a two input, two output device design for mixing two audio sources. It shall allow two mic or line level source to be combined and output as either a mic or line level signal.
- B. Technical
 1. Inputs: Two (2) selectable mic or line
 2. Input Level for +4 dBu Output:
 - a. Mic: -45 dBu to +65 dBu; Max input -28 dBu
 - b. Line: -18 dBv to +1- dBu; Max input +22 dBu
 3. Input Impedance: Mic 200 Ohm; Line 20 k Ohm bridging
 4. Input or Output Configuration: Balanced or unbalanced
 5. Outputs: Two (2); mic or line
 6. Output impedance: 150 Ohms (mic or line)
 7. Frequency Response:
 - a. Mic: 25 Hz to 50 kHz ($\pm 1/$ dB)
 - b. Line: 10 Hz to 30 kHz (± 0.25 dB)
 8. THD+N:
 - a. Mic: < 0.05% 25 to 20 kHz
 - b. Line: < 0.005%
 - c. IMD: < 0.004%
 9. Output Level: Mic: -45 dBu; Line +4 dBu
 10. Headroom:
 - a. Mic Input: >22 dB
 - b. Line Input: >32 dB
 - c. Output: > 20 dB
 11. Noise: Mic: <-70 dB; Line <-90 dB
 12. CMRR: Mic: > 65 dB; Line >45 dB
- C. The Mixer shall be provided with a power supply
- D. The Contractor shall provide and install Line Level Mixers as necessary for signal compatibility between system equipment.
- E. Manufacturers
 1. Basis of Design
 - a. Radio Design Labs St-MS2 Line Level Mixer or acceptable substitution

2.9 DIGITAL AUDIO NETWORKING PLATFORM

A. Audio Core Panel

1. The System Processor shall be an Intel based centralized processor and control engine. It shall be a single-chassis processor with no internal or external audio busses to other processors. The system shall operate on a native gigabit Ethernet, employ DiffServ quality of service, IEEE 1588 time reference, UDP/IP data transport, and floating point format audio data representation. The overall system latency from analog input to synchronized analog outputs shall be 2.5 ms or less. For routed networks, the end to end system latency shall be 3.2 ms or less.
2. The system shall have the capability of being completely redundant. The processor shall be able to support a second synchronized backup processor with complete automatic failover in ten seconds or less. Each processor and I/O peripheral shall have redundant network connections for seamless audio stream failover.
3. The system processor shall have a minimum network channel capability of 128 channels 64 channels and an end node capacity of at least 128 channels 64 channels of audio. I/O capacity shall be 8 card slots using one of six I/O circuit cards (HD-15 pin Amp Out, Line Out, High-performance Mic/Line In, Standard Mic/Line In, CobraNet In/Out, and AES/EBU In/Out).
4. The system processor shall have the following front panel controls and indicators: LCD page forward momentary switch, Unit ID button momentary switch, Clear settings momentary switch, Power On blue LED, Device Status tri-color LED, 32 audio signal tri-color LEDs, and a 240 x 64 monochrome LCD graphics display displaying the device name, design name and status, type of I/O cards in the I/O slots, LAN A and B settings, and the firmware version.
5. On the rear panel, the system processor shall have one RS232 DE-9 (male 9-pin D-shell) connector, VGA and DVI Video Out, GPIO A: DA-15 (female 15-pin D shell) connector, GPIO B: DA-15 (female 15-pin D shell) connector, LAN A RJ45 1000 MBps only, LAN B: RJ45 1000 MBps only.
6. The system processor shall store a single design which can be comprised of components, wiring, links, text, and graphics on a single or multiple schematic pages. Designs shall include any of the following DSP functions, test and measurement components, control components, and layout components: Acoustic Echo Cancellers, Audio Players, Audio Streaming components, Crossfaders, Crossovers, Delay components, Auto Gain control elements, Compressors, Gates, Duckers, Expanders, Ambient Noise Compensators, Limiters, Gain blocks, Graphic Equalizers, Parametric Equalizers, FIR Filters, All-Pass Filters, Band-Pass Filters, Band-Stop Filters, High-Pass Filters, Low-Pass Filters, FIR High-Pass filters, FIR Low-Pass Filters, Dual-Shelf Equalizers, Notch Filters, Meters, Matrix Mixers, Gain-Sharing Automatic Mixers, Gated Automatic Mixers, Signal Routers, Public Address Routers, Room Combiners, Signal Presence Meters, Tone Generators, Tone and Noise Generators, Dual Trace FFT Measurement Modules, Real Time Analyzers, Signal Injectors, and Signal Probes.
7. The system processor shall support custom user control interfaces either on proprietary touch screen controllers, or network computers utilizing a control application, or iOS devices on Wi-Fi. Custom control interfaces shall be capable of having multiple user-selectable pages with different controls on each.

8. Functions and Features

- a. Centralized processing architecture using Intel® processing
- b. Eight on board slots accommodate all I/O cards
- c. Abundant DSP capacity
- d. Uses standard GigabitEthernet hardware and protocols for audio transport and control
- e. Control and interface to external devices using TCP/IP, GPIO and RS-232
- f. Powerful and intuitive design GUI
- g. System seamlessly integrates with amplifiers and loudspeakers
- h. Supports multiple levels of system redundancy
- i. Technical support is available from manufacturer 24/7 – worldwide

9. Technical

- a. Description System processor and control engine
- b. Front Panel Controls LCD page forward momentary switch
- c. Unit ID button momentary switch
- d. Clear settings momentary switch
- e. Front Panel Indicators Power On: Blue LED; Device Status: Tri-color LED
- f. Audio Signal: 32 Tri-color LEDs
- g. Card Status: 8 tri-color LEDs
- h. 240 x 64 monochrome LCD graphics display
- i. Rear Panel Controls Power Switch
- j. Rear Panel Connectors RS-232: DE-9 (male 9-pin D shell connector)
- k. Video Out: HD-15 (female 15-pin D shell connector); DVI-D, HDMI (500i only)
- l. Aux USB ports: USB host (type A) x4
- m. Aux Network Port: RJ45 10/100/1000 Mbps (switchable between Q-Sys LAN B or Aux Network Port on 250i model)
- n. GPIO ports: DA-15 (female 15-pin D shell connector) x2
- o. LAN A: RJ45 1000 Mbps only
- p. LAN B: RJ45 1000 Mbps only (switchable between Q-Sys LAN B or Aux Network Port 10/100/1000 Mbps on 250i model)
- q. IEC inlet: AC mains power connector
- r. Network Channel Capacity 128
- s. Audio I/O Capacity 8 card slots, up to 32 channels; Requires purchase of Q-Sys Type 2 audio I/O cards: CB, CIML4, CIML4-HP, COL4, CODP4, CAES4, CCN32
- t. Line Voltage Requirements 100 VAC - 240 VAC, 50 - 60 Hz
- u. Current Draw 1.5A (120V mains) 1.7A (120V mains)
- v. Thermal 500 BTU/h (typical) 650 BTU/h (typical)
- w. Included Accessories 6 ft UL/CSA/IEC line cord, User Manual, Software CD

B. Input/Output Peripherals

1. Input/Output Frame

- a. The I/O Frame shall operate on a native gigabit Ethernet network, employing DiffServ quality of service, IEEE 1588 audio clock synchronization, UDP/IP data transport, and floating-point format audio data representation. The overall system latency from analog input to synchronized analog output(s) shall be 2.5 ms or less. For routed networks, the end to end system latency shall be 3.2 ms or less.
 - b. The I/O Frame shall have the capability of being redundant. The Frame shall have a backup that has the same input source as the primary. The outputs of the backup are disconnected by relays, until a failover occurs, at which time the primary outputs are disconnected. Each I/O Frame shall have redundant "hot" network connections for seamless audio stream failover.
 - c. The I/O capacity shall be up to 16 analog input and/or output channels using any combination of the following: Mic/Line Input card (High Performance or Standard), Line Output card, DataPort Output card. The I/O capacity shall be up to 32 digital channels using the AES-3 Input/Output card.
 - d. The I/O Frame shall have the following front panel controls and indicators: LCD page forward momentary switch, Unit ID momentary switch, Clear settings momentary switch, Power on - blue LED, Device status - tri-color LED, audio signal - five tri-color LEDs per I/O card slot, 240 x 64 monochrome LCD graphics display.
 - e. The I/O Frame shall have the following rear panel connectors: RS232 - DE-9 (male 9-pin D shell connector), GPIO - DA-15 (female 15-pin D shell connector), Q-Sys Network LAN A and LAN B - RJ45 1000 MBps only, line voltage connection for 100 VAC - 240 VAC, 47 - 63 Hz.
2. Required Input/Output Cards

a. Mic/Line Input Card

- 1) Description: Four channels of microphone/line-level analog audio input with 48V phantom power
- 2) Performance: Dynamic Range >105 dB min
- 3) Distortion (20 Hz – 20 kHz +4 dBu nominal input): <0.009% THD+N
- 4) Crosstalk (20 Hz – 20 kHz): > 100 dB min.
- 5) Frequency Response: 20 Hz – 20 kHz +/- 0.5 dB
- 6) Input Impedance: 10 kohms
- 7) Common Mode Rejection: >45 dB min.
- 8) Max Input Level: 0.123, 2.25, 8.70, 17.35 VMS; -16, 10, 21, 27 dBu; -18.2, 7.04, 18.8, 24.78 dBv (4 selections)
- 9) Mute: Infinite attenuation (via digital mute)
- 10) Audio Converters: 24-bit delta-sigma at 48 or 96 kHz sample rate analog to digital conversion
- 11) Connectors: Four 3-terminal Euro-style detachable terminal blocks
- 12) User-Configurable Options: +48V phantom power

b. High Performance Mic/Line Input Card

- 1) Description: Four channels of microphone/line-level analog audio input with 48V phantom power and high performance pre-amplifiers and A/D converters
 - 2) Performance: Dynamic Range >112 dB min
 - 3) Distortion (20 Hz – 20 kHz +4 dBu nominal input): <0.004% THD+N
 - 4) Crosstalk (20 Hz – 20 kHz): > 100 dB min.
 - 5) Frequency Response: 20 Hz – 20 kHz +/- 0.5 dB
 - 6) Input Impedance: 10 kohms
 - 7) Common Mode Rejection: >45 dB min.
 - 8) Max Input Level: 0.123 to 17.35 VMS; -56 to 27 dBu; -58.2 to 24.8 dBv (continuously variable)
 - 9) Mute: Infinite attenuation (via digital mute)
 - 10) Audio Converters: 24-bit delta-sigma at 48 or 96 kHz sample rate analog to digital conversion
 - 11) Connectors: Four 3-terminal Euro-style detachable terminal blocks
 - 12) User-Configurable Options: +48V phantom power
- c. Line Output Card
- 1) Description: Four channels of line-level analog audio output
 - 2) Performance: Dynamic Range >112 dB min
 - 3) Distortion (20 Hz – 20 kHz +4 dBu nominal input): <0.004% THD+N
 - 4) Crosstalk (20 Hz – 20 kHz): > 100 dB min.
 - 5) Frequency Response: 20 Hz – 20 kHz +/- 0.5 dB
 - 6) Mute: Infinite attenuation (via digital mute)
 - 7) Audio Converters: 24-bit delta-sigma at 48 or 96 kHz sample rate digital to analog conversion
 - 8) Output Trim: 8.7 V Vrms; 21 dBu; 18.8 dBv
 - 9) Connectors: Four 3-terminal Euro-style detachable terminal blocks
- d. DataPort Output Card
- 1) Description: Four audio output channels for connection to DataPort equipped audio power amplifiers
 - 2) Performance: Dynamic Range >114 dB min
 - 3) Distortion (20 Hz – 20 kHz +4 dBu nominal input): <0.004% THD+N
 - 4) Crosstalk (20 Hz – 20 kHz): > 95 dB min.
 - 5) Frequency Response: 20 Hz – 20 kHz +/- 0.5 dB
 - 6) Mute: Infinite attenuation (via digital mute)
 - 7) Audio Converters: 24-bit delta-sigma at 48 or 96 kHz sample rate digital to analog conversion
 - 8) User-Configurable Options
 - a) Amplifier Standby: Set or clear amplifier in stanby mode
 - b) Mute: Set or clear individual channel mutes

- c) Enable Meters: Enable data collection of meters for each channel
- d) Audio Output Levels: Adjust individual audio channel levels.
- e. CobraNet Bridge Card
 - 1) Description: Up to 32 input and 32 output channels of CobraNet digital audio
 - 2) Frequency Response: 20 Hz – 20 kHz +/- 0.2 dB
 - 3) Mute: Infinite attenuation (via digital mute)
 - 4) Group Delay: 64 Samples (2.687 ms actual), 128 Samples (4.020 ms actual), 256 Samples (6.686 ms actual)
 - 5) I/O Capacity: Selectable 4X4, 8X8, 16X16 or 32X32 (in Core only)
 - 6) Bundle Packing: 0 to 8 channels
 - 7) Network Transmitters: 4
 - 8) Network Receivers: 4
 - 9) Management: CobraNet management via SNMP
 - 10) Connectors: Dual RJ-45
- f. Remote Input/Output Module
 - 1) Shall include all functions and features of the I/O Frame and Cards except as modified below.
 - 2) Functions and Features
 - a) Two mic/line inputs and two line outputs
 - b) One 9-Watt speaker output
 - c) May use Power over Ethernet (PoE) or local power supply
 - d) Premium 24-bit AD and DA conversion used throughout
 - e) Includes mounting brackets
 - f) Uses standard Gigabit Ethernet hardware for audio transport with dual Ethernet connection for network redundancy.

C. Audio Power Amplifiers

- 1. Shall be a four (4) channel audio power amplifier specifically designed for Pro Audio Sound Reinforcement systems.
- 2. Functions and Features
 - a. Compact size: Only 2 RU and 14" deep for reduced rack cost and floor space
 - b. Bridgeable channels 1 + 2 and 3 + 4, for maximum flexibility
 - c. Active inrush limiting eliminates AC inrush current, removing the need for expensive power sequencers
 - d. HD15 DataPort connector for computer control and monitoring
 - e. Custom integrated security cover for tamper-proof installations
 - f. Variable-speed fan for low noise
 - g. 1-dB detented gain controls for fast and accurate gain settings

- h. Detachable Euro style input connectors
 - i. DIP switch control for clip limiters, high pass filters, bridge mono and parallel operation
 - j. Exclusive PowerLight switch-mode power supply technology for high performance and compact size
 - k. Selectable high-pass filters protect speakers and prevent speaker transformer saturation with minimal effect on program material (33 Hz or 75 Hz on non-V models, 50 Hz or 75 Hz on V models)
 - l. Comprehensive front panel indicators including signal, clip, protect and QSC's exclusive bridge mono and parallel input LEDs
 - m. Barrier strip output connector
 - n. Comprehensive protection circuitry including DC, infrasonic, thermal overload and short circuit protection
 - o. High-performance Class AB+B complementary bipolar output circuitry
 - p. 3-year warranty plus optional 3-year extended service contract
3. Technical Requirements
- a. Power Per Channel: 70 V, 20 Hz-20 kHz; 0.05% THD
 - b. Noise (20 Hz – 20 kHz): >106 dB
 - c. Input Sensitivity: 1.26 V rms
 - d. Maximum Voltage Gain: 35 dB
 - e. Input Clipping: 10 V rms +22 dBu)
 - f. Distortion: Less than 0.02%
 - g. Frequency Response: 20 Hz – 20 kHz
 - h. Damping Factor: Greater than 500
 - i. Amplifier Protection: Full short circuit, open circuit, thermal, ultrasonic. Stable into reactive or mismatched loads.

D. Project Performance Requirements

- 1. The system shall be provided with design software specifically created by the equipment manufacturer for use in developing and programming the system equipment for operation. The Contractor shall utilize this software to install and program the system and then, at the end of construction as part of the close-out documentation, shall provide the Owner with an original copy of the software and all programming files and system passwords. Use of backdoor type passwords by the Contractor shall not be acceptable.
- 2. A DataPort I/O Card shall be installed in each Audio Core Panel.
- 3. All system equipment shall use Type 2 hardware and connectors.
- 4. Mic/Line Level Input Card shall all be High Performance Type
- 5. System shall be provided with one (1) CobraNet Bridge Card for connection to Owner's future building-wide system.
- 6. The system shall be interfaced to the Control System (refer to Section 16751) for full control as described therein. Interconnect the system to the Control System as necessary, providing all required equipment, materials, and programming necessary, to provide the Owner with a single unified Audio/Video Control System. Interconnection of the system to the Control System shall not eliminate the need for the system software as described herein.
- 7. The Audio Power Amplifiers shall be provided with 70V outputs.

E. Manufacturers

1. Basis of Design

- a. QSC Q-Sys System with Core 500i, I/O Frame, I/O Cards including but not limited to CIML4-HP High-Performance Mic/Line Input Cards, COL4 Line Output Cards, CODP4 DataPort Output Cards, and CCN32 CobraNet Bridge Cards, I/O 22 Remote I/O Module and CX204V 4-Channel Professional Power Amplifier or acceptable substitutions.

2.10 RACK MOUNT COMPUTER, MONITOR AND KEYBOARD

A. Computer

- 1. Shall include an Intel i5 or i7 processor, 16 GB or RAM, and a 500 GB hard drive. Hard drive shall include Operating System that is compatible with the Digital Audio Networking Platform System Software. Shall be rack mounted
- 2. Manufacturers

- a. Basis of Design

- 1) Lenovo

- b. Acceptable Substitutions

- 1) HP
 - 2) Dell

B. Monitor and Keyboard

- 1. The Monitor/Keyboard/Mouse Console consisting of a 17" LCD single rail Console with integral KVM Switch.
- 2. 17" LCD Single Rail Console shall have the following functions and features:

- a. Support for SunT Native Resolution
 - b. Support for seventeen different keyboard languages
 - c. Bright Active TFT Display
 - d. OSD Functions for LCD Display and KVM Switch
 - e. Durable Keyboard with Touchpad
 - f. LCD Panel protected by tempered glass
 - g. Integration with various KVM switches

- 3. The KVM Switch shall have the following functions and features:

- a. KVM Type: PS/2 and USB interface
 - b. Console Port plus one Remote Module
 - c. PC Port Connector: HDDB-15
 - d. PC Ports: 8
 - e. Max Distance (KVM Switch – Host): 32 feet
 - f. Video Resolution: 1920 x 1440 (Local Console); 1280 x 1024 (IP-based remote console)

- g. IP-Based Remote Module: RJ-45 for 10/100M Ethernet, DB9 male for Modem; Null modem and serial power control; Mini USB 2.0 receptacle.
 - h. Daisy Chaining: Support with both Bus (8-layer) and Tree (2-layer) topologies; DB15 female connector
 - i. Computer Port Selection: On Screen Display (OSD) Menu, Hot Key
 - j. Security: Access Control List (SCL) security function; up to 8 independent controllable computer lists.
 - k. Auto-Scan Intercals: 5 ~ 99 sec.
 - l. Keyboard Emulation: PS/2 or USB
 - m. Mouse Emulation: PS/2 or USB
4. Manufacturers
- a. Basis of Design:
 - 1) Atlas Soundolier MMK17-RM 17" LCD Console with MMK-KVM8 Modular KVM Switch or acceptable substitution

2.11 DATA SWITCHES

- A. The Data Switch required for interconnection of the Digital Audio Networking Platform and the future Building-Wide Audio System (as shown in the drawings) shall be provided by the Owner and Installed by the Contractor. All other data switches shall be Contractor provided and installed.

