JOLIET JUNIOR COLLEGE 1901

Joliet Junior College
Respiratory Therapy

Issued for Bid

1215 Houbolt Road
Joliet, Illinois 60431

PROJECT MANUAL

ESA Project Number 19130
November 30, 2020

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PROJECT MANUAL
TABLE OF CONTENTS

The following listed documents comprise the Project Manual for the Joliet Junior College Respiratory Therapy project. Where numerical sequence of Section numbering is interrupted, such interruptions are intentional.

DIVISION 20 MECHANICAL

DIVISION 21 FIRE SUPPRESSION

DIVISION 22 PLUMBING

DIVISION 23 HEATING, VENTILATING AND AIR CONDITIONING

DIVISION 26 ELECTRICAL

DIVISION 27 COMMUNICATIONS

DIVISION 28 ELECTRONIC SAFETY AND SECURITY

END OF TABLE OF CONTENTS

RESPIRATORY THERAPY – SCOPE OF WORK

1.0 OVERVIEW OF THE PROJECT

1.1 General Project Information

Joliet Junior College is building out approximately 7200 square feet of shell space within the first floor of the U bldg. for a Respiratory Therapy program. The construction of this project is to be completed through a general contractor public bid process. For the duration of this document the term "contractor" shall be interpreted to mean the general contractor and/or any subcontractor that falls under him. Ultimately, the general contractor is responsible for a complete project consisting of all required material and labor that falls within the drawings, specs and this scope of work document.

2.0 SCOPE OF WORK OVERVIEW

2.1 General Contractor Requirements

The general contractor (may be referred to as "contractor" in this document) shall be the coordinating contractor of all his subcontractors, and all work required to provide a complete project. This coordination will be inclusive of creating an overall schedule with input from his subcontractors. All work will be scheduled by the general contractor and will ensure no work is installed out of sequence. The general contractor will champion the project, lead weekly meetings with the owner, A/E and pertinent subcontractors in attendance. Provide meeting minutes/notes and records of any necessary logs. Joliet Junior College is not providing the coordination and/or construction sequencing of any subcontractors that fall under the general contractor. However, Joliet Junior College will coordinate the efforts of purchasing and installing of the security card access system, as well as any security cameras within the space (card access cabling and camera data cabling by general contractor's electrical sub-contractor). Furniture will be provided and installed by JJC under separate contract.

2.1.1 All work to be completed in strict accordance with the drawings and specifications. Existing conditions are to be field verified and taken into consideration that the general contractor is competent to provide a finish product as intended by the project design and this scope of work. Unknown concealed conditions are an acceptable means to an adjustment to scope. However, any existing condition that is viewable during the bid process will be the responsibility of the general contractor.

2.1.2 Contractor shall furnish all shop drawings, catalogue cuts, submittals, mix designs or any other necessary submittals within ten (10) days of award of contract for architect's review/approval. Shop drawings that take longer to develop shall be coordinated with owner and A/E. Development of a master shop drawing submittal schedule shall be the responsibility of the contractor.

2.1.3 If it applies to this project, the contractor will be responsible for any through-wall, through-floor and/or through roof penetrations related to their scope of work. If this work will impact the operation of adjacent classrooms, the contractor shall notify the owner prior to starting any of this work for coordination of proper scheduling.

2.1.4 The contractors' personnel shall comply with Joliet Junior College requirements of mandatory orange or yellow safety vests (no offensive messages or graphics), hard hats, safety glasses, safety shoes worn at all times. General contractor shall submit their safety plan to JJC and shall be maintained on site for the duration of the project.

2.1.5 The general contractor will be given an office work space within the U building (will be on second floor directly above the Respiratory Therapy space). Contractor responsible for documenting condition of the space and furniture prior to project starting, and must provide cleaning of the space for the duration of the project. Vacuuming of carpet, dusting and emptying of garbage by contractor. Contractor to provide final cleaning that returns the space to the original condition. Any damage to the space or furniture will be at the contractor's expense. There will not be office space provided to the general contractor's sub-contractors.

2.2 Except as otherwise expressly provided herein, the contractor shall supply all adequate and competent labor, supervision, tools, equipment, materials, services, testing devices, and each and every item of expense necessary for complete installation according to the contract documents, including but not limited to:

2.2.1 The contractor shall provide all required labor and material expenses to provide a safe working environment in accordance with all OSHA requirements whether called for in drawings, specs or not. This includes all temporary barricades, ramps, fire extinguishers and stands, signage, etc.

2.2.2 The contractor will provide all necessary dust protection at adjacent existing areas of construction. Provide any necessary temporary walls and doors to block access to the construction site by unauthorized personnel (faculty, staff, students, etc.). Joliet Junior College facilities department will be provided with access codes or keys to any temporary locks.

2.2.3 The contractor shall determine means and methods of pouring concrete floor. If a window(s) is removed for pumping concrete, contractor shall replace same. Exterior of building to be protected from splatter or damage, and landscape area (bushes, grass, mulch, etc) or cracked concrete shall be restored to original. Contractor should document and photo all existing exterior conditions prior to starting. All necessary pedestrian and auto traffic safety around the building will be the responsibility of the contractor.

2.2.4 The contractor will provide all wood blocking in wall framing at all necessary locations where items on the drawings are interpreted as being secured to gyp. brd. walls whether drawings state to provide blocking or not (i.e. shelving brackets, paper towel dispensers, projector screen brackets, etc.).

2.2.5 The contractor will provide finish floor protection, as well as protection of any other surfaces that may get damaged or scratched while construction is on-

going. Materials, means and methods of this protection is to be determined by the contractor, but must adequately protect the surface from on-going activity.

2.2.6 Should an exterior/outdoor staging area for material or equipment be necessary, the contractor is to provide chain link fencing around the perimeter and shall be responsible for security.

2.2.7 Although this is an interior project, the contractor shall be responsible for cleaning and sweeping of dirt/mud from parking lots and roadways at anytime construction activity from the site creates such hazard (hauling out excavated spoils, concrete trucks, etc.)

2.2.8 The contractor shall restore all adjacent landscape areas that may be disturbed from construction activities (including, not limited to replace trees, bushes, repair ruts, place grass seed, etc.).

2.2.9 The contractor shall provide all dumpsters required for the project. General contractor is to determine amount of dumpsters they believe will be required. Should more dumpsters be required than contractor figured within their bid, additional cost of dumpsters will be at the expense of the contractor.

2.2.10 Contractor to be solely responsible for site clean-up on a daily basis. An unclean/unsafe site will be the responsibility of the contractor to correct, and ultimately responsible for cleanliness of the site and surrounding areas (hallways/corridor).

2.2.11 The contractor shall provide a spontaneous safety check of the entire site (including observation of subcontractors) when directed by the JJC project manager twice monthly. The general contractor will have their safety representative provide a written report of any near misses, accidents and/or violations. This report will be used for weekly coordination and progress meetings for discussion under the safety topic.

2.2.12 Carpet tile shall be provided by JJC and installed by contractor. Contractor will be responsible for picking up carpet tiles from the JJC facilities building located on the north side of campus. Unused carpet tiles shall be brought to the storage area in the U building by the contractor. Contractor to provide carpet glue per the manufacturer's recommendation.

2.2.13 Contractor to provide and install VCT tile in accordance with drawings and specifications. VCT flooring shall be cleaned and prepped for wax ready condition. Waxing of floors (material and labor) to be by JJC personnel. Contractor to coordinate with JJC for floor wax install into schedule prior to furniture delivery and install (by JJC).

2.2.14 Contractor to provide (1) one temporary toilet on the north side of U bldg. with a minimum of 1 service weekly for the duration of the project. Interior restrooms are for students, staff and faculty use, and are not to be used by the contractors' personnel.

2.2.15 Contractor to remove all excavation spoils (if any) from inside bldg. off site (no storing spoils on JJC property).

2.2.16 Contractor shall coordinate deliveries with his subs. Deliveries made to JJC receiving area may or may not be accepted. Deliveries will be turned away during non JJC working hours. JJC will not unload contractor deliveries with their forklift, deliveries will be redirected to the contractor. Contractor will not be compensated for extra charges if deliveries are turned away.

2.2.17 General contractor to provide all final cleaning of the entire project. It shall include, but not be limited to:

- Vacuuming carpeted areas including any mats
- Sweep and mop all interior VCT or hard surface floors according to manufacturers' recommendations.
- Wipe down base boards (rubber, wood or other).
- Wipe down all railings (if any)
- Wipe down all countertops, backsplashes, shelving and flat surfaces.
- Wipe down all door frames and doors.
- Wipe down all hanging light fixtures.
- Wipe all plumbing fixtures such as sinks, faucets, mirrors, etc.
- Clean and wipe all fire extinguisher cabinets.
- Clean all windows
- Wipe down any surfaces/fixtures mounted to walls.
- If not listed above, clean it if it requires cleaning prior to owner acceptance.