2.12 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. Shall be an interactive UPS with enhanced LCD interface offering network-grade power protection for critical server, network, and telecommunications equipment.
- B. Shall have built-in Auto-Voltage Regulation (AVR) to actively correct for brownouts and over-voltages back to usable levels while maintaining a full battery charge in case of power failure.
- C. Features
 - 1. 2RU rack mount UPS with 3000 VA / 3kVA capacity (1600W maximum load)
 - 2. Corrects for brownouts and over-voltages from 83 to 145V
 - 3. NEMA L5-30P input plug; 8 NEBA 5-15/20R and 1 L5-30R output receptacles. Two independently switchable output load banks.
 - 4. 98% efficiency rating in line-power mode
 - 5. Internal batteries offering 10 minutes at 50% load (1125W) and 3.5 minutes at 100% load (2250W)
 - 6. Hot-swappable, user-replaceable internal batteries.
 - 7. Front panel LCD monitoring screen with MODE and ENTER buttons reporting operating mode with 5-bar battery charge graphic plus seven selectable screens of detailed UPS and site power information.
- D. Shall include:
 - 1. PowerAlert software with USB, Serial, and IPO cabling

2. 4-post rack mount kit
3. Instruction manual

E. Project Performance Requirements

1. Shall be provided with SNMPWEBCARD
2. Quantity of UPS's Required: Minimum of two (2) UPS's to provide a minimum of ten (10) minutes of up time for all connected equipment upon loss of normal power. Increase size or quantity of UPS's as necessary to meet project requirements.

F. Manufacturers

1. Basis of Design
 - a. Triplite SMART3000RM2U with SNMPWEBCARD option
2. Acceptable Substitutions
 - a. APC

2.13 AUDIO PATCH PANELS

A. Shall be a programmable audio patchbay in a 2 X 24, 1 RU size.

B. Functions and Features

1. Front programmable audio long-frame 1/4" patchbay
2. Normals and grounds can be programmed by the end user.
3. Rear interface options including E-3, E-90, and D-25.

C. Project Performance Requirements

1. Contractor shall provide, install and configure Patchbays to meet the Owner's AV staff requirements in regard to normal and ground configuration.

D. Manufacturers

1. Basis of Design
 - a. Blttree 488 Series Audio Patchbay or acceptable substitution.

2.14 CONTROL SYSTEM

A. Refer to Section 16751.

2.15 ASSISTED LISTENING SYSTEM

A. Transmitter

1. The FM Transmitter shall be designed to provide auditory assistance in both personal and group situations. It operates on the 17 narrow-band channels in

the 72-76 MHz band. The base FM transmitter is rack mountable and accepts balanced and unbalanced audio inputs. It runs from a wall plug 12 VAC transformer and includes a detachable telescoping ¼ wave antenna.

2. System Components

- a. The FM Transmitter shall transmit 17 FCC-approved narrow band frequencies (in the 72-76 MHz radio band) available for the transmitter. The transmitter must identify numerically with a back lit LCD indicator the designated radio channel being transmitted.
- b. The FM Transmitter shall accept unbalanced line level, balanced microphone level and 70 Volt distributed audio sources.
- c. The transmitter shall have Enhanced Dynamic Range (E.D.R.) feature to improve Signal to Noise and audio quality when used with the SR-400 in E.D.R. mode.
- d. The FM Transmitter shall have Normal and High RF transmitter settings.
- e. The FM Transmitter shall have an on/off power switch.
- f. The FM Transmitter LCD shall be backlit to indicate "on" status.
- g. The FM Transmitter shall be mountable in a 19 inch equipment rack.
- h. The FM Transmitter shall have a three year parts and labor warranty.

3. Technical

- a. Audio Input Characteristics: XLR-3F Balanced, ¼ inch unbalanced.
- b. Antenna: detachable ¼ wave telescoping
- c. Modulation: FM, +/- 25 KHz deviation
- d. Frequency Response (System): 100 Hz to 10,000 Hz
- e. Automatic Gain Control Range: 30 dB
- f. System Signal to Noise: 58 dB, > 77 dB with E.D.R.
- g. Preemphasis: 100 micro seconds
- h. Maximum Power: 80K micro Volt/m @ 3 m (25K micro V/m in Normal)
- i. Power Requirements: 13-20 Vdc or 12 Vac; 115Vac 60 Hz @ 300 mA plug-in wallpack power supply

B. Receiver

1. General Description

- a. The Personal FM Receiver shall be designed for use in auditory assistance and personal communication applications. The Personal FM Receiver provides amplification for mild to severe hearing losses. Persons with normal hearing, when used with an appropriate listening accessory may also use the Personal FM receiver.
- b. The Multi-Channel Personal FM Receiver shall feature an advanced digital PLL synthesizer which makes 17 narrow band hearing assistance channels in the 72-76 MHz range available in one unit. The current channel must be displayed on a back lit LCD display.

2. Multi-Channel Personal FM Receiver

- a. Shall have seventeen-channel synthesized user adjustable.

- b. Shall have a high frequency boost filter accessible by a push button switch. This filter shall increase intelligibility of the audio signal, providing additional assistance for individuals with reduced high frequency sensitivity and for users wearing earphones with limited audio response.
 - c. Shall have Enhanced Dynamic Range (E.D.R.) feature to improve the signal to noise ratio and audio quality.
 - d. Shall have an advanced synthesized design which eliminates channel drift.
 - e. Shall have top mounted, tactile-feel controls to make operating any function easy.
 - f. Shall have power saving feature which automatically shuts off power when the earphone, headset, or neckloop is removed.
 - g. The Personal FM Receiver shall run on 2 AA-size alkaline batteries (20 hrs. continuous use), or 2 Ni-MH batteries (14 hrs. continuous use).
 - h. Earphone jack shall accept any standard 3.5 mm (0.138 inch) mini stereo or mono earphone/headphone.
 - i. The Personal FM Receiver shall have a three year parts and labor warranty.
3. Technical
- a. RF Frequency Range: 72.1 - 75.9 MHz
 - b. Audio Response: 100 - 10,000 Hz +/- 3 dB
 - c. Modulation: FM, +/- 25 KHz deviation
 - d. Harmonic & Spurious Emissions: Meets FCC part 15
 - e. Sensitivity: 0.5 μ v typical, 1.0 μ v maximum, 12 dB SINAD @ 25 KHz deviation
 - f. Image Rejection: >65 dB
 - g. Signal-to-Noise Ratio: >65 dB, >77 dB with E.D.R.
 - h. Distortion: <2% T.H.D.
 - i. Audio Output: @10% distortion ----- Into 8 Ohms--48 mW Into 32 Ohms--30 mW
 - j. Antenna Type: 1/4 wave omni-directional, in earphone cord
 - k. Batteries: 2 AA-size alkaline (20 hrs. continuous use), or 2 Ni-MH (14 hrs. continuous use)
 - l. Audio Controls: Volume, On/Off, High Frequency Boost (push-on type)
 - m. Earphone Connector Type: 3.5 mm (0.138 inch) mini stereo or mono
 - n. Channels Tuned: 72.1, 72.2, 72.3, 72.4, 72.5, 72.6, 72.7, 72.8, 72.9, 74.7, 75.3, 75.4, 75.5, 75.6, 75.7, 75.8, 75.9
- C. The system shall be provided with
- 1. An antenna connector kit that the Installer can use to field assemble the antenna cable using coaxial cable as specified by the equipment manufacturer.
 - 2. An antenna.
 - 3. All required cables.
- D. The Contractor shall accomplish a factory scan of the installation site to determine the proper frequencies for the system (transmitter and receiver).

- E. The Contractor shall provide and install the Assisted Listening System with all accessories required for the complete and fully functional system within this specific facility. The accessories shall include but not be limited to an Antenna Splitter and Mounting package and Boosters for proper receipt of signals from remote antennas. The Contractor shall provide a block diagram as part of his Submittals that identifies all equipment and materials, as well as the specific installed location for each, to confirm the system configuration to be installed as part of this project. The Contractor shall coordinate with the Manufacturer prior to providing Submittals for review.
- F. Provide and install two (2) receivers for each system as shown on the drawings.
- G. Manufacturers
 - 1. Basis of Design
 - a. Telex Soundmate Personal Listening System with ST-300 Transmitter and SR-400 Receivers or acceptable substitution
 - 2. Acceptable Substitutions
 - a. Williams Sound
 - b. Phonic Ear

2.16 VOLUME CONTROLS

- A. Shall be an industry standard, commercial grade Volume Control on a flush mount single-gang stainless steel plate.
- B. Functions and Features
 - 1. A Range of Attenuation Steps (1.5dB or 3dB Steps) as well as Continuous to Meet Application and Budget Requirements
 - 2. Wall Plates are Stainless Steel with Stamped and Filled or Screen Printed Dial Scale, and a Skirted Black Knob.
 - 3. Mounts into Most 1-Gang E.O. Boxes. (2-3/4" Deep)
 - 4. UL Listed
- C. Technical
 - 1. Power Rating: 10, 35, or 100 watts
 - 2. Attenuation Per Step: 3 dB
 - 3. Insertion Loss: No greater than 0.6 dB
- D. Contractor shall provide and install Volume Control with power rating for connected speaker load plus fifty percent spare capacity.
- E. Manufacturers
 - 1. Basis of Design
 - a. Atlas Sound AT Series Volume Controls or acceptable substitution

2.17 SPEAKERS (DESTINATION LOUNGE)

- A. The Speaker shall be a high output, full-range, two-way pendant type loudspeaker to provides superb sound reproduction and very consistent, wide coverage for rooms with open architecture ceilings.
- B. Installation of the Speaker shall be accomplished with a galvanized steel cable affixed to the speaker chassis via an integrated snap hook. For safety redundancy, a secondary steel cable shall be installed.
- C. Technical
 - 1. Frequency Response (-10 dB): 58 Hz – 18 kHz
 - 2. Frequency Range (3 dB): 78 Hz – 16 kHz
 - 3. Power Capacity: 75 Watts continuous pink noise; 150 watts continuous program
 - 4. Sensitivity (dB @ 2.83 V/1 m): 90.0 dB
 - 5. Nominal Coverage Angle: 120 degrees
 - 6. Directivity (Q): 5.7
 - 7. Directivity Index (DI): 7.5 dB
 - 8. Max SPL @ 1 m: 109.0 dB
 - 9. Transformer Taps: 70V – 60W, 30W, 15W, 7.5W
 - 10. Transducer
 - a. Low-Frequency Driver: 6.5 inch polypropylene-coated paper with pure butyl rubber surround, 1 inch copper voice coil, vented fiberglass resin voice coil-former
 - b. High-Frequency driver: 1.0 inch textile soft-dome, neodymium magnet assembly, ferro-fluid cooling, aluminum voice coil former.
 - 11. Regulatory: UL 1480
- D. The Speakers and all hanging hardware shall be black in color.
- E. The Speaker shall include all required hanging hardware. The Contractor shall provide and install structural bracing as necessary to fly the Speaker in the correct location for proper sound reinforcement of the floor area being covered.
- F. The Contractor shall field verify the mounting of the speakers so that they are coordinated with other installed equipment within the space.
- G. Manufacturers
 - 1. Basis of Design
 - a. JBL Control 321CT 12" Coaxial Ceiling Loudspeaker with HF Compression Driver
 - 2. Acceptable Substitutions
 - a. Soundtube Entertainment HP129a High-Power Speaker

2.18 SPEAKERS (CONFERENCE CENTER)

- A. The Speaker shall consist of an 8" full range, point source, constant directivity dual concentric transducer and passive frequency dividing network mounted in a vented, injection molded, paintable front baffle in UL94V-0 ABS material.
- B. The back can shall be constructed of zinc plated steel. A recessed termination box shall be integrated with the back can, a removable locking connector with screw terminals for secure wire termination with loop through facility shall be provided. Strain relief shall be provided by a clamping mechanism for use with plenum rated cable or conduit.
- C. Performance of the Speaker shall meet or exceed the following criteria:
 - 1. The Speaker shall have a conical coverage pattern of 100 degrees (1kHz to 6 kHz).
 - 2. Frequency response measure on axis shall be 40 Hz – 34 kHz (-10 dB from rated sensitivity, measured in an IEC baffle in an anechoic chamber) with no equalization.
 - 3. Sensitivity shall be 92 dB (1W @ 1m).
 - 4. Long term power handling capacity as defined in EIA-426B test shall be 90W, recommended amplifier power 180W. Dynamic high frequency protection shall be provided for occasional overpowering.
 - 5. The nominal system impedance shall be 8 Ohms (in low impedance setting).
- D. The Speaker shall be equipped with a 60W high performance line transformer for use in 70.7 and 100 V distributed audio systems with 60, 30, 15, and 7.5 Watt taps available. An easily accessible rotary switch located on the front baffle shall be available for selecting transformer and low impedance settings. A weather resistant perforated steel grille shall cover the transducer and switch.
- E. Two support rails and one C-ring shall be included with the Speaker.
- F. Manufacturers
 - 1. Basis of Design
 - a. Tannoy CMS 801DC Ceiling Speaker Assembly
 - 2. Acceptable Substitutions
 - a. JBL

2.19 CABLE

- A. Microphone Cable:
 - 1. Two (2) conductor, 20 (19 x32) AWG, high-strength custom alloy, TV braid shield (85% coverage), 11.5 ohm per 1000 feet, EPDM jacket with nominal O.D. of .262 inch.
 - 2. Manufacturers

a. Basis of Design:

- 1) Belden #1776 Microphone Cable or acceptable substitution

B. Line Level Cable:

1. The speaker cable shall be a power-limited type suitable for sound and audio applications.
2. Two (2) conductor, 22 AWG Solid, tinned copper, 17.5 ohm per 1000 feet, overall 75 degree PVC jacket with a nominal O.D. of .118 inch, 22 AWG solid drain wire. UL Listed NEC Type CM; constructed in accordance with UL Standard 444; complies with UL 1581 Vertical Tray Flame Test; meets 300 volt requirements as specified in Section 800-51 of the NEC.
3. Manufacturers:

a. Basis of Design

- 1) West Penn #450

b. Acceptable Substitutions

- 1) Belden
- 2) CommScope

C. Speaker Cable:

1. The speaker cable shall be a power-limited type suitable for sound and audio applications.
2. Two (2) conductor minimum 16 AWG, UL Listed NEC type CL2, complying with UL 1581 Vertical Tray Flame Test, bare copper, nominal DCR of 4.2 Ohms per 1000 feet, with PVC insulation with nylon, and short overall twist lengths.
3. The Contractor shall increase the size of speaker cables as necessary for the connected speaker load.
4. Manufacturers

a. Basis of Design

- 1) West Penn #C205

b. Acceptable Substitutions

- 1) Belden
- 2) CommScope

D. Category 6 Cable

1. Category 6 cable required for Audio Systems shall be provided and installed by the Audio System Installer. Refer to Section 16710 for cable specifications.

E. Fiber Optic Cable

1. Fiber Optic cable required for the Audio System shall be per Section 16751.

PART 3 - EXECUTION

3.1 COMPLY WITH REQUIREMENTS OF SECTION 16701

3.2 GENERAL

- A. Equipment and materials shall be installed in accordance with manufacturer's installation instructions.
- B. The Vendor shall tune the installed system for the room being utilized. Accessories required to achieve this response are to be considered a part of the contract.
- C. Upon completion, the system shall be clean and in good operating condition. There shall be no evidence of audible components of hum, noise or distortion.
- D. Loudspeaker grills shall be installed with hardware matching the color of the grills, Grill color to match ceiling color.
- E. Loudspeaker grills shall be flush against the ceiling and enclosures shall be supported from the structure above.
- F. Infrared receivers shall be mounted on the ceiling to a flush outlet box.

3.3 TESTING

- A. Comply with the requirements of Section 16701.
- B. Sound Reinforcement Systems
 - 1. Equalization
 - a. The purpose of the equalization is to adjust the acoustic amplitude response of the Audio system to a specified uniformity measured throughout the entire audience area. This adjustment is made to realize maximum acoustic gain and optimum tonal balance from the Audio system throughout the audience area and stage monitoring area.
 - b. Instrumentation: Provide the following minimal standard laboratory test equipment. Any substitutions or additions to the following list must be accepted by the Designer.
 - 1) Impedance Bridge.
 - 2) Audio Oscillator.
 - 3) Random-noise generator.
 - 4) Precision sound level meter.
 - 5) Octave real-time audio frequency analyzer.
 - 6) Oscilloscope.
 - 7) Sound level calibrator.
 - 8) Master equalizer set with broad band (i.e. full octave) and narrow band (i.e. 1/3 octave), high-pass, and low-pass filters, plus comparator switch and attenuator.
 - 9) Digital camera.

- c. Inspection of Audio System Prior to Equalization:
- 1) Prior to undertaking equalization of the Audio System, perform the following inspections on the Audio System, and submit to the Designer the written results of each inspection for inclusion on the permanent records of the Audio System.
 - 2) Measure and record the impedance of each loudspeaker line before connecting it to the output of its respective amplifier. The load impedance shall be equal to or greater than the rated impedance. Record the total impedance.
 - 3) Measure and record the output impedance of each active device operating as a source to any passive device or series of passive devices. Record the dc resistance of any buildout resistor used.
 - 4) Measure and record the input impedance of any active device used to terminate passive devices, and record the total impedance of all such devices. Record the dc resistance of any terminating resistor used.
 - 5) Measure and record the acoustic distribution of the loudspeakers in the Audio System throughout the entire seating area. Record the location of all positions in the seating area where any 1/3 octave band, from 250 to 5000 Hz. deviates more than 3 dB from the desired house curve.
 - 6) Measure and record the polarity of all microphones to be used in the system.
 - 7) Measure and record, with an oscilloscope, the output of each power amplifier. The input source to each amplifier being measured shall be a sinewave oscillator with less than 0.5% THD adjusted to 10 dB less than full power output of the amplifier. Inspect the output sinewave appearing on the oscilloscope of complete freedom from hum, noise, parasitic oscillation and RF interference.
 - 8) Measure and record the frequency response of each mixer preamplifier and power amplifier in the system.
- d. Microphone Proximity Instability: Suppress the tendency of the Audio System microphone to become unstable when approached by a talker. Identify the 1/3 octave band affected by the approach of a person, and provide enough attenuation to ensure stability. Records shall be made of additional attenuation provided.

2. Documentation of Tests, Measurements, and Adjustments Performed:

- a. List of personnel and certified test equipment used.
- b. Impedance of all loudspeaker lines.
- c. Output impedance of all active sources connected to passive devices and the value of any buildout resistor used.
- d. The input impedance of all active devices used to terminate passive devices and the value of any termination resistor used.
- e. The variation of acoustic distribution throughout the seating area above and below a reference level at each 1/3 octave center frequency from 20 to 5000 Hz.

- f. The recorded polarity of the loudspeakers.
- g. The documented information for all settings in the audio mixer / processor.
- h. The list of microphones tested.
- i. The recorded inspection results observed for hum, noise, parasitic oscillation, and RF interference from the output of each power amplifier.
- j. All DSP settings.

END OF SECTION 16741

SECTION 16751 - VIDEO SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Division 16 Section 16701 "Common Work Results for Communications".
- B. In addition to the requirements of Section 16701 comply with the following additional requirements:
 - 1. Standards, Codes, References, And Regulatory Requirements
 - a. The equipment and installation shall comply with the current or applicable provisions of the following standards, codes, references, and regulatory requirements:
 - 1) Sound System Engineering by Don & Carolyn Davis (2nd Edition, Published by Howard W. Sams & Co., Inc.)
 - 2) UL 1410 - Television Receivers and High-Voltage Video Products
 - 3) UL 1419 - Professional Video and Audio Equipment
 - 4) UL 1492 - Audio-Video Products and Accessories
 - 2. Submittals
 - a. Shop Drawings: The Contractor shall provide complete shop drawings showing how he intends to install the Video system. Shop drawings shall, as a minimum, include the following:
 - 1) A point-to-point wiring diagram showing:
 - a) All system equipment, cabling, interconnections to other systems, etc.
 - b) Identifiers for the various types of cable to be used. This shall include a matrix that identifies the manufacturer, model number and descriptive identifier for each cable
 - c) Quantity of cables in each conduit
 - d) Signal type: Provide signal type designation on all cables. Signal type shall be identified in a fashion similar to that on the contract drawings (e.g. RGBHV, S-Video, Composite, etc. for video; and data, RS-232, etc. for control).
 - 2) A plan showing how the Contractor intends on installing system conduits to provide an organized layout at the Video Equipment Cabinet for separation of conduits by signal type and signal level. Where installed with audio system equipment the Contractor's

- submittals shall show coordination between equipment and cabling.
- 3) Plan view drawings for the Video Equipment Cabinets showing cable entrance areas for the various signal types. If necessary, the Contractor shall show both bottom and top plan views in order to clearly show how cables enter cabinets and maintain proper separation.
3. Spare Capacity
 - a. The Contractor shall provide and install Video system equipment and materials in quantities that will provide the Owner with twenty percent (20%) spare capacity (e.g. termination points, jacks, ports, etc.) after connection of all circuits as required by the contract documents.
 4. Extra Materials
 - a. Provide two (2) extra of each type of system patch cord.

1.2 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete Video Systems, as described herein and shown on the drawings, providing the following:
 1. The pickup, processing, distribution, and reproduction of video program material from various video sources.
 2. Control of various equipment as outlined herein and shown on the drawings.
- B. System to include but not be limited to:
 1. Support
 - a. Equipment Cabinet
 - b. Power Sequencer
 2. Video
 - a. Flush, wall mounted outlet plates with appropriate connectors for equipment to be connected.
 - b. Fiber Optic Transmitters and Receivers
 - c. Video Patch Panels
 - d. Fiber Optic Patch Panels
 - e. Fiber Optic to Copper Converters
 - f. HDTV Processor
 - g. HDMI Scalers
 - h. HDMI Audio De-Embedders
 - i. Fiber and Video Matrix Switcher
 - j. Video Wall Processors
 - k. HDMI Distribution Amplifiers
 - l. HDMI Extenders
 - m. Control System

- n. Video Monitors and Structural Wall Mounts
- o. Video Projectors
- p. Video Projector Lift
- q. Video Projection Screen
- r. Video Cables (System cabling, patch cords, etc.)
- s. Video Patch Cords

1.3 FUNCTIONS AND OBJECTIVES

- A. The design and configuration of the Video System as installed shall allow all source signals to be routed to all target devices.
 - 1. Provide video capture from source devices
 - 2. Provide video distribution to target devices
 - 3. Provide routing and switching as necessary to send video signals through system to and from various points to meet the design intent.
 - 4. Provide video distribution to remote locations as indicated in the drawings and outlined within these specifications.
 - 5. Provide routing and switching of audio signals as required for interfacing the Video System with the Audio System.

1.4 ALTERNATES

- A. Additive Alternate #2: All work associated with Conference Center (S222A).

1.5 SPECIAL REQUIREMENTS

- A. The Contractor shall provide and install all equipment, materials, programming, testing, and labor necessary to provide and install a complete and fully functional system whether or not specifically shown on the drawings or called out herein. Claims for additional equipment and materials not called out in the contract document shall not be allowed.
- B. The equipment cabinets for the Video System equipment have been specified in Section 16741. The Contractor shall coordinate installation of equipment and materials for both systems as shown on the drawings.
- C. Outlet faceplates installed above the ceiling shall be black and have black inserts. Outlet faceplates installed on walls shall be white and have white inserts.
- D. All fiber optic equipment shall be singlemode to allow direct interface with the Owner's existing facility fiber optic infrastructure.
- E. The Contractor shall be responsible for programming services associated with touch screens associated with the AV Control System. In general the Control System shall provide full capability associated with all equipment to which it is interconnected as shown on the drawings. The Contractor shall, as part of his submittals, provide a detailed list recommending the functions and features for the Control System organized by touch screen page in a logical manner that clearly outlines his recommendations as to the organization of the touch screens as a group and each screen's individual layout showing all functions and features (i.e. buttons, controls, and other interactive items).

The Designer will review the submittal information and provide comments in regard to revisions to the Contractor's recommendations. The Contractor shall take the resulting information and prepare draft layouts for each touch screen page and provide a single PDF file with all touch screen pages generally in the order in which they would appear on the touch screen for review by the Designer and the Owner. After the Designer and Owner have reviewed the drawings touch screen pages a meeting will be scheduled to review and discuss required changes with the Contractor and system Installer. Based on the results of the meeting, the Contractor shall prepare the preliminary Control System programming and, once the AV and Control System are functional, shall install the programming and put the system into a functional state. Once the touch screen programming is functional the Contractor shall request a 2nd meeting with the Owner and Designer to review the actual operation of the Control System. The Contractor shall make final adjustments to the Control System and touch screen programming based on that meeting and complete all work prior to requesting the Substantial Completion inspection for the project. During the Substantial Completion inspection the Contractor shall be prepared to demonstrate to the Owner and the Designer that all items regarding the system operation and programming and been properly completed.

PART 2 - PRODUCTS

2.1 GENERAL EQUIPMENT AND MATERIALS

A. FLOOR MOUNT EQUIPMENT CABINET

1. Refer to Section 16741. All Video equipment shall be installed in the same equipment cabinets as the Audio System equipment. Refer to the drawings.

2.2 FIBER OPTIC AND VIDEO OUTLET PLATES

A. Faceplate

1. Shall be single or 2-gang mini-architectural adapter plates configured as required for each individual location and quantity of connectors to be installed.
2. Shall accept a variety of inserts to allow connectivity as necessary for the circuits and devices as shown on the drawings.
3. Shall be designed for installation on wall, lectern, table, or other A/V presentation furniture.
4. Shall be available in white and black.

B. Inserts

1. Shall be mounting plates designed to work with the specified faceplates. Shall include a variety of mounting plates with various connectors including but not limited to:
 - a. Video (composite, component, S-video, VGA, HDMI, DVI, SDI, etc.), Audio (XLR, phono jack, RCA jack, etc.), Telephone, Data, Computer, and Control Connectors.

2. Empty slots in faceplates shall be provided with blank plates of the same color as the faceplate.
3. Shall be available in white and black. Inserts shall be the same color as the faceplate.
4. Shall be installed as shown in the drawings.

C. Manufacturers

1. Basis of Design
 - a. Extron MAAP Mounting Frames and MAAP Mini-Architectural Adapter Plates or acceptable substitution

2.3 FIBER OPTIC VGA EXTENDERS

- A. The Fiber Optic VGA Extender (FOVE) shall be a transmitter and receiver set for long haul transmission of high resolution VGA or HD component video, audio, and RS-232 control signals over a single fiber. The FOVE shall be engineered for reliability and exceptional high resolution image performance. It shall use all digital technology to deliver perfect pixel-for-pixel transmission of computer-video images up to UXGA (1600 x 1200) resolution. It shall be designed specifically for A/V system and shall include a host of integrator-friendly features such as image adjustments and calibration, dual RGB and audio outputs at the receiver, RS-232 control from multiple locations, rack-mount capability, and real-time system monitoring.

B. Features

1. Daisy-chain capability
2. Real-time status LED indicators for troubleshooting and monitoring
3. Alarm notification for fiber link loss
4. Auto Input Memory
5. RS-232 control of transmitter and receiver
6. Shall be capable of processing video, audio, and RS-232 signals

C. Technical

1. Optical
 - a. Operating Distance (Singlemode): 30 km
 - b. Nominal Peak Wavelength: 1310 nm for SM
 - c. Data Rate: 4.25 Gbps
 - d. Transmission Power (Singlemode): -5 dBm, typical
 - e. Maximum Receiver Sensitivity (Singlemode): -18 dBm, typical
 - f. Optical Loss Budget (Multimode): 13 dB, maximum
2. Audio/Video
 - a. Number/Signal Type: 1 VGA-UXGA RGBHV, RGBS, RGsB, RsGsBs input; 1 VGA-UXGA RGBHV, RGBS, RGsB, RsGsBs loop-through
 - b. Maximum Resolution: 1600 x 1200 or 1080p @ 60 Hz, digitized pixel for pixel, higher resolutions up to 2048 x 1120, undersampled

- c. Video Output Delay: 1-2 Frames
 - d. Audio Output Delay: 1.5 frames
- D. The Contractor shall provide two (2) pairs of extenders for the Owner's use in transmitting signals across the fiber Infrastructure within the Destination Lounge.
- E. Manufacturers
- 1. Basis of Design
 - a. Extron FOXBOX VGA Fiber Optic Extender or acceptable substitution

2.4 FIBER OPTIC DVI EXTENDERS

- A. The Fiber Optic DVI Extender (FODE) shall be a transmitter and receiver set for long haul transmission of DVI, audio, and RS-232 control signals over a single fiber. The FODE shall be engineered for reliability and exceptional high resolution image performance. It shall use all digital technology to deliver perfect pixel-for-pixel transmission of DVI computer-video images as well as HDTV. IT shall include an EDID emulation mode, Auto Input Memory, RS-232 control from multiple locations, internal test patterns, and real-time system monitoring.
- B. Features
- 1. Daisy-chain capability
 - 2. Real-time status LED indicators for troubleshooting and mentoring
 - 3. Alarm notification for fiber link loss
 - 4. Auto Input Memory
- C. Technical
- 1. Optical
 - a. Operating Distance (Multimode): 30 km
 - b. Nominal Peak Wavelength: 1310 nm for SM
 - c. Data Rate: 4.25 Gbps
 - d. Transmission Power (Singlemode): -5 dBm, typical
 - e. Maximum Receiver Sensitivity (Singlemode): -18 dBm, typical
 - f. Optical Loss Budget (Singlemode): 13 dB, maximum
 - 2. Audio/Video
 - a. Video Resolution Range: Up to 1920x1200 or 1080p @ 60Hz pixel for pixel on all signal types.
 - b. Video Delay: 1-2 frames
- D. The Contractor shall provide two (2) pairs of extenders for the Owner's use in transmitting signals across the fiber Infrastructure within the Destination Lounge.
- E. Manufacturers

1. Basis of Design
 - a. Extron FOXBOX DVI Series Optic Extender or acceptable substitution

2.5 Fiber Optic HDMI Extenders

A. The Fiber Optic HDMI Extender (FOHE) shall be a transmitter and receiver set for long haul transmission of HDCP-compliant HDMI video, stereo audio, and RS-232 control signals over fiber optic cabling. The FOHE shall be engineered for reliability and exceptional high resolution image performance. It shall use all digital technology to deliver perfect pixel-for-pixel transmission of HDMI computer-video images up to WUXGA (1920 x 1200) resolution including HDTV 1080p/60.

B. Features

1. HDCP compliant
2. All digital technology provides pixel-for-pixel performance with signals up to 1920x1200, including HDTV 1080p/60
3. Key Minder continuously verified HDCP compliance
4. EDID Minder automatically manages EDID communication between connected devices
5. HDMI 1.3 compatible
6. Buffered HDMI input loop-through
7. Audio embedding with gain, attenuation, and muting control.

C. Technical

1. Optical
 - a. Operating Distance (Multimode): 1 km (3280') with 50 µm multimode cable
 - b. Data Rate: 4.25 Gbps
 - c. Transmission Power (Multimode): -5 dBm, typical
 - d. Maximum Receiver Sensitivity (Multimode): -12 dBm, typical
 - e. Optical Loss Budget (Multimode): 7 dB, maximum
2. Video Resolution Range: Up to 1920x12 or 1080p # 60 Hz
3. Standards
 - a. EDID: Supports emulation of custom or factory present EDID tables
 - b. HDCP: Compliant with high-bandwidth digital content protection (HDCP) using DVI and HDMI 1.3 standards.

D. Manufacturers

1. Basis of Design
 - a. Extron FOXBOX Tx/Rx HDMI Fiber Optic Extender or acceptable substitution

2.6 Fiber Optic SDI Extenders

A. The Fiber Optic SDI Extender (FOSE) shall be a device for long haul transmission of multi-rate SDI video, with embedded audio and metadata, over a single fiber. The FOSE shall be engineered for reliability and exceptional high resolution image performance, it shall use all digital technology to transmit multi-rate SDI signals up to 2.97 Gbps including SDI, HD-SDI, and 3G-SDI. Input signals shall be automatically equalized and output signals shall be reclocked. The FOSE shall function as a transmitter and a receiver in various user-configurable modes. It shall be ideally suited for use in digital signage, broadcast and production, rental and staging, and medical applications.

B. Features

1. Extends SDI, HD-SDI, and 3G-SDI signals very long distances over a single fiber.
2. Input equalization and reclocking on buffered outputs
3. Immunity to SDI and HD-SDI pathological signal patterns
4. Dual buffered outputs
5. Daisy-chain capability.
6. Real-time status LED indicators for troubleshooting and monitoring.

C. Technical

1. Optical
 - a. Operating Distance (Singlemode): 30 km
 - b. Transmission Power (Singlemode): -5 dBm, typical
 - c. Maximum Receiver Sensitivity (Singlemode): -18 dBm, typical
 - d. Optical Loss Budget (Singlemode): 13 dB, maximum
2. Video: HD-SDI, SDI, and 3G-SDI digital video signals
3. Data Rates: 270 Mbps, 1.485 Gbps, 2.970 Gbps
4. Operation Standards: SMPTE 259M-C, SMPTE 292M, SMPTE 424M, ITU-R BT.601, ITU-R BT.1120
5. Auto Data Rate Lock: Yes
6. Video Transmitter Signals: One (1) single link SDI, HD-SDI, or 3G-SDI digital component video
7. Video Receiver Signals: Two (2) single link SDI, HD-SDI, or 3G-SDI digital component video
8. Reclocking: Automatic for 270 Mbps, 1.485 Gbps, 2.97 Gbps, or bypassed for unrecognized rates.

D. Manufacturers

1. Basis of Design
 - a. Extron FOX 3G HD-SDI Fiber Optic Extender or acceptable substitution

2.7 FIBER OPTIC PATCH PANELS

A. Modular panels housing multiple-numbered, duplex cable connectors.

- B. Shall support of 10 Gbps transmission speeds
- C. Number of Connectors per Field: As shown on the drawings. Include quantity necessary for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- D. Shall be fully loaded with LC connectors as shown on the drawings.
- E. Durable metal construction with mounting for standard EIA 19" equipment racks/cabinets.
- F. Shall include cable entry holes on top, bottom and sides
- G. Shall include removable hinged front and rear doors.
- H. Provide rack mounted or wall mounted as shown on the drawings.
- I. Manufacturers:
 - 1. Basis of Design
 - a. Siemon 10Gb/s XGLO RIC3 Interconnect Center
 - 2. Acceptable Substitutions
 - a. Ortronics
 - b. Hubbell

2.8 FIBER OPTIC PATCH CORDS

- A. Shall be by the same Manufacturer as the Fiber Optic Patch Panels.
- B. Shall be provided with the same connector type as the Fiber Optic Patch Panel.
- C. Shall meet the same specifications as the backbone Fiber Optic cable being installed as part of this project.
- D. Shall be of lengths necessary to meet the requirements of the project.
- E. Contractor shall provide twenty-four (24) duplex Fiber Optic Patch Cords for use as part of the Video System.
- F. Manufacturers:
 - 1. Basis of Design
 - a. Siemon
 - 2. Acceptable Substitutions
 - a. Ortronics
 - b. Hubbell

2.9 FIBER OPTIC SCALING RECEIVER

- A. Shall be a high performance fiber optic-to-HDMI scaling receiver (FOSR) for use with fiber optic transmitters. It shall accept a fiber optic signal with HDCP-compliant HDMI, DVI, VGA, or component video, stereo audio, and RS-232 control from a fiber optic transmitter, scaling the video to the optimal output resolution. The FOSR shall be engineered for reliability and exceptional high resolution image performance; it shall support resolutions up to 1920 x 1200, including HDTV 1080p/60. It shall also provide many integrator-friendly features such as EDID minder, audio de—embedding, auto input memory, and internal test patterns.
- B. Features
1. Accepts fiber optic signals from fiber optic transmitters and provides scaled HDMI video, stereo audio, and RS-232 control signals.
 2. High performance scaler providing selectable output resolutions up to 1920 x 1200, including HDTV 1080p/60.
 3. HDMI 1.3 compatible
 4. HDCP compliant
 5. Key minder continuously verifies HDCP compliance for quick, reliable switching
 6. HDMI, DVI, RGB, and HD component video upscaling and downscaling
 7. HDMI audio de-embedding with analog stereo outputs.
- C. Technical
1. Operating Distance (Singlemode): 30 km
 2. Data Rate: 4.25 Gbps
 3. Transmission Power (Singlemode): -5 dBm, typical
 4. Maximum Receiver Sensitivity (Singlemode): -18 dBm, typical
 5. Optical Loss Budget (Singlemode): -18 dB, maximum
 6. Resolution Range: Up to 1920x1200 or 1080p @ 60 Hz pixel for pixel
 7. EDID: Supports emulation of custom or factory preset Extended Display Identification Data (EDID) tables.
 8. HDCP: Compliant with High –bandwidth Digital Content Protection (HDCP) using DVI and HDMI 1.3 standards.
 9. Video Delay: 1-2 frames
 10. Vertical Frequency: 24 Hz, 25 Hz, 30 Hz, 50 Hz, 60 Hz, or 75 Hz, depending on selected output resolution
 11. Audio Delay: 1.5 frames.
- D. Manufacturers
1. Basis of Design
 - a. Extron FOXBOX SR HDMI Fiber Optic Scaling Receiver or acceptable substitution

2.10 FIBER OPTIC SDI to RGB/DVI CONVERTER

- A. Shall be a device that receives fiber optic SDI, HD-SDI, and 3G-SDI serial digital video signals, converting them to DVI-D and analog RGB or component video. It shall feature

extraction of embedded AES3 audio, RS-232 serial control, and a fiber optic input loop-through that allows multiple units to be daisy-chained. It shall be designed for applications including TV production, medical imaging, military simulation, churches, and live events that require long distance transmission of SDI signals from broadcast-type sources and interfacing them with professional/consumer level devices.