2.3 Contractor shall provide all necessary temporary lighting for the duration of the project as necessary.

2.4 Contractor shall provide all necessary temporary power for the duration of the project as necessary.

2.5 Any demolition required prior to start of this project falls under the scope of the general contractor.

3.0 MEDIA/AV/IT/SECURITY

3.1 Joliet Junior College will provide all ceiling mounted projectors and ceiling projector plates in the classrooms and lab. Contractor to provide all necessary cable, terminations and installation of projectors. Contractor to closely coordinate with JJC for exact location and positioning of projectors. The plans showing location are to be verified with JJC prior to install. Each projector shall require (2) Cat. 6 Panduit data cables. One from the projector to IDF closet U1120 and one from projector to floor plate at podium.

3.2 All AV equipment (other than projectors stated above), is to be provided, installed and integrated by the contractor, and closely coordinated with JJC during the purchase and install. Complete training of the system(s) is to be provided and coordinated with JJC staff with 4 hours of consulting time for JJC Media Department to coordinate with mfgr./equipment provider/installer after training has been provided.

3.3 All projector screens will be provided by JJC and installed by contractor. Locations of the screens shall be closely coordinated with locations of projectors and shall be directed by the JJC media department. Do not install projectors or screens without exact location approval from JJC. Should relocation of projectors and screens be necessary, it will be at contractor's expense if locations are not coordinated and documented by contractor.

3.4 All IT data cabling (Panduit) shall be provided, installed and tested by contractor. Cabling shall be terminated by contractor in all areas within Reception/Security and Respiratory Therapy areas. Cabling shall be run back to JJC IDF closet in room U1120 which is approximately 150 feet away (to the west) from the center of the Respiratory Therapy Space. Cabling within the IDF shall be terminated. JJC will provide patch cables. This installation shall be closely coordinated with JJC IT staff during weekly project meetings.

3.5 All security cameras (this is different than the cameras associated to the lab AV equipment) will be provided and installed by JJC. The data cable (Panduit) and JB at ceiling or walls will be provided and installed by the contractor. Cable to be run back to IDF closet in room U1120 which is approximately 150 feet away (to the west) from the center of the Respiratory Space. This installation to be closely coordinated with JJC maintenance staff during weekly project meetings. Provide a minimum of 15 feet of coiled cable at each location to allow future relocation of cameras if necessary.

4.0 DOOR ACCESS SYSTEM

4.1 The contractor will not be providing a door access control system. The door access system is provided and installed by JJC. However, there are portions of the system that will fall under the contractor's scope.

4.1.1 Contractor to provide and install door access control cable ("banana cable" to be Windy City Wire P/N 446100 plenum rated or equal) at each door with a "CR" designation on the drawing. This cable is to be ran from each door location back to IDF closet room U1120 which is approximately 150 feet away (to the west) from the center of the Respiratory Therapy Space. These cables shall be coiled up inside the IDF room with 25' of slack. Each cable shall be labeled in the IDF closet with door info. JJC will terminate these cables in their door access control system.

4.1.2 Door frames are to be prepped for a Von Duprin 6211 electric strike. This electric strike will be provided by JJC to contractor. Contractor to terminate and install the electric strikes.

4.1.3 Door frames should have ½" diameter hole drilled 42" AFF with banana cable extending through hole on the card reader side of frame. JJC will provide, terminate and install the card reader.

5.0 DOCUMENT CONTROL

4.1 Joliet Junior College will provide SmartSheet as a project management/document control platform for the architects, engineers, consultants, contractors and JJC employees for management of RFI's, submittals, daily reports, material procurement, meeting minutes,

etc. for the duration of the project. Contractor and their subs will be responsible to include any necessary training time necessary to become familiar with the use of this platform. No change orders will be given for time spent learning SmartSheet.

6.0 SCHEDULE

6.1 Contractor to submit a construction schedule with all related sub tasks, delivery dates, milestones, etc. as part of the preconstruction meeting with JJC that meets or improves JJC's schedule included s part of this bid package. This schedule is to be updated and reviewed at each weekly progress meeting.