B. Features

1. Accepts fiber optic multi-rate SDI signals up to 2.97 Gbps
2. Shall be compatible with fiber optic extenders and other equipment provided as part of this project.
3. Simultaneous DVI-D and analog RGB/component video outputs
4. Daisy-chain capability
5. AES3 audio de-embedding
6. Audio gain and attenuation control
7. Internal test patterns for calibration and setup
8. Output muting control
9. RS-232 control port

C. Technical

1. Operating Distance (Singlemode): 30 km
2. Transmission Power (Singlemode): -5 dBm, typical
3. Maximum Receiver Sensitivity (Singlemode): -18 dBm, typical
4. Optical Loss Budget (Singlemode): -13 dB, maximum
5. Video Output: One (1) single link DVI-D; One (1) RGB, TUV/YPbPr

D. Manufacturers

1. Basis of Design
 - a. Extron FOX 3G DVC Fiber Optic Multi-Rate SDI to DVI and RGB/Component Converter or acceptable substitution

2.11 HDTV PROCESSOR

- A. Shall be an agile analog heterodyne processor that accepts one analog RF input (CATV sub-band channels T7-T13, CATV standard channels 2-134, VHF channels 2013, and UHF channels 14-69) and delivers one analog RF output (CATV standard channels 2-135); accepts one digital cable QAM input (CATV sub-band channels T7-T13, and CATV standard channels 2-135) and delivers one digital cable QAM output (CATV standard channels 2-135); accepts one digital off-air 8VSB or digital cable QAM input (CTV standard channels 2-135, VHF channels 2-13, and UHF channels 14-69) and delivers one analog RF output (CATV standard channels 2-135). It shall be equipped with EAS interface which can also be used as an IF (Intermediate Frequency) input. It shall support closed captioning (EIA-608)

B. Technical

1. Input:

- a. Connector: "F" female
- b. Analog Mode:
 - 1) Standard: NTSC
 - 2) Tuning: CATV 2-135, Broadcast 2-69, Sub T7-13
 - 3) Bandwidth: 6 MHz
 - 4) Power Level: -20 to +30 dBmV
- c. QAM Mode
 - 1) Standard: ITU-T J.83 – Annex B
 - 2) Tuning Range: CATV Ch. 2-135, T7-T13
 - 3) Data Rate: 38.8 Mbps or 26.97 Mbps
 - 4) Bandwidth: 6 MHz
 - 5) Power Level -20 to +3- dBmV
- d. QAM/8VSB Mode
 - 1) Standard: 8VSB AtSC Digital Television A/53E; ITU-T J.83 – Annex B
 - 2) Tuning Range: 8VSB VHF, UHF; QAM CATV Ch. 2-135, T7-T13
 - 3) Data Rate: 8VSB: 19.392 Mbps; 38.8 Mbps or 26.97 Mbps
 - 4) Bandwidth: 6 MHz
 - 5) Power Level -20 to +3- dBmV

2. Output

- a. RF Output: "F" Female
- b. Frequency Range: 54 to 864 MHz
- c. Channels: UHF, VHF, CATV
- d. Power Level: +55 to +60 (dependent on Mode)
- e. Power Level Range (+45 to +62 dBmV (dependent on Mode)
- f. Broadband Noise: -75 to -77 dBc (dependent on Mode)
- g. Spurious: -63 dBc
- h. Impedance: 75 ohms
- i. Return Loss: 15 dB
- j. Aural/Visual Carrier Ratio: -15 dB +/- 2

C. Manufacturers

1. Basis of Design

- a. Blonder-Tongue AP-60-860A Agile Processor or acceptable substitution

2.12 HDMI SCALER

- A. Shall be a compact video scaler that accepts a wide variety of video formats including HDMI, HDTV, RGB, and standard definition video.
- B. Features

1. HDMI, RGB, HDTV, and video scaling to HDMI
2. Auto-switching between inputs
3. HDMI audio embedding
4. Advanced scaling engine with 30-bit processing and 1080i deinterlacing
5. HDCP compliant
6. Supports DMI specification features including data rates up to 6.75 Gbps, Deep Color, and HD lossless audio formats
7. EDID minder
8. Aspect ratio control
9. HDCP visual confirmation providing a green signal when encrypted content is sent to a non-compliant display
10. Seamless switching
11. Frame lock
12. Image freeze control
13. Auto-Image setup
14. Output standby mode
15. Power save mode
16. Automatic 3:2 and 2:2 pulldown detection.
17. Quad standard, 3D composite video decoding
18. Internal test patterns for calibration and setup
19. Audio switching transitions
20. Front panel security lockout
21. RS-232 control port
22. Front panel USB configuration port.

C. Technical

1. Video Input Number/Signal Type: One (1) Composite; One (1) RGBHV/YUV; One (1) HDMI/DVI
2. Video Resolution Range: 640x480 to 1600x1200 NTSC, PAL, SECAM, 480p, 576p, 720p, 1080i, 1080p, and 2K
3. Video Processing Analog Sampling: 12 bits per color; 13.5 MHz standard (video); 170 MHz standard (RGB)
4. Video Processing Digital Pixel Data Bit Depth: 8, 10, 12 bits per channel; 165 MHz pixel clock (HDMI)
5. Video Output: One (1) HDMI
6. Audio
 - a. Frequency Response: 20 Hz to 20 kHz
 - b. THD + Noise: <0.1% @ 1 KHz
 - c. S/N: > 90 dB at maximum output
7. Control: One (1) bidirectional RS-232; One (1) USB

D. Manufacturers

1. Basis of Design
 - a. Extron DSC 301 HD Three Input Compact HDCP-Compliant Video Scaler or acceptable substitution

2.13 HDMI AUDIO DE-EMBEDDER

- A. Shall be an audio de-embedder that extracts the audio from the HDMI signal and provides outputs for analog stereo and digital S/PDIF audio. It shall support data rates up to 6.75 Gbps for compatibility with HDMI 1.3 Deep Color. It shall be HDCP compliant and compatible with HDTV 1080p/60 or computer-video resolutions up to 1920x1200.
- B. Features
 - 1. De-embeds audio with or without DMI output connected.
 - 2. EDID minder automatically manages communication between connected devices.
 - 3. Automatic input cable equalizations
 - 4. Comprehensive, real-time status LED indicators for troubleshooting and monitoring
 - 5. Front panel USB configuration port.
- C. Technical
 - 1. Video
 - a. Maximum Data Rate: 6.75 Gbps
 - b. Maximum Pixel Clock: 225 MHz
 - c. Resolution Range: Up to 1920x1200 or 1080p @ 60 Hz, 12-bit color
 - d. Formats: RGB and RCBcCr digital video
 - e. Standards: DVI 1.0, HDMI 1.3, HDCP 1.2, EDID 1.3
 - 2. Video Input: One (1) single link HDMI on female HDMI type A connector
 - 3. Video Output: One (1) single link HDMI on female HDMI type A connector
 - 4. AudioS/N: >90 dB, balanced.
 - 5. Maximum Level: >16 dBu, balanced, 7.8 dBv, unbalanced
 - 6. Impedance: 75 ohms
- D. Manufacturers
 - 1. Basis of Design
 - a. Extron HAE 100 HDMI Audio De-Embedder or acceptable substitution

2.14 FIBER & VIDEO SWITCHER

- A. Shall be a modular, field-configurable matrix switching card cage frame design that allows for multi-pane matrix switchers to be combined in multiple, independent digital and analog matrix switchers. Configuration shall include the selection and installation of matrix cards in the most common signal types and I/O sizes. Available matrix cards shall include:
 - 1. DVI
 - 2. HDMI
 - 3. USB

4. 3G HD-SDI
 5. Fiber Optic
 6. Wideband RGB
 7. VGA
 8. S-Video
 9. Composite Video
 10. Stereo Audio
- B. It shall support up to ten (10) independent matrix switchers, all under a single point of control. It shall be available in four sizes: 2 RU, 3 RU, 4 RU, and 5 RU providing four, six, eight and ten matrix board slots respectively.
- C. Features
1. Shall include RS-232 and Ethernet control capabilities
 2. Back-lit Input/Output Selection Buttons
 3. Configuration Port
 4. Hot-Swappable Back Plane
- D. Technical
1. Card Cage
 - a. Control/Remote
 - 1) Serial Host Control Port: One (1) bidirectional RS-232 or RS-422, rear panel 9-pin female D connector
 - 2) Baud Rate and Protocol: 9600, 19200, 38400, 115200, adjustable; 8 data bits, 1 stop bit, no parity
 - 3) Ethernet: One (1) RJ-45 female jack for 10/100 Base-T, half/full duplex with autodetect
 - 4) Ethernet Protocol: ARP, DHCP, ICMP (ping), TCP/IP, Telnet, HTTP, SMTP
 - 5) Web Server: Up to 200 simultaneous sessions; 7.0 MB nonvolatile user memory
 - 6) Program Control: Control/configuration program for Windows included
 2. Matrix Cards
 - a. HDMI
 - 1) HDCP compliant
 - 2) Supports HDMI specification features including data rates up to 6.75 Gbps, Deep Color up to 12-bit, 3D, and HD lossless audio formats.
 - 3) EDID Minder to ensure that all sources power up properly and reliably output content to the displays
 - 4) Key Minder continuously authenticates HDCP-compliant input and output devices to ensure quick and reliable switching

- 5) Automatic cable equalization for each input to 100 feet at 1920 x 1200/ 8-bit color
 - 6) Automatic output reclocking to enable signal transmission over long cables
 - 7) +5VDC, 250 mA power on each output for external devices.
- b. Fiber Optic
- 1) Fully compatible with fiber optic extenders being provided as part of this project.
 - 2) High speed digital switching up to 4.25 Gbps
 - 3) Input video signal detection
 - 4) Alarm notification for input fiber link loss
 - 5) Industry standard LC connectors
 - 6) Singlemode
3. Regulatory Compliance: CE, c-UL, UL
 4. MTBF: 30,000 hours
 5. Warranty: 3 years parts and labor

E. Manufacturers

1. Basis of Design

- a. Extron SMX System Multimatrix Modular Multi-Plane Matrix Switcher with Fiber Optic and HDMI Matrix Cards or acceptable substitution

2.15 VIDEO WALL PROCESSOR

- A. Shall be an HDCP-compliant, scalable, expandable videowall processor configurable to support a variety of input, output, and windowing capabilities. It shall feature high performance video caling capable of producing very high quality images. It shall have various card cage options that support various combinations of input and output cards for HDMI, DVI, RGB, HDTV or video sources.

B. Features

1. Scalable videowall processing
2. HDCP-compliant input/output options
3. HDCP visual confirmation
4. Key Minder continuously verifies HDCP compliance for quick, reliable switching
5. High speed, dedicated video/graphic bus delivering real-time performance
6. Flexibility to support a variety of input and output configurations.
7. Dual HDMI/DVI output card supports resolutions up to 1920x1200 and HDTV 1080p/60
8. Up to 128 video/graphic windows per dual output card
9. Dual input card for HDMI or DVI graphics and video
10. High quality image upscaling and downscaling
11. Supports digital and analog input signals up to 1920 x 1200
12. Includes configuration and control software

C. Technical

1. Video Input Card (HDMI)

- a. Number/Signal Type: Two (2) single link HDMI
- b. Connectors: 2 female HDMI type A
- c. Signal Type: Single link HDMI (or DVI)
- d. HDCP: Compliant with HDCP using DVI and HDMI 1.3 standards.
- e. Resolution Range: 640x480 to 1920x1200, 480p, 575p, 720p, 1080i, or 1080p
- f. Standards: DVI 1.0, HDMI 1.3, HDCP 1.1

2. Video Output Card (HDMI)

- a. Number/Signal Type: Two (2) single link HDMI (HDCP Compliant)
- b. Connectors: 2 female HDMI type A
- c. HDCP: Compliant with HDCP using DVI and HDMI 1.3 standards.
- d. Resolution Range: 640x480 to 1920x1200, 480p, 575p, 720p, 1080i, or 1080p
- e. Standards: DVI 1.0, HDMI 1.3, HDCP 1.1

3. Control

- a. Ethernet Ports: One (1) female RJ-45 connector for control, networked.

D. Contractor shall provide and install frame sized for input and output cards to be installed plus twenty percent (20%) spare capacity of future cards.

E. Contractor shall provide and install input and output cards in quantities as necessary to connect all system inputs and outputs as shown on the drawings and described herein.

F. Manufacturers

1. Basis of Design

- a. Destination Lounge (5x5): Extron Quantum Elite or acceptable substitution
- b. Conference Center (2x2): Extron Quantum Connect or acceptable substitution

2.16 HDMI EXTENDER

A. Shall be an HDMI equalizer for extending HDMI signals beyond suggested maximum distance limit of 45 feet for HDMI cables.

B. Shall be used in conjunction with cables up to 200 feet in length to provide signals at 1080p/60 with 8-bit color minimum. It shall automatically provide the necessary active equalization to ensure optimal image quality with HDTV signals 1080p/60 and high resolution computer-video signals up to 1920 x 1200.

- C. Shall be HDCP compliant ensuring display of content-protected media and interoperability with other HDP-compliant devices.
- D. Features
 - 1. HDMI 1.3 compatible
 - 2. Powered by device at distances up to 125 feet.
 - 3. LED indicator for source signal presence and power
 - 4. Cable lacing brackets
- E. Contractor shall provide and install an HDMI Cable Equalizer on each HDMI cable that exceeds 75 feet in length.
- F. Manufacturers
 - 1. Basis of Design
 - a. Extron HDMI 101 Plus or acceptable substitution

2.17 CONTROL SYSTEM

- A. General
 - 1. Shall be an Audio/Video Control system providing logical, organized control of system components from a single user touchscreen interface with mobile device capability.
- B. Processor
 - 1. Shall be designed for enhanced scalability that affords high-speed, real-time multi-tasking to seamlessly run multiple programs simultaneously. The programming architecture shall allow independently developed device-specific programs to provide Audio and Video system control as shown on the drawings and specified herein.
 - 2. Functions and Features
 - a. Modular programming architecture
 - b. Onboard 1 GB RAM and 4 GB Flash memory.
 - c. Expandable storage up to 1TB
 - d. Rear panel memory card slot
 - e. High-speed USB 2.0 Host port
 - f. Industry-standard wired communications
 - g. Control Subnet – dedicated local network for system devices
 - h. Graphics computer and Web based control
 - i. iPhone, iPad, Android, and Samsung Smart TV control app support
 - j. Enterprise Management software and support
 - k. SNMP support
 - l. Two (2) RS-232/422/485 COM ports with hardware and software handshaking
 - m. Four (4) RS-22 COM ports with software handshaking only
 - n. Eight (8) IR/serial, eight (8) relay, and eight (8) I/O ports

- o. Three built-in control card expansion slots.
 - p. Native BACnet/IP Support
 - q. IEC 61000-4-5 installation Class 4 surge immunity on COM, I/O and network connections.
 - r. Installer setup via front panel, custom software, or Internet Explorer
 - s. Full Unicode (multi-language) support
 - t. Secure access through Active Director integration or standalone account management
 - u. Hardware level security using 802.1x authentication
 - v. IIS v6.0 We Server
 - w. IPv6 ready
 - x. Front panel color LCD display for setup and diagnostics
 - y. Front panel USB computer console port
 - z. Rack Mountable.
3. Technical
- a. Control Engine: Real-time, preemptive multi-threaded/multitasking kernel; transaction-safe extended FAT file system; support up to ten (10) simultaneously running programs.
 - b. Memory
 - 1) SDRAM: 1 GB
 - 2) Flash: 4 GB
 - 3) Memory Card: supports SD and SDHC cards up to 32 GB
 - 4) External Storage: support USB mass storage devices up to 1 TB
 - c. Communications
 - 1) Ethernet: 10/100/1000 Mbps; auto-switching; auto-negotiating; auto-discovery; full/half duplex; industry-standard TCP/IP stack; UDP/IP; CIP; DHCP; SSL; IEEE 802.1X; SNMP; BACnet/IP; IPv4 or IPv6; Active Directory authentication; IIS v6.0 Web Server; SMTP email client
 - 2) Control Subnet: 10/100/1000 Mbps Ethernet
 - 3) USB: 2.0
 - 4) RS-232/RS-485: for 2-way device control and monitoring, all ports support RS-232 up to 115.2k baud
 - 5) IR/Serial: Supports 1-way device control via infrared up to 1.2 MHz or serial TTL/RS-232 up to 115.2k baud.
 - d. Connectors and Card Slots
 - 1) S1-S3 control card expansion slots
 - 2) COM 1-2: 5-pin 3.5 mm
 - 3) COM 3-6: 3-pin 3.5mm
 - 4) IR-Serial Output 1-8: 8-pin 3.5mm
 - 5) Relay Output 1-8: 8-pin 3.5 mm
 - 6) LAN: 8-wire RJ45 jack
 - 7) Control Subnet: 8-wire RJ45 jack
 - 8) USB: Type A female

- 9) Memory: SD memory card slot
 - 10) I/O 1-8: 9-pin 3.5 mm
 - 11) Net: 4-pin 3.5 mm
 - 12) Ground
- e. LCD Display
- 1) Type: TFT active matrix color LCD
 - 2) Size: 2.8" diagonal
 - 3) Resolution: 320 x 240 pixels
 - 4) Functions: Displays configuration menus, control port activity and other system information.
- f. Rack mountable
- C. PoE Data Switch
1. Shall be a 16-port managed Power over Ethernet (PoE) data switch designed and manufactured by the same manufacturer as the Control System Processor to provide network connectivity between system devices and AV system equipment.
 2. Functions and Features
 - a. All ports support 1000 Base-T Gigabit Ethernet
 - b. Provides full PoE (802.3at Type 1) on all ports simultaneously
 - c. Also supports PoE+ (802.3at Type 2) powered devices
 - d. Provides up to 34.2 W per port, 255 W total
 - e. PoE switchable per port via control system
 - f. Auto-negotiating and auto MDI/MDIX
 - g. Layer 2 managed switching functionality
 - h. Port configuration settings for speed and duplex
 - i. LLDP support
 - j. Port mirroring capability
 - k. 32 Gbps switching fabric (non-blocking)
 3. Technical
 - a. Ethernet
 - 1) Ports: Sixteen (16) 10/100/1000 Base-T auto-sensing Gigabit Ethernet w/ PoE
 - 2) Network Standards: IEEE 802.3, 802.3u, 802.3ab, 802.3bc, 702.3af, 802.3at Type 1 and 2
 - 3) Transmission Method: Store-and-Forward
 - 4) MAC Addresses: Up to 4K
 - 5) Switch Fabric: 32 Gbps non-blocking
 - b. Indicators
 - 1) PWR: Green LED
 - 2) LINK/SPEED 1 -16: green/yellow dual-color LED's

- 3) ACT 1-16: yellow LED's
- 4) POE 1-16: green LED's

D. Mobile App

1. Shall be a control application (app) designed to allow an iPhone, iPod, or iPad to be used as a touch screen enabling remote control of the AV control system and its programs.
2. Functions and Features
 - a. Global Connectivity
 - b. Smart Graphics
 - c. Other App Integration
 - d. Streaming Video
 - e. Rava SIP Intercom
3. Technical
 - a. Compatible Devices
 - 1) iPad Air, iPad with Retina display, iPad, iPad 2, iPad mini with Retina display, iPad mini, iPhone (5s, 5c, 5, 4S, 4), iPad touch
 - 2) Video
 - a) Streaming Formats: MJPEG
 - 3) Audio
 - a) Intercom: Supports Rava SIP Intercom
 - b) Audio Feedback Formats: MP3

E. Touchscreen

1. Shall be a 10.1" Touch Screen designed for AV Control applications
2. Functions and Features
 - a. Thin profile and compact footprint
 - b. Widescreen active-matrix color display
 - c. 1280 x 800 WXGA display resolution
 - d. Capacitive touch screen technology
 - e. Smart graphics support
 - f. H.264 streaming video
 - g. Rava SIP intercom and phone technology
 - h. Customizable audio feedback
 - i. Built-in microphone and speakers
 - j. 5 soft-touch capacitive buttons
 - k. Single-wire Ethernet connectivity
 - l. PoE network powered
3. Technical

- a. Touch Screen Display
 - 1) Display Type: TFT Active matrix color LCD
 - 2) Size: 10.1 inch diagonal
 - 3) Aspect Ratio: 16:10 WXGA
 - 4) Resolution: 1280x800 pixels
 - 5) Brightness: 400 nits
 - 6) Contrast: 800:1
 - 7) Color Depth: 24-bit, 16.7 M colors
 - 8) Illumination: Edgelit LED
 - 9) Viewing Angle: 80 degrees all directions
 - 10) Touch Screen: Projected Capacitive
- b. Buttons: Five (5) hard keys
- c. Reset Button
- d. Memory
 - 1) LPDDR2 RAM: 1 GB
 - 2) Flash: 4 GB
 - 3) Maximum Project Size: 512 MB
- e. Graphics Engine: Supports Smart Graphics
- f. Communications: Ethernet

F. Project Performance Requirements

- 1. Contractor shall provide and install data switches, control system modules (internal or external), control system cards, power supplies, and other required equipment in quantities as necessary for a complete and fully functional system to provide the AV system control as shown on the drawings and described herein.
- 2. Contractor shall provide and install Touch Screen where shown on the floor plans and one at the equipment cabinets. The Touch Screen in the public areas of Destination Lounge shall be provided with limited, password protected control intended for use by organizations using the space for meetings, presentations and other temporary or short-term events. The Touch Screen at the equipment cabinets shall be for use by the Owner's staff only and shall provide full, password protected control and access to all system functionality.
- 3. Contractor shall provide and install 16-port Data Switches interconnected as necessary for an aggregate total of sixty-four (64) total ports to be used for interconnection to various pieces of audio and video system equipment.

G. Manufacturers

- 1. Basis of Design
 - a. Crestron PRO3 3-Series Control System with CEN-SWPOE-16 16-Port Managed PoE Data Switches, Control App for Apple iOS, and TSW-1050 10.1" Touch Screen or acceptable substitution

2.18 RACK MOUNT COMPUTER, MONITOR AND KEYBOARD

A. Computer

1. Shall include an Intel i5 or i7 processor, 16 GB or RAM, and a 500 GB hard drive. Hard drive shall include Operating System that is compatible with the Digital Audio Networking Platform System Software. Shall be rack mounted
2. Manufacturers
 - a. Basis of Design
 - 1) Lenovo
 - b. Acceptable Substitutions
 - 1) HP
 - 2) Dell

B. Monitor and Keyboard

1. The Monitor/Keyboard/Mouse Console consisting of a 17" LCD single rail Console with integral KVM Switch.
2. 17" LCD Single Rail Console shall have the following functions and features:
 - a. Support for SunT Native Resolution
 - b. Support for seventeen different keyboard languages
 - c. Bright Active TFT Display
 - d. OSD Functions for LCD Display and KVM Switch
 - e. Durable Keyboard with Touchpad
 - f. LCD Panel protected by tempered glass
 - g. Integration with various KVM switches
3. The KVM Switch shall have the following functions and features:
 - a. KVM Type: PS/2 and USB interface
 - b. Console Port plus one Remote Module
 - c. PC Port Connector: HDDB-15
 - d. PC Ports: 8
 - e. Max Distance (KVM Switch – Host): 32 feet
 - f. Video Resolution: 1920 x 1440 (Local Console); 1280 x 1024 (IP-based remote console)
 - g. IP-Based Remote Module: RJ-45 for 10/100M Ethernet, DB9 male for Modem; Null modem and serial power control; Mini USB 2.0 receptacle.
 - h. Daisy Chaining: Support with both Bus (8-layer) and Tree (2-layer) topologies; DB15 female connector
 - i. Computer Port Selection: On Screen Display (OSD) Menu, Hot Key
 - j. Security: Access Control List (SCL) security function; up to 8 independent controllable computer lists.
 - k. Auto-Scan Intercals: 5 ~ 99 sec.
 - l. Keyboard Emulation: PS/2 or USB
 - m. Mouse Emulation: PS/2 or USB
4. Manufacturers

a. Basis of Design:

- 1) Atlas Soundolier MMK17-RM 17" LCD Console with MMK-KVM8 Modular KVM Switch or acceptable substitution

2.19 VIDEO WALL MONITORS

- A. Owner provided and installed.

2.20 VIDEO WALL MONITOR MOUNTS

- A. Owner provided and installed.

2.21 STAND-ALONE VIDEO MONITOR WITH TUNER

- A. Owner provided and installed.

2.22 STAND-ALONE VIDEO MONITOR WALL BRACKET

- A. Owner provided and installed.

2.23 PROJECTORS

- A. The Video Projector shall be a high-performance video processing/scaling device utilizing the Hollywood Quality Video processor designed for computer signals as well as standard or high-definition video. The Projector shall be a 6000 ANSI lumens projector designed for permanent installations.

B. Features

1. Integrated RJ45 connection for connection to a LAN (10/100 base-T capability)
2. High-speed wireless LAN IEEE 802.11b/g/n capability
3. Extended lamp life with eco mode technology to increase lamp life up to 4000 hours.
4. Power management enabling Projector to automatically turn off when an incoming signal is not detected from any of the inputs.
5. Auto Power On via the RGB (15-pin) input connector when a signal is detected.
6. Carbon savings meter

C. Technical

1. Optical

- a. Display Technology: 0.79" LCD with MLA
- b. Resolution: XGA 1024 x 768 (native); WUXGA 1920 x 1200 (maximum)
- c. Light Output (lumens): 6000
- d. Contrast Ratio: 2000:1 with auto iris
- e. Lamp Type: 330W AC / 264W economy

2. Signal Compatibility / Connectivity

- a. Scan Rate: Horizontal 15-108 kHz / Vertical 48-120 Hz

- b. Supported Video Standards: NTSC, NTSC4.43, PAL, PAL-60, PAL-M, PAL-N, SECAM
 - c. SD/HD Video Signal Compatibility: 1080p, 1080i, 720p, 576p, 576i, 480p, 480i.
 - d. PC Signal Compatibility: VGA, SVGA, XGA, SXGA, SXGA+, UXGA, WUXGA.
 - e. Macintosh Compatible: Yes
 - f. Input/Output Terminals: RGB1 (15 pin; analog), RGB 2 (15 pin; analog), RGB3 (5 BNC, analog), RGB4 (HDMI w/ HDCP; digital), RGB5 (DisplayPort w/ HDCP), Video 1 (RCA), Video 2 (S/Video), Audio (mini stereo), Audio Out, Monitor Out (15 pin)
 - g. External Control: RS-232, IR, Wired LAN, DDC/CI, USB, Wireless LAN
 - h. Sync Compatibility: Separate Sync; Composite Sync; Sync on G
 - i. Networking: RJ-45 and Wireless LAN
 - j. Screen Trigger: Yes
- D. Shall be provided with a lens sized for the installed location
- E. Shall be provided with a remote control
- F. Manufacturers
- 1. Basis of Design
 - a. NEC PA600X Digital Video Projector
 - 2. Acceptable Substitution
 - a. Proxima
 - b. Mitsubishi
- G. Manufacturers
- 1. Basis of Design
 - a. Conference Center: NEC PA Series Professional Installation Video Projector
- 2.24 PROJECTOR LIFT
- A. Type: Electrically operated, scissor type projector lift to lower projector from ceiling storage position for use or service and then retract projector.
 - B. Lift shall consist of housing, ceiling closure, scissor operating mechanism, motor, controls, limit switches, and other components necessary for complete installation. Lift shall be capable of extending seventeen feet (17').
 - C. Operating pan: 3-1/4 by 24 by 26 inches, 11 gauge steel pan with grey powder coat paint finish for attachment of suspended projector.

- D. Housing: Fabricated from steel panels for recessing projector lift in ceiling space used as Environmental Airspace. Provide with universal closure and metal trim to finish ceiling opening.
- E. Operating mechanism: Operating pan to be lowered and raised by 3 sets of stabilizing scissors positioned on sides and rear of pan and two 3/16 inch diameter cables with 4,200 foot-pounds tensile strength per cable. Mechanism operated by 110 VAC, 60 HZ, instantly reversible, thermally protected, lifetime lubricated, right angle gear motor and chain drive system.
- F. Safety belt: Provide lift with fail-safe inertial safety belt system.
- G. Cable management system: Provide lift with means for attachment of cables to rear scissor to eliminate cord tangles. Include 110 V pre-wired power cable and prewired hookups for video cables as shown on the drawings.
- H. Closure panel: Steel closure panel suspended below projector from rods attached to operating pan. Closure mounted flush with adjacent ceiling surface and finished with white powder coat paint finish.
- I. Operation: Projector bolted to operating pan. Projector automatically lowered from ceiling store position to show position. Projector lowered to service position by key-operated, momentary switch. Projector raised from show and service positions to store position. Travel automatically stopped by factory set limit switches.
- J. Access door: Provide ceiling access door with white finish to be installed in architectural enclosure and allow access to projector and mount.
- K. Show position: To be field adjusted based on the installation of the projection screens and the height above floor of the lift.
- L. Maximum lift capacity: 350 pounds.
- M. Approximate travel speed: 1 foot in 9 seconds.
- N. The projector lift shall be interfaced with the video projector to automatically turn on the projector when the lift is lowered and turn off the projector when the lift is returned to the stored position.
- O. Exact model of Lift shall be based on requirements of Video Project being installed as part of this project.
- P. Manufacturers
 - 1. Basis of Design
 - a. Draper, Inc. SLX Series Motorized Scissor Lift or acceptable substitution.

2.25 PROJECTION SCREEN

- A. Electric motor operated, extruded aluminum case, independently motorized closure, tab tensioned. Ceiling-recessed, extruded aluminum headbox, 10 inches (254 mm) deep and 9 inches (229 mm) wide. UL approved "Suitable for use in environmental air space." Case finished white. Bottom of case consists of an independently motorized trap door that opens up inside the screen case. The trap door and the access door both hinge downward to allow access to inside of screen case. The doors shall remain attached to the screen case via a concealed full-length hinge. Releasing one latch at each end of screen case allows the doors to hinge downward and a prop arm at each end may be pivoted to engage with endcaps, keeping the door assembly in its fully open position. Symmetrical case allows for viewing surface to unroll from the back or front of the roller. The screen is attached to roller with roller brackets. The case may be ordered in advance and the screen installed later to eliminate field damage. Metal roller mounted on rubber isolation mounts.
- B. Motor mounted inside screen roller on rubber isolation insulators. Motor UL certified, rated 110-120V AC, 60 Hz, three wire, instantly reversible, lifetime lubricated with pre-set accessible limit switches.
- C. Motor Screen Controls, UL certified.
 - 1. Low voltage control unit with three button 24V switches and cover plate to stop or reverse screen at any point.
- D. System Options:
 - 1. Ceiling Trim Kit for recessing above acoustical tile ceiling grid.
- E. Projection Viewing Surface: Mildew resistant 100 percent vinyl with black masking borders and 12 inch (305 mm) black drop.
 - 1. OptiFlex ReAct MS1000V – On Axis gain of 1.0.
- F. Tab-Tensioning System:
 - 1. Viewing surface with integrated tabs and cable on each side of fabric to provide tension and ensure flat viewing surface. Viewing surface and tabs CNC cut as a single piece. Tabs RF welded to the back of viewing surface to prevent tab separation. Tab adhesives are not acceptable. Viewing surface inserted into aluminum bottom dowel.
 - 2. Viewing Area H x W.: As shown on the drawings
 - 3. Screen Format: To match installed Video Projector.
 - 4. Provide an extra screen drop as necessary based on installed height of Projection Screen.
- G. The Projection Screen shall be provided with an RS-232 interface module for connection/control by the AV Control System.
- H. Manufacturers
 - 1. Basis of Design

- a. Draper Inc. Ultimate Access V Series Motorized, Flush Ceiling Mounted Projection Screen with OptiFlex ReAct MS1000V Screen Material and MC1 RS-232 Interface Module or acceptable substitution

2.26 CABLE

A. HDMI Cable

1. Shall be designed for high performance transmission of HDMI digital video and audio signals.
2. Shall conform to HDMI Standard Speed Cable Specifications and shall support 1920 x 1200 @ 60 Hz and 1080p/60 up to 75 feet within a cable equalizer.
3. Shall be pre-connectorized by the manufacturer and shall be available in 3, 6, 12, 25, 35, 50, 75, 100, 125, 150, 175, and 200 foot lengths. Shall be by the same manufacturer and fully compatible with the system's HDMI equipment.
4. Manufacturers
 - a. Basis of Design
 - 1) Extron Electronics HDMI Pro Series cables or acceptable substitution

B. Fiber Optic (Backbone)

1. Shall be a singlemode, color-coded fiber optic cable.
2. The cable shall be loose tube, gel-filled or water-blocked design.
3. Construction:
 - a. Number of fibers: as shown on the drawings
 - b. Fiber: 10G/300 fiber
 - c. Buffering: 900 μ m
 - d. Operating Wavelength: 1310/1550 nm
 - e. Max Attenuation: 0.80/0.50 db/km
 - f. Sheath Construction: Non-metallic.
4. Manufacturers:
 - a. Basis of Design:
 - 1) Mohawk Wire and Cable #M9X Series Fiber Optic Cable
 - b. Acceptable Substitutions
 - 1) CommScope
 - 2) Belden

C. Fiber Optic (Horizontal)

1. Shall be singlemode fiber optic cable.
2. The cable shall be a duplex, tight buffered, non gel-filled design.
3. Construction:

- a. Number of fibers: Two (2)
 - b. Fiber: 10G/300 fiber
 - c. Operating Wavelength: 1310/1550 nm
 - d. Max Attenuation: 0.80/0.50 db/km
 - e. Sheath Construction: Non-metallic.
4. Manufacturers:
- a. Basis of Design:
 - 1) Mohawk Wire and Cable #M9X Series Duplex Fiber Optic Cable
 - b. Acceptable Substitutions
 - 1) CommScope
 - 2) Belden
- D. Category 6 Data Cable
1. Comply with requirements outlined in Section 16710.

PART 3 - EXECUTION

- 3.1 Comply with the requirements of Section 16701.
- 3.2 Labels
- A. General
1. All equipment, control and system cabling shall be provided with permanent descriptive labels.
 2. The Contractor shall provide samples of labeling with his submittals for review.
 3. Equipment and cable labels shall be noted on the Contractor's as-built drawings exactly as they are installed on the equipment or cables.
- B. Equipment
1. The Contractor shall provide and install permanent, engraved labels on all equipment where the original manufacturer has not already provided labels.
 2. All custom, fabricated, or field assembled assemblies and equipment shall be provided with permanent engraved or non-removable silk-screened labels. The Contractor shall provide samples of labels to Architect for review and approval prior to fabrication or final installation. The Contractor shall modify labeling as required by the Architect.
- C. Outlet Plates
1. Shall be installed level and flush with the mounting surface.
- D. Cables

1. The Contractor shall provide and install a permanent, machine printed, protected label on both ends of each system cable. The label at each end of the cable shall provide the following information:
 - a. Signal type shall be either plain English or represented by the following designators
 - 1) R = RGBHV video
 - 2) V = S-Video
 - 3) C = Composite video
 - 4) +C = Control
 - b. Room number where other end of cable is terminated
 - c. Where system cables are routed between buildings the Contractor shall preface the Room Number with a Building Number
 - d. Room numbers shall coincide with numbering scheme included in contract documents.
 - e. Device identifier where other end of cable is terminated
 - f. Device identifier shall provide a clear indication of device connected to.

3.3 TESTING

- A. Comply with Section 16701 "Common Work Results for Communications"
- B. Video
 1. Test all cables for shorts, opens, and grounds. Record results.
 2. Accomplish an operational test of the video signals utilizing color bars, still pictures, and motion video to demonstrate proper video signal to all video targets.
 3. Visible evidence of banding, bending, blooming, chroma delay, improper convergence, hum bars, ground loops, jaggies, jitter, luma delay, retrace, signal loss, smearing, horizontal double images, vertical double images, or wrap around shall not be acceptable. The Contractor shall make system adjustments as necessary to eliminate any of these abnormalities.
- C. Control
 1. Accomplish full operational test of the system to verify all system programming is correct and functions as intended.

END OF SECTION 16751

SECTION 16758 – TV DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Division 16 Section 16701 “Common Work Results for Communications”.

1.2 DESCRIPTION OF SYSTEM

- A. Provide and install a complete and satisfactorily functioning system providing the following:
 - 1. A complete and fully functional extension of the existing building HDTV Distribution system providing transmission of video and associated audio signals for individual channels. In general terms, the system shall utilize an incoming cable TV feed from the local Cable TV Company, shall process source signals as necessary and as shown in the drawings, and then distribute the combined signals through a distributed cable infrastructure to the various locations throughout the facility. Distributed signals shall be maintained through the use of distribution amplifiers, splitters, taps, and a cable system designed to provide an optimal signal level at each system outlet in the facility.
 - a. The TV Distribution system shall employ a cabling system providing homerun cables from each outlet to the local serving system’s room or closet.
 - b. Provide a video signal to each TV Distribution Outlet between 5 and 10 dbmV at the television input for all channels.
 - c. The system bandwidth shall include all frequencies from the sub-band through the hyper-band (5 MHz to 750 MHz)
 - 2. Provide and install broadband distribution amplifiers, with return channel option, in locations shown on the drawings as required to provide the proper signal levels to all system outlets.
- B. All necessary hookup, installation, programming, and testing shall be by a factory trained and certified technician.
- C. Contractor shall provide and install patch cords for the system as necessary for all equipment and outlets including Owner provided, Contractor installed equipment.
- D. System to include but not be limited to:
 - 1. Horizontal Raceway System
 - 2. Horizontal Cabling System
 - 3. TV Outlet Faceplates with “F” type connectors
 - 4. Splitters
 - 5. Directional Couplers

1.3 FUNCTIONS AND OBJECTIVES

- A. The system shall provide for the reception and display of both black and white and color signals and associated audio at every outlet in the facility
- B. The system shall:
 - 1. Meet or exceed all requirements in FCC Rules Part 76.
 - 2. Provide a minimum signal level of +5 dBmv at each outlet for EIA Channels 02 through 116 inclusive.
 - a. Actual transmitted channels may include both Cable TV channels as well as locally generated RF signals. The system shall be cable of transmitting all system signals within the 5 MHz to 750 MHz bandwidth.
 - b. The difference between any two adjacent outlets shall not exceed 2 dB. Isolation between any two outlets shall be better than 28 dB in the sub-band through the super-band range (7 MHz – 300 MHz). Isolation in the hyper-band (300 MHz to 750 MHz) shall be greater than 20 dB.
 - 3. Be capable of transmitting sub-band (7 MHz to 49 MHz) to the head-end equipment from any outlet in the facility.
 - 4. Be designed to provide a minimum of +15 dB at the input to each system amplifier (head-end or remote).
 - 5. Be designed to provide a minimum of 43 dB carrier-to-noise ratio and –45 dB (0.5%) cross-modulation level at the output of the last amplifier in the distribution system.
 - 6. Not exceed radiation levels promulgated by the FCC.