7.0 PROJECT CLOSEOUT

5.1 Contractor to ensure the following are complete as part of the project close out process:

7.1.1 All as-built drawings/documents are complete.

7.1.2 All Operations & Maintenance manuals have been provided to JJC. All training has been completed with contacts of who and when to call.

7.1.3 All warranties have been reviewed and provided.

7.1.4 Obtain all final unconditional final lien waivers from subs and suppliers.

7.1.5 Certificate of substantial completion issued for start of warranty.

7.1.6 Completed punchlist documentation.

7.1.7 All close-out documents are well organized and provided in a project manual as well as submitted electronically.

SECTION 01 1000
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project Name: Joliet Junior College Respiratory Therapy.

B. Owner's Name: Joliet Junior College.

C. Architect's Name: Eckenhoff Saunders Architects.

D. The Project consists of the construction of a new respiratory therapy education department within the existing Health Professions "U" building at Joliet Junior College.

1.02 WORK BY OWNER

A. Owner may award separate contracts to perform other work on the premises.

B. Items noted NIC (Not in Contract) will be supplied and installed by others.

C. Review schedules on drawings for items furnished and installed by Owner.

D. Review schedules on drawings for items furnished by the Owner for installation by the Contractor.

1.03 OWNER OCCUPANCY

A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.

B. Owner intends to occupy the Project upon Substantial Completion.

C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

D. Schedule the Work to accommodate Owner occupancy.

1.04 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations: Limited to areas noted on Drawings.

B. Refer to Respiratory Therapy - Scope of Work document, included as a part of this Project Manual.

C. Arrange use of site and premises to allow:
   1. Owner occupancy.
   2. Work by Others.
   3. Work by Owner.
   4. Use of site and premises by the public.
   5. Unrestricted emergency services, doctor, staff and patient access.

D. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

E. Time Restrictions:
   1. Limit conduct of all interior work to the hours of 7:00 AM to 3:30 PM Monday to Friday.
   2. Limit conduct of all interior work to the hours directed by Owner.

F. Utility Outages and Shutdown:
   1. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
   2. Prevent accidental disruption of utility services to other facilities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 1019
CONTRACT CONSIDERATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Permit Fees.

B. Tax-Exempt Status.

C. General Conditions.

D. Building Information Modeling.

1.02 RELATED REQUIREMENTS

A. General Conditions: Contract sum including allowances.

B. Section 01 2000 - Price and Payment Procedures: Requirements for progress payments, change orders, and final payment.

C. Section 01 2500 - Substitution Procedures.

D. Section 01 3000 - Administrative Requirements.

E. Section 01 4000 - Quality Requirements.

1.03 TAX-EXEMPT STATUS

A. Joliet Junior College is a tax-exempt not for profit organization. A tax exempt letter will be provided upon request.

1.04 PERMIT FEES

A. The Owner will pay for and procure the building permit if one is required.

B. The Contractor will procure and pay for all other permits, inspections and other Fees as required by governing authorities as part of the Base Proposal.

1.05 GENERAL CONDITITIONS

A. For purposes of this Proposal, General Conditions shall include, but not be limited to, the following line items:
   1. All field supervision and engineering staff located on-site full time.
   2. All management staff located on-site full time.
   3. Field office, supplies, telephone, fax, electronic mail.
   4. Reproductions, photographs, messengers.
   5. Small tools and general equipment.
   6. All cleanup and dumpsters.
   7. Safety program implementation and management.
   8. Stairs and ladders.
   9. Barricades, covers, closures and all temporary entries and exits to occupied spaces.
   10. Groundwater control and dewatering.
   11. Layout, surveys, samples and tests.
   12. Temporary toilets.
   13. Material storage.
   14. OSHA Requirements.

1.06 BUILDING INFORMATION MODELING

A. Contractor's use of a BIM model during construction is optional.
   1. Refer to Section 01 3000 - Administrative Requirements for information on Coordination Drawings with and without the use of a BIM model during construction.

B. General Requirements:
   1. Nothing in this Section shall relieve the Architect from its obligation, nor diminish the role of the Architect, as the person responsible for and in charge of the design of the Project.
   2. Participation of the Contractor or its subcontractors and suppliers in Contributions to a Model shall not constitute the performance of design services.

3. Unless otherwise agreed in the BIM Execution Plan, a Design Model is not intended to provide the level of detail needed in order to extract precise material or object quantities.
4. In the event of a conflict between the contents of a Design Model and any other Model, the Design Model shall take precedence.
5. If any Project Participant becomes aware of a discrepancy between a Model and either another Model or another Contract Document, such Project Participant shall promptly notify the Architect.
6. Unless otherwise agreed in the BIM Execution Plan, the dimensional tolerances provided by the Contract Documents shall apply to dimensions in a Model.

C. Definitions:
1. **Model**: A three-dimensional representaiton in electronic format of building elements representing solid objects with true-to-scale spatial relationships and dimensions. A Model may include additional information or data.
2. **Construction Model:** A Model with the following characteristics:
   a. Consists of those aspects of the Project that are to be modeled as specified in the BIM Execution Plan prepared pursuant to this Section;
   b. Utilizes data imported from a Design Model or, if none, from a designer's Construction Documents; and
   c. Contains the equivalent of shop drawings and other information useful for construction.
3. **Contribution:** The expression, design, data or information that a Project Participant creates or prepares, and incorporates, distributes, transmits, communicates or otherwise shares with other Project Participant(s) for use in or in connection with a Model for the Project.
4. **Contributor:** A Project Participant who makes a Contribution.
5. **Design Model**: A Model of those aspects of the Project that have reached the stage of completion that would customarily be expressed in two-dimensional Construction Documents.
6. **Federated Model:** A Model consisting of linked but distinct component Models, drawings derived from the Models, texts, and other data sources that do not lose their identity or integrity by being so linked, so that a change to one component Model in a Federated Model does not create a change in another component Model in that Federated Model.
7. **Information Management:** Measures that protect and defend information and information systems with respect to their availability, integrity, authentication, confidentiality, and nonrepudiation. These measures include providing for restoration of information systems by incorporating protection, detection, and reaction capabilities.
8. **Information Manager (or IM):** One or more individuals responsible for the Building Information Modeling Information Management program.

D. Information Management:
1. The Contractor shall appoint one or more Information Manager(s) for the Project.
2. The role and responsibility of the IM with respect to a Federated Model for the Project, including the Construction Model, shall be to perform or procure from a third party acceptable to the Owner the the services of maintaining the model and overseeing its use.

E. Risk Allocation:
1. Each Party shall be responsible for any Contribution that it makes to a Model or that arises from that Party's access to that Model.
2. Design Models will not be included as Contract Documents and are provided for the convenience of the Contractor. Any Project Participant may rely on the dimensional accuracy of any Model only to the extent agreed upon in the BIM Execution Plan.
3. Each Party shall use its best efforts to minimize the risk of claims and liability arising from the use of or access to its Model or the Project Model. Such efforts shall include promptly reporting to the relevant Project Participants any errors, inconsistencies, or omissions it discovers in its Model or the Project Model; however, nothing in this paragraph shall relieve any Party of liability it would otherwise bear under the Contract.

4. No Party involved in creating a Model shall be responsible for costs, expenses, liabilities, or damages which may result from use of its Model beyond the uses set forth in this Section or the BIM Execution Plan.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 2000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparation and submittal of applications for progress payments.

B. Documentation of changes in Contract Sum and Contract Time.

C. Change procedures.

D. Correlation of Contractor submittals based on changes.

E. Procedures for preparation and submittal of application for final payment.

1.02 SCHEDULE OF VALUES

A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.

B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.

C. Forms filled out by hand will not be accepted.

D. Submit Schedule of Values electronically within 15 days after date of Owner-Contractor Agreement.

E. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.

F. Revise schedule to list approved Change Orders, with each Application For Payment.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

A. Payment Period: Submit at intervals stipulated in the Agreement.

B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.

C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.

D. Forms filled out by hand will not be accepted.

E. For each item, provide a column for listing each of the following:
   1. Item Number.
   2. Description of work.
   3. Scheduled Values.
   4. Previous Applications.
   5. Work in Place and Stored Materials under this Application.
   6. Authorized Change Orders.
   7. Total Completed and Stored to Date of Application.
   8. Percentage of Completion.
   9. Balance to Finish.
   10. Retainage.

F. Execute certification by signature of authorized officer.

G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.

H. Submit electronic copies of each Application for Payment.

I. Include the following with the application:
   1. Construction progress schedule, revised and current as specified in Section 01 3000.
   2. Partial release of liens from major subcontractors and vendors.

J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.04 MODIFICATION PROCEDURES

A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.