1.4 ALTERNATES

- A. Additive Alternate #2: All work associated with Conference Center (S222A).

1.5 SPECIAL REQUIREMENTS

- A. Not used.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General:
 - 1. All pathways (conduit, raceways, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of sections within Division 167XX of these specifications.
- B. Conduit. (Comply with Division 167XX except as noted below).

1. Bushings: Provide insulated bushings on ends of all raceway. All metallic conduits shall have bonding bushings and be bonded to the Systems Ground Bus Bar with an insulated #6 AWG wire.
2. Pull Cords: Install pull cords in all raceway runs that are installed without cable.
3. Size:
 - a. Minimum size shall be ¾".
 - b. The Contractor shall size raceways in accordance with the National Electric Code unless noted otherwise.

C. Boxes:

1. All outlet boxes, junction boxes, pull boxes, etc. shall comply with applicable section of these specifications.
2. Boxes shall be sized as required by NEC for cables, conduit and/or device installed.

2.2 "SYSTEMS" AND "LOCAL" GROUND BUS

- A. Bus to comply with applicable sections of these specifications.

2.3 TV'S

- A. To be provided and installed by the Owner.

2.4 ACTIVE DEVICES

- A. Broadband Indoor Rack Mount Hybrid Distribution Amplifier:

1. The hybrid amplifier shall have 33 db of operational gain and still retain low distortion characteristics.
2. The amplifier shall have -30 db input and -30 db output test points. The amplifier shall have optional plug-in flat attenuators and/or plug-in cable equalizer pads.
3. The amplifier shall have the following minimum electrical specifications:
 - a. Frequency Range: 40-750 Mhz
 - b. Gain: 30 Db
 - c. Flatness: +/- 1.0 Db
 - d. Gain Control Range: 15 Db
 - e. Slope Control Range: 10 Db
 - f. Return Loss Input: 14 Db
 - g. Return Loss Output: 14 Db
 - h. Noise Figure: 9.0 Db
 - i. Hum Mod: -65 Db
 - j. Output Level: 44 Dbmv
 - k. Ctb: -55 Db
 - l. X-Mod: -58 Db
 - m. 2nd Order Intermod: -68 Db
4. The amplifier shall be the Blonder-Tongue 75A-30P.

2.5 PASSIVE DEVICES

A. Radiation Proof Hybrid Splitters:

1. Splitters used in systems, which obtain their signals from a CATV feed, shall comply with FCC specifications concerning radiation shielding. Housings shall be sealed and weatherproofed. Splitters may be two, four, or eight port devices.
2. Specifications:
 - a. 2 Port
 - 1) Bandwidth: 5 – 750 MHz
 - 2) Thru loss (Max): 3.5 dB (5-500 MHz); 4.5 dB (600-750 MHz)
 - 3) Isolation (Min.): 27 dB
 - 4) Return Loss: 17 dB
 - 5) Radiation Shielding: >-80 dB
 - b. 4 Port
 - 1) Bandwidth: 5 – 750 MHz
 - 2) Thru loss (Max): 7.2 dB (5-500 MHz); 8.5 dB (600-750 MHz)
 - 3) Isolation (Min.): 27 dB
 - 4) Return Loss: 18 dB
 - 5) Radiation Shielding: >-80 dB
 - c. 8 Port
 - 1) Bandwidth: 5 – 750 MHz
 - 2) Thru loss (Max): 12.0 dB (5-500 MHz); 14.0 dB (600-750 MHz)
 - 3) Isolation (Min.): 27 dB
 - 4) Return Loss: 14 dB
 - 5) Radiation Shielding: >-80 dB
3. Manufacturers
 - a. Basis of Design
 - 1) Blonder-Tongue SRT Series Splitters.
 - b. Acceptable Substitution
 - 1) Pico Macom

B. Radiation Proof Directional Couplers:

1. Directional couplers used in systems which obtain their signals from a CATV feed shall comply with FCC specifications concerning radiation shielding. Housings shall be sealed and weatherproofed.
2. Specifications:

- a. Frequency Range: 5 - 1000 MHz
- b. Tap Values: 4-6-9-12-16-20-24-27 and 30 dB
- c. Thru-loss: 3.5 - 0.5 dB dependent upon tap value
- d. Isolation: 18 - 40 dB dependent upon tap value
- e. Input Return Loss: 12 - 18 dB dependent upon tap value
- f. Tap Down Loss: 3 - 30 dB dependent upon tap value
- g. Radiation Shielding: > -80 dB

3. Manufacturers

- a. Basis of Design
 - 1) Blonder-Tongue model CRT Series
- b. Acceptable Substitution
 - 1) Pico Macom

2.6 OUTLETS

A. Wall Taps

1. Taps shall be capable of mounting in a standard electrical wall outlet box.
2. Stainless steel, feed thru.
3. Outlets to have 'F' connector for television distribution system.
4. Manufacturers
 - a. Basis of Design
 - 1) Blonder-Tongue Versa-Tap Series
 - b. Acceptable Substitution
 - 1) Pico Macom

B. Jumper Cable

1. Contractor/Installer shall provide one fabricated jumper cable for each outlet to the following specification. Transformer not required for cable-ready TV's.
2. Receiving Outlets -- length 8 ft.
3. Cable: Type RG/6.
4. Connectors: Two "F" male connectors; Blonder-Tongue #BTF-56 Hex
5. Transformer: 75 to 300 ohm; Blonder Tongue #4005
6. Provide one (1) jumper cable and one transformer at each TV outlet.
7. Manufacturers
 - a. Basis of Design
 - 1) Blonder-Tongue
 - b. Acceptable Substitution

- 1) Pico Macom

2.7 WIRE AND CABLE

A. General

1. All cables shall be 100% factory swept tested to 1GHz. Certification shall be available for each reel.
2. If cable is used in a plenum environment it shall be UL listed for plenum application.
3. All underground or below slab cable runs shall be of the flooded type.

B. Drop Cable

1. Non-Plenum

- a. RG6 Series Coaxial Cable
- b. NEC Type: CATV CM
- c. Conductor Type & Nom. DCR: 18 AWG (Solid) BC 6.5 Ohm/M'
- d. Insulation Type and Thickness: Gas Injected PE; .180 inches
- e. Shielding & % Coverage: Bifoil 100% and Alum. Braid 65%
- f. Jacket Type: PVC
- g. Nominal Capacitance: 16.2 pf/ft.
- h. Nominal VP: 82%
- i. Nominal Impedance: 75 Ohms
- j. Jacket Color: Black
- k. Manufacturers

1) Basis of Design

- a) West Penn #841

2) Acceptable Substitutions

- a) Belden
- b) Commscope

2. Plenum

- a. RG6 Series Coaxial Cable
- b. NEC Type: CATVP CMP
- c. Conductor Type & Nom. DCR: 18 AWG (Solid) BC 6.5 Ohm/M'
- d. Insulation Type and Thickness: Foam FEP; .170 inches
- e. Shielding & % Coverage: Bifoil 100% and Alum. Braid 77%
- f. Jacket Type: Flexible Plenum
- g. Nominal Capacitance: 16.2 pf/ft.
- h. Nominal VP: 82%
- i. Nominal Impedance: 75 Ohms
- j. Jacket Color: Ivory
- k. Manufacturers

- 1) Basis of Design
 - a) West Penn #25841
- 2) Acceptable Substitutions
 - a) Belden
 - b) Commscope

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. The Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings.
 - a. The Contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications.
 - b. The Contractor shall provide and install a properly sized, flush mounted outlet box for every device.
 - c. The Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable unless specifically required by the equipment manufacturer for proper operation of the equipment.
 - d. In locations where raceway and/or conduit are not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device.
 - e. Contractor shall properly terminate each device according to the manufacturer's recommendations. Unless specifically noted otherwise, the Contractor shall provide and install cabling to connect all circuitry associated with a device.
 - f. Provide and install firestopping where penetrations are made through rated walls and floors.
2. Install equipment in accordance with manufacturer's instructions.
3. Install equipment, cables, and raceways as required to comply with all applicable requirements of the references and/or regulatory requirements called for under PART 1 of this section of specifications, as a minimum installation requirement. Exceed this minimum requirement when called for herein.
4. Install all electrical basic materials per applicable sections of these specifications.
5. Install all rack mountable equipment in equipment cabinet.

6. All equipment, except portable equipment, shall be held firmly in place. (The exception shall be when the Contractor is required to use resilient shock mounting to decouple equipment from the structure it is being mounted to.
7. Fastenings and supports shall be adequate to support their loads with a safety factor of five (5).
8. All switches, connectors, outlets, etc., shall be clearly, logically, and permanently marked during installation. Where the equipment manufacturer does not provide markings or for fabricated and installed equipment the Contractor shall provide and install permanent, engraved labels for proper identification.
9. Install cabinets/racks in locations shown; arrange to provide adequate ventilation and access.
10. Properly ground system per applicable sections of these specifications.
11. Support raceways, backboards, and cabinets per applicable sections of these specifications and as recommended by the manufacturer.
12. Install raceways to conform to applicable sections of these specifications.
13. Install system wiring and/or raceways away from any surface that may become hot, including and not limited to, hot water piping and heating ducts.
14. Install system wiring with at least 12 inches of separation from line voltage power wiring on parallel runs. Wiring crossing power circuits shall be at right angles. For metal enclosed electric light or power or Class 1 circuits, separation may be reduced as described in the National Electric Code (NEC). Increase separation if so required to comply with referenced standards.
15. The majority of the system wiring will be installed above ceilings. All cabling used throughout this project shall comply with the requirements outlined in the National Electric Code (NEC) Article 760. All cabling shall bear CMP and/or appropriate markings for the environment in which they are installed.
16. Sealing of openings between floors, through rated fire and smoke walls, existing or created by the Contractor for cable pass through shall be the responsibility of the Contractor. Sealing material and application of this material shall be accomplished in such a manner which is acceptable to the fire and building authorities having jurisdiction over this work. Creation of such openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of the Contractor's work. Any openings created by or for the Contractor and left unused shall also be sealed as part of this work.
17. The Contractor shall be responsible for any damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.
18. Maintain proper separation between system cables and all power and/or unshielded cables, as required to prevent noise, crosstalk, etc.
19. Each system outlet shall have splice-free cables homerun to its respective equipment as indicated on the drawings.

B. Equipment Racks/Cabinets:

1. Where multiple enclosures are configured as one continuous enclosure, they shall be installed with six inches (6") of clearance from any other structure to ensure adequate airflow for circulation fans.
2. In installations where it is not possible to maintain six inches (6") of clearance from a structure, or where specifically noted in the drawings and specifications,

the Contractor shall provide a fan assembly to provide adequate airflow to the satisfaction of the Designer.

C. Outlets

1. Contractor shall provide and install an outlet plate with appropriate connectors for every device whether or not shown on the drawings.
2. Install devices/inserts in outlets so that same orientation is used throughout project.
3. Install per applicable section of these specifications (i.e., outlet boxes, indoor service poles, floor boxes, etc.).
4. Install wall plates with all inserts required to properly connect all equipment circuits and complete the installation in a professional manner.

D. Pathway

1. General

- a. Raceway system shall meet the applicable requirements of all Division 167XX sections.
- b. Raceway system shall not be shared by power or any other electrical wiring that is not part of the system.
- c. Bend raceway with minimum inside radius of 6 times the internal diameter. Increase bend radius to 10 times for raceway larger than 2 inch size. Provide proper bend for all changes of direction. Pull and splice boxes shall not be used in lieu of a bend.
- d. Install raceways so no more than two 90° bends are in any raceway section without a pullbox. Install additional pullboxes as required to maintain maximum of two 90° bends between pullboxes and/or termination points.
- e. Install raceways so no more than one hundred (100) feet of raceway are in any raceway section without a pullbox. Install additional pullboxes as required to maintain maximum of one hundred (100) feet between pullboxes and/or termination points.
- f. Label all raceways at both ends to indicate destination and source. Also indicate length of raceway. This labeling/identification shall be fully documented in as-built (record) drawings.
- g. Install polyethylene pulling string in each empty conduit over 10 feet in length or containing a bend.
- h. Properly support cables/wire not installed in raceways.
- i. Special Raceway Systems: Special raceway systems may be specified for some portions of the system. Refer to the drawings and other sections of these specifications to determine where or if such systems are used.
- j. Fire Stop
 - 1) Where conduit penetrates a fire rated wall, floor, etc., firestopping shall be provided.
 - 2) Provide permanent firestopping seals after cable Installers have pulled risers and distribution cables.

- 3) Meet all requirements for UL assembly involved. Provide firestopping UL listed for assembly, conduit, and/or cable involved.

E. Grounding

1. Provide and install complete grounding system as required to comply with all sections of these specifications and applicable codes.
2. Connect equipment cabinets to "systems" ground bus with #6 green insulated copper ground wire.
3. Connect metal conduit (via grounding bushing) to "systems" ground bus.
4. Connect cable shields to "systems" ground busbar.
5. Connect surge suppression equipment to "systems" ground busbar.
6. The Contractor shall take such precautions as are necessary to guard against electromagnetic and electrostatic hum, and to install all equipment so as to provide maximum safety to the person who operates it.

F. Cables/Wires

1. Install cables/wires in accordance with manufacturer's instructions.
2. All cables shall be installed as illustrated on the drawings except where necessary to avoid EMI sources or other obstacles. Major deviations from the illustrated path must be accepted in advance by the Designer.
3. Cables shall not be spliced.
4. Provide adequate cable size and length for each run.
5. Install system cables no closer than 12" from any wire/cable installed for power system cable/raceway or fluorescent/ballasted light fixtures.
6. Provide protection for exposed cables.
7. All joints and connections shall be made with rosin-core solder or with mechanical connectors accepted by the Designer.
8. All cabling used throughout this project shall comply with the requirements outlined in the National Electric Code (NEC) Article 760. All cabling shall bear CMP and/or appropriate markings for the environment in which they are installed.

G. Labels

1. All equipment, control, and system cabling shall be provided with permanent descriptive labels
2. The Contractor shall provide samples of labeling with his submittals for review by the Designer.
3. Equipment and cable labels shall be noted on the Contractor's as-built drawings exactly as they are installed on the equipment or cables.
4. Equipment
 - a. The Contractor shall provide and install permanent, engraved labels on all equipment where the original manufacturer has not already provided labels.
 - b. All custom, fabricated, or field assembled assemblies and equipment shall be provided with permanent engraved or non-removable silk-screened labels. The Contractor shall provide samples of labels to

Designer for review and approval prior to fabrication or final installation.
The Contractor shall modify labeling as required by the Designer.

5. Cables

- a. The Contractor shall provide and install a permanent, machine printed, protected label on both ends of each system cable. The label at each end of the cable shall provide the following information:
 - 1) System identifier
 - 2) Room number where other end of cable is terminated
 - a) Where system cables are routed between buildings the Contractor shall preface the Room Number with a Building Number
 - b) Room numbers shall coincide with numbering scheme included in contract documents.
 - 3) Device identifier where other end of cable is terminated
 - a) Device identifier shall provide a clear indication of device connected to.

3.2 SYSTEM TESTING

A. General

1. Provide all required testing apparatus necessary to successfully complete the system testing.
2. Provide factory trained personnel to perform the tests and adjust the system.
3. Kits, home-built, and other nonprofessional test equipment shall not be acceptable.
4. Documentation of Tests, Measurements, and Adjustments Performed:
 - a. List of personnel and certified test equipment used.
 - b. Impedance of all circuits.
 - c. The documented information for all settings of all active equipment.
5. Test all cables for shorts, opens, and grounds. Record results.
6. Accomplish full operational test of the system to verify all system programming is correct and functions as intended.

3.3 FIELD QUALITY CONTROL

- A. Perform all testing where necessary or specified to assure a fully functional system. Replace and/or repair and retest components that fail performance standards.
- B. Test all cables/outlets.
- C. System verification and acceptance documentation signed and dated by the Contractor shall be provided. This documentation shall include test measurements and system

calibrations performed for the entire system. Sample system operations shall also be performed with actual hardware or using Contractor provided test equipment and documented to verify that the system is operational and ready for acceptance. This shall also establish the baseline performance of the system.

D. System Commissioning:

1. Upon completion of the aforementioned tests and before system commissioning, testing shall be performed. The tests shall be performed with the system equipment and using Contractor provided test equipment. The tests shall be witnessed by the Designer.

END OF SECTION 16758

SECTION 16772 – ACCESS CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 “Common Work Results for Communications”.

1.2 DEFINITIONS

- A. Not used.

1.3 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete and fully functional Access Control System as shown on the drawings and specified herein.
- B. System shall include:
 - 1. Controller Panel including power supplies and battery backup
 - 2. Card Readers
 - 3. Equipment and Interfaces to Door Hardware and Strikes
 - 4. System Wire and Cable
 - 5. Raceway, fittings, outlet boxes, etc.
 - 6. Power (refer to Division 16)
 - 7. Grounding
 - 8. Wire and cable labeling
 - 9. J-Hook type support assemblies

1.4 SPECIAL REQUIREMENTS

- A. Not used.

1.5 FUNCTIONS AND OBJECTIVES

- A. Provide and install a complete and satisfactorily functioning extension of the existing system providing the following:
 - 1. Interconnection, control, and indication of the various protected spaces and devices included in the system in both the main monitoring location and at remote locations as shown on the drawings and outlined herein.
 - 2. Monitoring and indication of the status of protected doors throughout the facility. Alarm indication of doors that have been opened during unauthorized times, opened without presenting a properly authorized Access Control System access card to the card reader associated with a specific door, or doors that have been held open beyond the time programmed into the system for passage.

1.6 ALTERNATES

- A. Additive Alternate #2: All work associated with Conference Center (S222A).

PART 2 - PRODUCTS

2.1 ACCESS CONTROL SYSTEM CONTROLLER PANEL

- A. Shall match existing.
- B. Manufacturers
 - 1. Basis of Design
 - a. Johnson Control P2000 Access Control Card Reader Panel (no substitutions allowed)

2.2 CARD READERS

- A. Shall match existing
- B. Manufacturers
 - 1. Basis of Design
 - a. Johnson Controls L73-G-2W Card Reader (no substitutions allowed)

2.3 EQUIPMENT AND INTERFACES TO DOOR HARDWARE AND STRIKES

- A. The Contractor shall provide and install all equipment and materials necessary to interface the Access Control system to door hardware and door strikes. The Contractor shall coordinate the work of the Access Control system Installer with the Electrical Sub-Contractor and Door Hardware Installer to ensure that all materials and equipment are provided and interconnected to provide a complete and fully functional system.

2.4 CABLE:

- A. Shall be as required by the equipment manufacturer.
- B. Manufacturers
 - 1. Basis of Design
 - a. Belden
 - 2. Acceptable Substitutions
 - a. West Penn
 - b. CommScope

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the requirements of Section 16701.
- B. Comply with the requirements of Section 16710.
- C. Installation of device back boxes shall be in accordance with the system manufacturer's requirements.
- D. Termination of devices shall be in accordance with manufacturer's requirements.

3.2 TESTING

- A. Comply with the requirements of Section 16701.