B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
   1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
   2. Promptly execute the change.

C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 10 days.

D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 6000.

E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.

F. Substantiation of Costs: Provide full information required for evaluation.
   1. Provide the following data:
      a. Quantities of products, labor, and equipment.
      b. Insurance, and bonds.
      c. Taxes, insurance, and bonds.
      d. Overhead and profit.
      e. Justification for any change in Contract Time.
      f. Credit for deletions from Contract, similarly documented.
   2. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

G. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

H. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.

I. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.

J. Promptly enter changes in Project Record Documents.

1.05 APPLICATION FOR FINAL PAYMENT

A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
   1. All closeout procedures specified in Section 01 7000.
   2. Submittal of all documentation specified in Section 01 7800.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 2100
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cash allowances.

B. Payment and modification procedures relating to allowances.

1.02 RELATED REQUIREMENTS

A. Section 01 2000 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 CASH ALLOWANCES

A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, unloading and handling costs at the Project Site, labor costs, installation costs, less applicable trade discounts.

B. Architect Responsibilities:
   1. Consult with Contractor for consideration and selection of products, suppliers , and installers.
   2. Select products in consultation with Owner and transmit decision to Contractor.

C. Contractor Responsibilities:
   1. Assist Architect in selection of products, suppliers , and installers.
   2. Obtain proposals from suppliers and installers and offer recommendations.
   3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
   4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
   5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
   6. Install products.

D. Differences in costs will be adjusted by Change Order.

1.04 ALLOWANCES SCHEDULE

A. Allowance #1: Specification 03 3000 - Cast-in-Place Concrete; Allow for Compacted Fill:
   1. Allow for compacted fill: Compacted fill is existing. It is anticipated that some fill has been disturbed and possibly displaced since core and shell construction. Provide unit cost and estimated volume of compacted fill to provide a level sub-base. Match material used on site. Field survey existing fill prior to ordering fill material.
   2. Allow for compaction of fill and testing coordination with Owner's Testing Agency: Compact fill to 95% of the materials modified Proctor maximum dry density (ASTM D 1557). Compaction to be verified by Owner's Testing Agency.

B. Allowance #2: Specification Section 09 0561 - Common Work Results for Flooring Preparation; Flooring Moisture Encapsulation (if necessary)
   1. Include the unit price of $8.50 per square foot for purchase, delivery, and installation of remedial coating of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions. Calculate the total allowance including the cost of the floor coating for all areas scheduled to receive resilient flooring or carpeting.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 2300
ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

1.02 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

A. Alternate No. 1 - 03 3000 - Cast-in-Place Concrete: Provide Carbon Cure in Concrete Mix.
   1. In-Situ Carbon Dioxide Mineralization Requirements
      a. Environmental / Sustainable Design Requirements
         1) In-situ carbon dioxide mineralization in concrete: Supply concrete that has undergone in-situ carbon dioxide mineralization, such that post-industrial carbon dioxide (CO_2) is injected into the concrete during mixing and chemically converted into a mineral. The concrete may undergo mix optimization whereby the strength enhancement property of CO_2 is utilized to optimize cementitious content, pending that the CO_2-mineralized and optimized concrete mix meets concrete performance requirements as outlined in this specification.
      b. Verification: Provide concrete producer’s verification of in-situ mineralization of carbon dioxide.
      c. Concrete Product with In-Situ Carbon Dioxide Mineralization: Minimum cementitious content and maximum water/cementing materials ratio requirement as outlined by this specification will be reviewed and may be adjusted by the Engineer pending review of submittal, if required. Adjustment of cementitious content and water/cementing materials ratio requirement will be at the sole discretion of the Engineer.
   2. Product: Carbon Cure.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.

B. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

C. Section 01 6001 - Substitution Request Form (During Bidding/Negotiation).

D. Section 01 6002 - Substitution Request Form (After Bidding/Negotiating).

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
   4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   5. Waives claims for additional costs or time extension that may subsequently become apparent.
   6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer. Provide items indicated on Substitution form and additional information, as applicable:
   1. Copy of applicable specification section.
      a. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated.
   2. Indicate deviations, if any, from the Work specified.