END OF SECTION 16772

SECTION 16781 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. Comply with the requirements of Section 16701 “Common Work Results for Communications”.
- B. Comply with applicable requirements of Division 23.
- C. In addition to the requirements of 16701 comply with the following requirements:
 - 1. Related Sections
 - a. Applicable sections of these specifications with regard to, but not limited to:
 - 1) Doors
 - 2) Sound Systems
 - b. Standards, Codes, References, And Regulatory Requirements
 - 1) The system shall have proper listing and/or approval from the following nationally recognized agencies:
 - a) UL Underwriters Laboratories Inc
 - b) ULC Underwriters Laboratories Canada
 - c) MEA Material Equipment Acceptance (NYC)
 - d) FM Factory Mutual
 - e) CSFM California State Fire Marshal
 - 2. Submittals
 - a. Where the Authority Having Jurisdiction requires the Contractor to submit signed and sealed drawings with his permit application it shall be the responsibility of the Fire Alarm Installer to have his drawings signed and sealed by his own Professional Engineer. The Engineer of Record for the project will not sign and seal the Contractor’s drawings.
- D. The equipment and installation shall comply with the current or applicable provisions of the following standards, codes, references, and regulatory requirements:
 - 1. NFPA
 - a. NFPA 13 – Standard for the installation of Sprinkler Systems
 - b. NFPA 72 – National Fire Alarm Code
 - c. NFPA 90A – Standard for the Installation of Air-Conditioning and Ventilating Systems
 - d. NFPA 101 – Safety to Life from Fire in Buildings and Structures
 - 2. Underwriters Laboratories

- a. UL 13 – Power-Limited Circuit Cables
 - b. UL 38 – Manual Signaling Boxes for Fire Alarm Systems
 - c. UL 217 – Single and Multiple Station Smoke Alarms
 - d. UL 228 – Door Closers-Holders, With or Without Integral Smoke Detectors
 - e. UL 268 – Smoke Detectors for Fire Protective Signaling Systems
 - f. UL 268A – Smoke Detectors for Duct Application
 - g. UL 521 – Heat Detectors for Fire Protective Signaling Systems
 - h. UL 539 – Single and Multiple Station Heat Detectors
 - i. UL 864 – Control Units for Fire Protective Signaling Systems
 - j. UL 1424 – Cables for Power-Limited Fire Alarm Circuits
 - k. UL 1425 – Cables for Non-Power-Limited Fire-Alarm Circuits
 - l. UL 1480 – Speakers for Fire Protective Signaling Systems
 - m. UL 1481 – Power Supplies for Fire Protective Signaling Systems
 - n. UL 1711 – Amplifiers for Fire Protective Signaling Systems
 - o. UL 1971 - Signaling Devices for the Hearing Impaired
3. Local and State Building Codes
- a. Florida Building Code: 2010 edition with all revisions
 - b. Florida Administrative Code. All applicable chapters including but not limited to:
 - 1) Chapter 69A Rules, including but not limited to:
 - a) Ch 69A-3 Fire Prevention - General Provisions.
 - b) Ch 69A-46 Fire Protection System Contractors and Systems.
 - c) Ch 69A-47 Uniform Fire Safety Standards for Elevators.
 - d) Ch 69A-48 Fire Safety Standards for the Fire Alarm Systems.
 - e) Ch 69A-58 Educational Facilities
 - f) Ch 69A-60 Florida Fire Prevention Code
 - c. Florida Fire Prevention Code
 - d. Florida Department of Insurance:
 - 1) Insurance Code: The fire alarm system and installation thereof shall comply with the State of Florida Department of Insurance rules. The requirements of the Florida State Department of Insurance shall be as promulgated by the Division of State Fire Marshal.
 - 2) Fire Alarm Rules: The fire alarm system and installation thereof shall comply with the Fire Safety Rules promulgated by the Florida State Fire Marshal.
 - e. Authority Having Jurisdiction:
 - 1) General: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local authority having jurisdiction.
 - 2) Fire Department: Orange County Fire Marshal
 - 3) Building Official: Orange County Building Dept.
 - 4) State of Florida: Division of State Fire Marshal

- f. Surge Suppression
 - 1) Equipment Certification: When available by any one manufacturer, all surge suppression equipment shall be listed by Underwriters' Laboratories, shall bear the UL seal and be marked in accordance with referenced standard. Such surge suppression equipment shall be UL listed and labeled for intended use.
 - 2) Comply with all standards and guides as listed under "References" above.

- 4. Quality Assurance
 - a. Installer:
 - 1) The Installer shall be currently licensed by the Electrical Contractors' Licensing Board as a Statewide Alarm Contractor I (EF).
 - 2) The Installer's Field Supervisor shall be currently certified by the National Institute for Certification in Engineering Technologies as a NICET Level III or Level IV. NICET Level I or Level II shall not be acceptable.

 - b. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten (10) years experience and with service facilities within 50 miles of Project.

 - c. Installer:
 - 1) Company specializing in installing the products specified in this section with minimum ten (10) years experience.
 - 2) The Installer shall be currently licensed by the Electrical Contractors' Licensing Board as a Certified Alarm System Contractor I (EF).
 - 3) The installing Contractor shall be a direct sales division of, or the authorized and designated distributor for, a fire alarm system manufacturer.
 - 4) Installing Contractor shall maintain a local staff of specialists, including a Fire Alarm Planning Superintendent, for planning, installation, and service.
 - 5) The installing Contractor shall maintain an office within fifty (50) miles of the project with capability to provide emergency service 7-days-a-week, 24 hour days. The installing Contractor shall have been actively engaged in the business of selling, installing and servicing fire alarm systems for at least ten (10) consecutive years going back from date of bid.

- 5. Submittals
 - a. Each system power supply including stand alone booster supplies
 - b. Each standby battery bank
 - c. Each notification appliance circuit
 - d. Each auxiliary control circuit that draws power from a system power supply.

- 1) Submit all load calculations and cable/wire sizing for each branch of the individual fire alarm field circuits. Wire sizing calculations to prove maximum three percent (3%) voltage drop at all AC voltages and maximum eight percent (8%) voltage drop at all DC voltages.
6. Additional Devices For Jurisdictional Compliance
 - a. Prior to bid, the Contractor shall review plans and specifications carefully for compliance with all codes and in particular, the ADA Requirements and NFPA 72. Contractor shall include in bid price any devices required to provide a fully compliant system. Said additional devices shall be shown on shop drawings submitted by contractor.
 7. Maintenance Service
 - a. Furnish service and maintenance of fire alarm system for one (1) year from date of Substantial Completion.
 - b. No charge shall be made by the installer and/or contractor for any labor, equipment, or transportation during this period to maintain functions.
 - c. Respond to trouble call within twenty-four (24) hours after receipt of such call.
 - d. Provide annual testing and inspection of fire alarm system at end of first year in accordance with NFPA 72. Correct any deficiencies found at no cost to the Owner. Affix fire alarm tag to panel.
 8. Spare Capacity
 - a. Contractor shall provide and install system equipment and materials in quantities that will provide the Owner with twenty percent (20%) spare capacity (e.g. termination points, jacks, ports, etc.) after connection of all circuits as required by the contract documents. Equipment and materials where spare capacity shall be provided include:
 - 1) System power supplies
 - 2) Audio Amplifiers

1.2 DEFINITIONS

- A. Not Used.

1.3 DESCRIPTION OF SYSTEM:

- A. Provide and install a complete and satisfactorily functioning, code compliant system configured for the specific environment in which it is installed.
- B. The Contractor shall furnish and install a complete Addressable Analog Fire Detection System. The system shall include but not be limited to:
 1. Main Fire Alarm Control Panel (FACP) including all required power supplies and properly sized battery backup
 2. Fire Alarm Annunciator Panel (FAAP)

3. Manual Pull Stations
 4. Smoke Detectors
 5. Duct Detectors
 6. Heat Detectors
 7. Analog and Addressable Fire Alarm Relays
 8. Combination Audible/Visual devices (indoor and outdoor weatherproof as indicated on the drawings)
 9. Visual devices (indoor and outdoor weatherproof as indicated on the drawings)
 10. Remote fire alarm control panels (Network Nodes)
 11. Remote power supplies (Remote power supplies shall be in a UL Listed assembly and be provided by the same manufacturer as the Fire Alarm Control Panel (FACP)).
 12. "Do not use elevator" warning lights.
 13. UL Listed Communicator (DMP:XR500 Panel with both telephone and network monitoring capabilities).
 14. Surge Suppression
 15. Programming.
 16. Grounding
 17. Wire and cable labeling.
 18. Electrical power required to comply with all functions and operations called for in this section of the specifications. Contractor shall provide and install all 120 VAC circuits as required.
 19. Conduit, wire, wire fittings, terminal cabinets with plywood and terminal strips, and all accessories required to provide a complete operating system.
 20. A complete and accurate schematic/drawing of the fire alarm system to be placed adjacent to the fire alarm annunciator panel and the main fire alarm panel.
- C. Unless specifically noted otherwise, Fire Alarm System equipment shall be the product of a single manufacturer.
- D. Contractor shall furnish and install all equipment (raceways, wire/cable, circuit breakers, modules, relays, etc.) necessary, and as required by applicable code, to accomplish incidental functions of the fire alarm system including but not limited to the following:
1. HVAC system control and/or shutdown.
 2. Ventilation system (supply fans, exhaust fans, fan terminal boxes, etc.) control and/or shutdown.
 3. Monitoring of kitchen hood fire suppression systems
 4. Control of door hold open devices.
 5. Control of time out room door lock devices.
- E. System shall operate as a non-coded, continuous ringing system which will sound all audible devices and activate all visual devices until it is manually silenced.
- F. System shall be wired as a Class B system for all circuits.
- G. System is to be a complete analog addressable system except for portables. Portables shall be wired as hard-wired circuits.

- H. Conduit and boxes to be installed by Electrical Contractor. System cabling, devices and equipment shall be by the Fire Alarm Installer.
- I. Fire alarm system shall not share a raceway, junction box, enclosure, manhole or device with any other system
- J. Contractor to advise owner of requirements for monitoring the fire alarm system by owner's monitoring company and provide all electrical required for remote monitoring including tie to security cabinet.
- K. Provide and install wiring, equipment, etc. for connection to devices furnished under other divisions of the work.
- L. Provide and install wiring, equipment, etc. as required to deactivate power in the elevator rooms by heat detectors via shunt trip breakers and arm sprinkler pre-action system.
- M. Provide and install wiring, equipment, etc. as required to deactivate power to computer power panels and air conditioning equipment by automatic or manual devices as shown on plans.
- N. Although they may not be indicated on the Fire Alarm system diagram and/or drawings, all required control and interlock wiring between the Fire Alarm system and building equipment shall be provided hereunder. Controls are required to/for/from:
 - 1. Fire/smoke air and duct detectors
 - 2. Fire, smoke and/or combination fire/smoke dampers.
 - 3. Supply/Return fans, Exhaust fans, and/or Fan Terminal Boxes (FTB)
 - 4. Automatic fire extinguishing systems
 - 5. Smoke evacuation equipment
 - 6. Sprinkler and/or Fire Protection system components
- O. Provide wiring for Post Indicator Valve Alarms, in each instance in which these are provided under work of Other Trades, connected to Fire Alarm System.
- P. Provide and install all relays (electric-electric, electric-pneumatic, and/or pneumatic-electric) as required for a complete and operational fire alarm system, complying with all applicable codes and all requirements, and coordinated with all divisions of these specifications.
- Q. Provide terminal cabinets sized to house terminal strips and surge suppression equipment.
- R. Surge Suppression
 - 1. The contractor shall have equipment installed on the AC voltage supply and other lines taking care to arrest damaging electrical transient and spikes which can cause damage to the microprocessor components of the system. Central office telephone lines shall have equipment installed to arrest high voltages from electrical and/or lightning from entering the system and causing damage.

2. Provide and install all materials, labor and auxiliaries required to furnish and install complete surge suppression for the protection of building fire alarm system from the effects of induced transient voltage surge and lightning discharge as indicated on drawings or specified in this section.
3. Provide surge suppression equipment at the following locations:
 - a. On each conductor pair and cable sheath entering or leaving a building.
 - b. On each conductor associated with fire protection (sprinkler) system fire alarm connections.
 - c. On any and all telephone lines.
 - d. In other locations where equipment sensitivity to surges and transients requires additional protection beyond that inherent to the design of the equipment. Where equipment being protected has internal surge suppression equipment, the surge protection equipment herein specified is required to be installed in addition to internal equipment protection.

1.4 SPECIAL REQUIREMENTS

- A. The Contractor shall, as part of his submittals, provide updated battery calculations for the existing system power supplies that take into consideration the existing circuits (outside the scope of work for this project) and the modified circuits (included in the scope of work for this project) to verify the existing batteries are adequate. If the battery calculations show that one or more battery banks will, at the end of this project, not meet the specified requirements the Contractor shall either upgrade the battery bank(s) in question or add an additional power supply with battery backup that meets the specified requirements.

1.5 FUNCTIONS AND OBJECTIVES

- A. System Operation
 1. System operation shall meet the operation requirements of all codes and regulatory requirements.
 2. Upon activation of the Fire Alarm System by a manual station, smoke detector, or any other new or existing automatic device the following shall take place:
 - a. Energize all alarm signaling devices.
 - b. Sound all audible alarms and flash visual signals throughout the campus.
 - c. Alert proprietary system.
 - d. Cause alarm to be displayed on the annunciator section of the control panel.
 - e. Cause alarm to be displayed on remote annunciator
 - f. Close all doors or fire shutters, held open by automatic release devices throughout the facility, (coordinate with architect and door hardware supplier, provide all electrical required).
 - g. Unlock all electrically locked time-out room doors (coordinate with the architect and door hardware supplier, provide all electrical required).
 - h. Shut down all air handlers, exhaust fans supplying or exhausting air, and fan terminal boxes (FTB).

- i. Shut all fire and/or smoke dampers in ducts associated with the air handling units and exhaust fans which are shut down.
 - j. Transmit signals to the building elevator control panel to initiate return to the main floor or alternate floor.
 - k. Transmit signals to the building automation system to tell system that the fire alarm system has taken control of respective mechanical system.
 - l. Send a signal to all dimming and lighting relay/control systems. Fire alarm signal shall initiate dimming system controls to drive all dimmed circuits to immediate full-on output. Fire alarm signal shall initiate lighting relay/control system to turn on all emergency lighting circuits.
 - m. Send a signal to all non-fire alarm sound reinforcement systems. Fire alarm signals shall override all other sound systems. Alarm notification signals shall take precedence over all other signals. Operation of other sound systems shall resume after fire alarm system clears alarm.
 - n. Activate the system dialer and transmit the signal to the monitoring contractor, to notify the local Fire Department.
3. System supervisory faults, such as shorts, opens, and grounds in conductors, operating power failure, or faults within supervised devices, shall place the system in the trouble mode, which causes the following system operations:
- a. Visual and audible trouble signal indicated by zone at the fire alarm control panel.
 - b. Visual and audible trouble signal indicated at remote annunciator panel.
 - c. Trouble signal transmitted to central station.
 - d. Manual acknowledgement function at fire alarm control panel shall silence audible trouble signal; visual signal shall be displayed until initiating failure or circuit trouble is cleared.
4. Alarm Reset: The system shall remain in the alarm mode until manually reset with a key accessible reset function. The system shall reset only if the initiating circuits are cleared.
5. Lamp Test: manual lamp test function causes alarm indication at each lamp on the fire alarm control panel and the remote annunciator.
6. When the fire alarm system is activated as a drill, all incidental functions shall be exercised including notification of the fire department.
7. Where required by codes or authority having jurisdiction:
- a. When system is silenced by silence switch in control panel, audible alarm is to silence but visual alarm devices are to continue to operate.
8. Fire sprinkler valve tamper switch, when closed, shall annunciate a supervision signal at the fire alarm control panel and annunciator panels, if any. This supervision signal shall not cause a general alarm.
9. Operation of auxiliary contacts in control panel to shut all smoke dampers in ducts associated with air handling units and exhaust fans which are shut down. (These shall not be controlled from detector unit contacts.)

B. Zoning

1. Alarm Zones.
 - a. Regardless of the number of zones shown on drawings, the minimum alarm zones required are:
 - 1) One per building, per floor for pull stations.
 - 2) One per building, per floor for automatic devices.
 - 3) One for each duct smoke detector).
 - 4) Each device shall be individually annunciated/addressable.
2. Notification Zones.
 - a. Regardless of the number of zones shown on drawings the minimum notification zones (horns and strobe lights) required are:
 - 1) One (or more) circuit(s) for administration building
 - 2) One (or more) circuit(s) for exterior horns
 - 3) One (or more) circuit(s) for remainder of campus.
 - b. Breakdown circuits as required for load and distances involved.

1.6 ALTERNATES

- A. Additive Alternate #2: All work associated with Conference Center (S222A).

PART 2 - PRODUCTS

2.1 FIRE ALARM CONTROL PANEL:

- A. All equipment and materials installed as part of this project shall be fully compatible with the equipment FACP.
- B. The existing Fire Alarm Control Panel (FACP) is a:
 1. Simplex 4100U

2.2 FIRE ALARM SYSTEM COMPONENTS:

- A. Audible Notification Devices:
 1. Voice Evac
 - a. Voice Evac speakers shall be installed where shown on the drawings.
 - b. Shall be speakers that operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.
 - c. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
 - d. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
 - e. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

B. Visual Notification Devices

1. Shall meet the requirements of the ADA, UL Standard 1971 and shall meet the following criteria:
 - a. The maximum pulse duration shall be 2/10 of one second.
 - b. Strobe intensity shall meet the requirements of UL 1971.
 - c. The flash rate shall meet the requirements of UL 1971.
2. Visual portion of the audible/visual notification devices shall comply with the Americans with Disabilities Act which includes the following:
 - a. Lamp shall be a xenon strobe type or equivalent.
 - b. Color shall be clear or nominal white (i.e. unfiltered or clear filtered white light).
 - c. Maximum pulse duration shall be two-tenths of one second (0.2 sec) with a maximum duty cycle of 40 percent. Pulse duration is defined as the time interval between initial and final points of 10 percent of maximum signal.
 - d. Intensity shall be a minimum of 75 candela. Use of visual devices rated at 15/75, 15 or 30 candela shall not be acceptable.
 - e. Flash rate shall be a minimum of 1 Hz and a maximum of 3 Hz.
 - f. More than two visible notification appliances in the same room or adjacent space within the field of view must flash in synchronization. This requirement shall not preclude synchronization of appliances that are not within the same field of view.
3. A suitable polycarbonate cover shall be provided to protect devices at locations where they may be subject to damage such as Gymnasiums.

2.3 FIRE ALARM SYSTEM COMPONENTS – ADDRESSABLE DEVICES:

A. Addressable Devices – General

1. Addressable devices shall use simple to install and maintain decade, numbered 0 to 9, address switches. Detectors that have expanded addressing will have decade switch numbered from 0 to 15 for the most significant digit to allow detector addressing from 1 to 159.
2. Addressable devices which use a binary-coded address setting method, such as a DIP switch, are not an allowable substitute.
3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signaling line circuits.
4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Base shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
11. Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
12. Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
13. A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

B. Intelligent Photoelectric Smoke Detector

1. The 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.

C. Intelligent Duct Smoke Detector

1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
2. Detector shall be zoned so that when either the supply or the return detector senses smoke it will cause a supervisory/trouble indication at the Fire Alarm

Control Panel and immediately shut down the air handler. The duct mounted detectors shall not cause a general alarm to sound.

D. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.
2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.
3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
4. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised, UL listed remote power supply.
5. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

E. Manufacturers

1. Basis of Design
 - a. Simplex (no substitutions allowed)

2.4 FIRE ALARM SYSTEM BATTERIES:

- A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
- B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.
- C. If necessary to meet standby requirements, external battery and charger systems may be used.

2.5 RELAYS:

- A. Relays required for control (i.e. Air Handler shutdown, Supply Fan shutdown, Exhaust Fan shutdown, Fan Terminal Box shutdown, Door Lock release, Fire Shutter release, Smoke Damper closure, Fire Damper closure, Smoke/Fire Damper closure, or any other interface required by these specifications or applicable codes) shall be UL Listed relays suitable for use in Fire Alarm systems.
- B. Per NFPA, relays used for control of other systems shall be located within three feet (3') of the device to be controlled.

- C. Relays shall be analog addressable devices powered and controlled from the fire alarm system. Each relay shall contain address switches to assign a unique input point for programming or control by the system.
- D. Each relay shall provide at least one set of Form "C" dry relay contacts.
- E. Manufacturers
 - 1. Basis of Design
 - a. Simplex

2.6 PATHWAYS:

- A. Comply with the requirements of Section 16701.

2.7 CABLE:

- A. Contractor shall provide and install cable as required by the manufacturer to provide a complete, fully operational, UL Listed Fire Alarm system.
- B. Fire alarm system cables installed in interior, exterior and/or underground raceways shall comply with the applicable sections of NEC Articles 760, 770 and 800.
- C. Cables shall be for power-limited fire alarm signal service Type FPL, and NRTL listed and labeled as complying with NFPA 70 Article 760, UL 1424 and UL 2196. Where installed in return air plenums cable shall be plenum rated. All vertical Fire Alarm cables and wiring traversing more than one level shall be routed in rated enclosures. In addition, all horizontal wiring serving devices located on floors other than where wiring originates shall be routed in 2-inch concrete encasement, suitable rated building construction, or 2-hour wrap application enclosure accepted by local authority having jurisdiction.
- D. Zip and zip type cables (e.g. West Penn 970, 971, 972, 974 or similarly constructed cables from other manufacturers) shall not be acceptable.
- E. Conductor: 98% conductivity, stranded copper with maximum of 19 strands. Stranded conductors shall have a compression lug installed at every end. Wrapping twisted strands at terminal block screw is not acceptable. As an acceptable equivalent, stranded conductors without crimp-on lugs may be terminated into terminal strips of box-lug connectors. SLC loops may use solid conductors.
- F. Insulation: A type accepted by NEC for the application. All cable shall be UL listed for fire-protective signaling application. Communication, Class 3 or Multi-Purpose cables shall not be substituted for FP cable types. All multiconductor cables shall have individually insulated conductors with an overall outer jacket.
- G. Size: All conductors shall be sized as prescribed by the system manufacturer, with following minimums:
 - 1. Multiplex Signaling Line Circuit: AWG #16, solid.

2. Notification Circuits, Devices: AWG #14, THHN/THWN stranded conductors.
3. Initiating Circuits, Hard-Wired Devices: AWG #14, THHN/THWN stranded conductors.
4. Initiating Circuits, Addressable Devices: AWG #14, shielded twisted pair.
5. The above wire sizes shall be increased to size as required to comply with authority having jurisdiction or as required for voltage drop, load, etc. Provide larger conductors where required to maintain voltage drop or signal strength within acceptable limits.
6. Multiplex signal line circuits and addressable circuits shall be either shielded or unshielded based on equipment manufacturer's recommendations for specific application.

H. UL:

1. General: Fire-protective signaling cable shall be UL listed as non-power limited or power limited as needed to match the output of the fire alarm equipment.
2. Non-Power Limited: Fire protective signaling circuits classified as non-power limited shall use cable listed under UL Electrical Construction Materials Directory, Category HNHT, "NON-POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". All such cable shall have fire resistance, listing and markings as described in NEC 760. Minimum cable marking shall be NPLF.
3. Power Limited: Fire protective signaling circuits classified as power limited shall use cable listed under UL Category HNIR, "POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". All such circuits shall be durably marked where plainly visible at terminations to indicate that it is a power-limited fire protective signaling circuit. Refer to paragraph titled "Fire Resistance of Cables" for additional requirements.
4. Fire Resistance of Cables: Power-limited fire-protective signaling circuit cables shall be UL listed as described in NEC 760. All such cable shall bear a cable marking that includes a Type designation as given in NEC 760. Provide Type FPL.

I. Wiring color code shall be as follows:

1. Horns/Strobes: Black/Red
2. Door Holders: White
3. Air Handler Duct Detectors: Purple
4. Gas Shut-Off Pull Stations: Orange
5. Addressable: Twisted Pair Data Wire
6. Hard-Wired: Brown/Blue

J. Manufacturers

1. Basis of Design
 - a. Belden
2. Acceptable Substitutions
 - a. West Penn Wire

b. Draka

2.8 SURGE SUPPRESSION:

A. Non-Addressable Initiation Devices:

1. Plug-in replacement modular design with associated female wiring connector.
2. UL 497B listed and labeled.
3. Multi-stage hybrid protection circuit.
4. Fail short/fail safe.
5. Surge Capacity: 10KA with 8 x 20 μ s waveform, 500A per line with 10 x 700 μ s waveform.
6. Clamp Voltage: 150% of circuit peak operating voltage with 100 amp 10 x 700 μ s waveform.
7. Maximum Continuous Operating Voltage: 125% of peak operating voltage, minimum.
8. Capacitance: 1500 pf.
9. Manufacturers

a. Basis of Design

- 1) EDCO #PC642C series with #PCBIB base or acceptable substitution.

B. Addressable Initiation Devices and Data Loops:

1. Plug-in replacement modular design with associated female wiring connector.
2. UL 497B listed and labeled.
3. Multi-stage hybrid protection circuit.
4. Fail short/fail safe.
5. Surge Capacity: 10KA with 8 x 20 μ s waveform, 500A per line with 10 x 700 μ s waveform.
6. Clamp Voltage: 150% of circuit peak operating voltage with 100 amp 10 x 700 μ s waveform.
7. Maximum Continuous Operating Voltage: 125% of peak operating voltage, minimum.
8. Capacitance: 50 pf.
9. Manufacturers

a. Basis of Design

- 1) EDCO #PC642C-LC series with #PCBIB base or acceptable substitution.

C. Horn, Strobe, Control Power (Low Voltage):

1. Plug-in replacement modular design with associated female wiring connector.
2. UL 497B listed and labeled.
3. Multi-stage hybrid protection circuit.
4. Fail short/fail safe.
5. Surge Capacity: 5KA with 8 x 20 μ s waveform.

6. Clamp Voltage: 150% of circuit peak operating voltage with 100 amp 10 x 700 μ s waveform.
7. Maximum Continuous Operating Voltage: 125% of peak operating voltage, minimum.
8. Series Resistance: 0.2 ohms total per pair.
9. Manufacturers

a. Basis of Design

- 1) EDCO #P164 series (1 pair); #P264 series (2 pair), each with #SD12-PC base or acceptable substitution.

PART 3 - EXECUTION

3.1 GENERAL

- A. Comply with the requirements of Section 16701.
- B. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.
- C. Pathways:
 1. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. The system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
 2. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
- D. Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications. Contractor shall provide and install a properly sized, flush mounted outlet box for every device. Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable. In locations where raceway and/or conduit is not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to junction and pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device. Contractor shall properly terminate each device according to the manufacturer's recommendations.
- E. Locate, install, and test fire alarm and detection systems in accordance with the equipment manufacturer's written instructions, and the latest editions of the National

Electric Code, the National Electrical Contractor's Association publication "Standard of Installation" and all applicable codes and standards referenced in this specification.

- F. Provide all work required for a complete system including complete system testing and checkout. All components shall be properly mounted and wired. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.
- G. Provide wiring, cabling, raceways, and electrical boxes in accordance with manufacturer's written instructions.
- H. Components shall be electrically "burned-in" by operating the component at full power for a period as recommended by the manufacturer.
- I. Installation shall be done in a neat workmanlike fashion by a firm regularly engaged in Fire Alarm Installation and Service.
- J. The installation and inspection of all fire detection and fire alarm devices and systems shall be performed by, or under the direct on-site supervision of, a licensed fire alarm technician or a fire alarm planning superintendent who shall certify the work upon completion of the activity. The certifying licensee shall be present for the final test prior to certification.
- K. As-built plans and wiring diagrams shall bear the signature and license number of the licensed fire alarm planning superintendent, the date of installation and the name, address, and certificate-of-registration number of the registered firm.
- L. All components shall be completely wired. System shall be fully operable when main power service has failed and the Emergency Standby Generator has assumed emergency system loads. This shall require that any devices which required 120 volt power shall receive supply from an emergency 120 volt source.
- M. Installation of detectors:
 - 1. All ceiling mounted detectors shall be installed in accordance with the requirements of NFPA 72.
 - 2. All concealed detectors shall be provided with a remote indicating lamp and test switch installed in an occupied space (corridor, etc.) on wall or on the ceiling grid indicating the type of detector and the zone to which it is connected. Label shall be red with white lettering.
 - 3. Duct detectors shall be installed in accordance with NFPA 90A. All brackets and hardware shall be provided as required to install detector housing in correct position. All detector housings shall be sealed as required to prevent air leakage between duct and housing. Sampling tubes of proper length shall be provided and installed to match duct width at the installed location.

3.2 RACEWAYS AND BOXES

- A. Comply with the requirements of Section 16701.

- B. Provide dedicated raceway with applicable boxes for all fire alarm wiring in accordance with applicable sections of these specifications.
- C. All initiating, indicating and auxiliary control devices shall be mounted on UL listed outlet boxes.
- D. Identify raceways and boxes per requirements of Division 16.

3.3 WIRE/CABLE

- A. Comply with the requirements of Section 16701.
- B. Comply with NECA 1 and NFPA 72.
- C. Connections of Installation Wiring:
 - 1. Connections to Equipment: In accordance with NFPA for monitoring integrity and with the equipment manufacturer's instructions.
 - 2. Connections of installation wiring to alarm initiating devices and alarm indicating appliances shall be monitored for integrity.
 - 3. Interconnecting means shall be arranged so that a single break or single ground fault will not cause an alarm signal.
 - 4. Apply a compression lug, similar to T&B Sta-Kon Terminal, to all stranded conductors at terminations or use box-lug terminal strips.
 - 5. There shall be no wire splices. All wiring shall be continuous, uncut between devices and terminal blocks.
 - 6. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 7. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
 - 8. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 9. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
 - 10. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
 - 11. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
 - 12. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
 - 13. Wiring used for the multiplex communication circuit SLC shall be twisted and shielded and support a minimum wiring distance of 10,000 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
 - 14. All field wiring shall be electrically supervised for open circuit and ground fault.

D. Rated Enclosures:

1. All vertical fire alarm wiring traversing more than one level shall be routed in rated enclosures. In addition, all horizontal wiring serving devices located on floors other than where wiring originates shall be routed in 2-inch concrete encasement, suitable rated building construction, or 2-hour wrap application enclosure accepted by local authority having jurisdiction.
2. Install wiring in a metal raceway system according to Division 16 Section "Raceway and Boxes for Electrical Systems."
 - a. Wire and cable shall be installed in a complete raceway system.
 - b. Wire and cable shall be installed in J-hook assemblies above accessible (drop) ceilings. Wire and cable installed underground, between buildings, within walls, in spaces with ceiling exposed to structure (e.g. not installed above accessible (drop) ceilings), above inaccessible ceilings, or where installed below ceilings shall be in conduit. All backbone cabling shall be in a complete conduit system. Install and size raceways in accordance with the specifications, National Electric Code (NEC), and the equipment manufacturer's recommendations.
3. 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 the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made. 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 cover red. 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 the receipt or transmission of signals from other floors or zones.

- G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) 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.

3.4 MANUAL PULL STATIONS

- A. Install at 48 inches to top above finished floor.
- B. All manual stations shall be in unobstructed locations.
- C. Install to comply with NFPA, ADA, and all handicap/accessibility code requirements.

- D. Provide, install, and connect additional pull stations (from that shown on drawings) as required to comply with above requirements.
- E. Shall be installed within five (5) feet of each exit door.

3.5 AUDIBLE SIGNAL DEVICES, VISUAL SIGNAL DEVICES OR COMBINATION
AUDIBLE/VISUAL SIGNAL DEVICES

- A. Shall comply with NFPA, the Americans with Disabilities Act and other applicable handicap/accessibility codes including but not limited to the following:
 - 1. Wall mounted devices shall have their bottom edge at heights above the finished floor of not less than 80 inches and no greater than 96 inches.
 - 2. In general, no place in any room or space required to have a visual signal appliance shall be more than 50 ft. (15 m) from the signal (in the horizontal plane). In large rooms and spaces exceeding 100 ft. (30 m) across, without obstructions 6 ft. (2 m) above the finished floor, such as auditoriums, devices may be placed around the perimeter, spaced a maximum 100 ft. (30 m) apart, in lieu of suspending appliances from the ceiling. Placement of visual devices shall not be less than the requirements as specified by NFPA 72.
 - 3. No place in common corridors or hallways in which visual alarm signaling appliances are required shall be more than 50 ft. (15 m) from the signal. Placement of visual devices shall not be less than the requirements as specified by NFPA 72.
 - 4. Audible device dB levels shall comply with NFPA 72 requirements and shall be a minimum of 15 dB above average ambient room noise or 5 dB above maximum room noise levels. The Contractor shall add devices as necessary to ensure dB levels per NFPA are met in all required spaces.

3.6 END-OF-LINE DEVICE

- A. Mount end-of-line device box with last device or separate box adjacent to last device in circuit.

3.7 DUCT DETECTORS

- A. Duct Detectors installed in concealed locations, locations more than ten feet (10'0") above finished floor, or installed so that the detector's supervisory indicator is not visible shall be provided with a remote test and indicator stations. Remote test and indicator stations shall be installed 48" A.F.F. in a readily accessible location.

3.8 AUXILIARY CONTROL RELAYS

- A. An auxiliary fire alarm relay used to control an emergency control device, e.g. motor controller for HVAC system fan or elevator controller shall be located within 3 ft. of the emergency control device.
- B. The installation wiring between the system panel and the auxiliary fire alarm relay shall be monitored for integrity.
- C. Auxiliary control relays shall be listed for use with fire alarm systems.

3.9 SPRINKLER FLOW SWITCHES

- A. Coordinate the electrical and operating characteristics of the flow switches with the fire alarm panel.
- B. Run conduit and wiring to the flow switches, and connect them so as to provide an operable supervised sprinkler alarm system per NFPA standards, and state and local codes.
- C. Provide all electrical including zones as required by authority having jurisdiction and codes.

3.10 SPRINKLER VALVE SUPERVISORY SWITCHES

- A. Coordinate the electrical and operating characteristics of the supervisory switches with the fire alarm panel.
- B. Run conduit and wiring to the supervisory switches, and connect them so as to provide an operable supervised sprinkler alarm system per NFPA standards, and state and local codes.
- C. Provide all electrical including zones as required by authority having jurisdiction and codes.

3.11 CABLE IDENTIFICATION

- A. Provide and install permanent cable markers on all cables/wire lines, telephone lines, etc. at terminal strips, terminal cabinets and at main equipment.

3.12 CONDUIT/BOX IDENTIFICATION

- A. Contractor shall identify fire alarm conduit and boxes with red paint in exposed locations. Identify conduit in concealed locations with 4" mark of red paint every 4'-0" O.C.

3.13 DEMONSTRATION

- A. When system is complete it shall be demonstrated to Owner's Representative who shall be given complete instructions, spare parts, manuals and maintenance information.

3.14 TESTING

- A. Comply with the requirements of Section 16701.
- B. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72.

- C. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- D. Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- E. Verify activation of all waterflow switches.
- F. Open initiating device circuits and verify that the trouble signal actuates.
- G. Open and short signaling line circuits and verify that the trouble signal actuates.
- H. Open and short notification appliance circuits and verify that trouble signal actuates.
- I. Ground all circuits and verify response of trouble signals.
- J. Check presence and audibility of tone at all alarm notification devices.
- K. Check installation, supervision, and operation of all intelligent smoke detectors using the walk test.
- L. Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- M. When the system is equipped with optional features, the manufacturer's manual shall be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

3.15 SYSTEM DEMONSTRATION

- A. Prior to certification of the fire alarm system the contractor shall accomplish a complete test of the fire alarm system in accordance with NFPA 72, Test Methods.
- B. Perform a complete, functional, component by component test of the entire fire alarm and detection system. Provide a detailed step by step testing procedure which is unique to this project, reflecting the type of system and the number and location of all components.
- C. Perform a sensitivity test of all smoke detectors and duct detectors. Perform a calibration/test of heat sensors.
- D. Demonstrate the proper operation of each component as follows:
 - 1. Photoelectric, and duct smoke detectors: activate the detector with a "false smoke" product which has been specifically formulated for testing smoke detection systems.
 - 2. Heat detectors: activate the detector by utilizing the detector check button.
 - 3. Pull Stations: activate the station by operating the station in its normal mode.

4. Audible and Visual Alarms: verify proper operation when the system is put into the alarm mode.
5. Sprinkler Flow Switches: open the sprinkler system's inspection test valve. Verify that the flow switch sends an alarm signal within the allowed time corresponding to the switch's time delay setting.
6. Fire Alarm Panels: functionally check-out and test the panel per the manufacturer's written instructions. Demonstrate the proper operation of each modular component. Demonstrate automatic power change to batteries and back to building power upon a drop in voltage below the voltage threshold as specified by the panel manufacturer.
7. Demonstrate the supervisory function at each device loop circuit, and at all single component wiring runs such as for the sprinkler valve supervisory switches.

3.16 CERTIFICATION

- A. After completion of the installation of the system, the licensee shall complete a NFPA Inspection and Testing form. The Inspection and Testing form format shall be as indicated in NFPA 72, Inspection and Testing Form. When an Inspection and Testing form has been completed, legible copies shall be distributed as directed by the Authority Having Jurisdiction.
- B. After an installation has been complete, affix a Fire Alarm Tag to the control panel. The Fire Alarm Tag is in addition to the Inspection and Testing form. Protect the Fire Alarm Tag from vandalism by applying pressure sensitive label; do not use a "tie-on" tag. It shall be as required in the Fire Safety Rules.
- C. After completion of the installation and testing provide NFPA 72 Record of Completion form to the Owner.

3.17 FINAL DRAWINGS

- A. As-built drawings shall be given to the Owner's representative, at time of instruction, in addition to those to be supplied as general requirements of the job.

3.18 AUTHORITY HAVING JURISDICTION

- A. The drawings and specifications herein comply to the best of the Designer's knowledge with all applicable codes at time of design. However, it is this contractor's responsibility to coordinate/verify (prior to bid) the requirements of the Authority Having Jurisdiction over this project and bring any discrepancies to the engineer's attention at least 7 days prior to bid. No changes in contract cost will be acceptable after the bid for work/equipment required to comply with the authority having jurisdiction.

END OF SECTION 16781