3. Product Data including drawings and descriptions of products and fabrication and installation procedures and samples where applicable or requested.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
5. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
6. Research reports evidencing compliance with building code in effect for Project.
7. 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.
8. Note explicitly any non-compliant characteristics.
9. 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.
10. If Substitution Request is made after contract award, provide the following in addition to all required and applicable information:
    a. Cost information, including a proposal of change, if any, in the Contract Sum.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
1. Forms included in the Project Manual are adequate for this purpose, and must be used.

E. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT (DURING BIDDING/NEGOTIATION)

A. Submittal Form (before award of contract):
1. Submit substitution requests by completing the form attached to this section. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION (AFTER BIDDING/NEGOTIATING)

A. Submittal Form (after award of contract):
1. Submit substitution requests by completing the form attached to this section. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. Submit request for Substitution for Cause immedately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.

C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
3. Bear the costs engendered by proposed substitution of:
    a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
    b. Other construction by Owner.
    c. Other unanticipated project considerations.

D. Substitutions will not be considered under one or more of the following circumstances:
1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
2. Without a separate written request.

3.04 RESOLUTION

A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.

B. Architect will notify Contractor in writing of decision to accept or reject request.
   1. Architect will notify Contractor of acceptance or rejection of proposed substitution within 10 business days of receipt of request, or 7 business days of receipt of additional information or documentation, whichever is later.
   2. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.05 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

B. Include completed Substitution Request Forms as part of the Project record.

END OF SECTION

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SECTION 01 3000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Insurance Certificates.

B. Electronic document submittal service.

C. Preconstruction meeting.

D. Site mobilization meeting.

E. Progress meetings.

F. Construction progress schedule.

G. Progress photographs.

H. Coordination drawings.

I. Submittals for review, information, and project closeout.

J. Number of copies of submittals.

K. Requests for Information (RFI) procedures.

L. Submittal procedures.

1.02 RELATED REQUIREMENTS

A. Section 01 6000 - Product Requirements: General product requirements.

B. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.

C. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

D. Respiratory Therapy - Scope of Work document.

1.03 INSURANCE CERTIFICATES

A. Before the commencement of the Work, Contractor shall forward to the Architect three copies of the certificates indicating that the required insurance is in force.

1. The Owner, Tenant, Architect and their respective consultants, agents and employees shall be named as "Additional Insureds" on the commercial general liability policy on Form CG-20 09 - Owners, Lessees or Contractors, (Form A) if such form is available at commercially reasonable costs and any such commercial general liability policy shall provide that:
    a. The coverage afforded the additional insureds shall be primary insurance for the additional insured with respect to claims arising out of operations performed by or on behalf of the Contractor.
    b. If the additional insureds have other insurance which is applicable to the loss, such other insurance shall be on an excess or contingent basis.
    c. The amount of the company's liability under this insurance policy shall not be reduced by the existence of such other insurance.
2. If the Contractor is unable to provide the primary insurance for the additional insureds, they shall provide a Owner and Architects Protective Liability Policy.
    a. Limits shall be the same as the commercial liability policy.

1.04 PROJECT COORDINATOR

A. Project Coordinator: Owner.

B. Cooperate with the Owner in allocation of mobilization areas of site; for field offices and sheds, for personnel access, traffic, and parking facilities.

C. During construction, coordinate use of site and facilities through the Owner.

D. Comply with Owner's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

E. Comply with instructions of the Owner for use of temporary utilities and construction facilities.

F. Coordinate field engineering and layout work under instructions of the Owner.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
   1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
      a. Contractor to provide this service.
   2. Contractor and Architect are required to use this service.
   3. It is Contractor's responsibility to submit documents in allowable format.
   4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
   5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
   6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
   7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.

B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.

3.02 PRECONSTRUCTION MEETING

A. Schedule meeting after Notice of Award.

B. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.
   4. Major subcontractors.

C. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of Subcontractors, list of Products, schedule of values, submittal schedule, and progress schedule.
   5. Designation of personnel representing the parties to Contract.
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.

D. Record minutes and distribute copies within two days after meeting to participants, with electronic copy each to Architect, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

A. Project Coordinator will schedule meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Contractor's superintendent.
   5. Major subcontractors.

C. Agenda:
   1. Use of premises by Owner and Contractor.
   2. Owner's requirements.
   3. Construction facilities and controls provided by Owner.
   4. Temporary utilities provided by Owner.
   5. Security and housekeeping procedures.
   6. Schedules.
   7. Application for payment procedures.
   8. Procedures for testing.
   9. Procedures for maintaining record documents.
   10. Requirements for start-up of equipment.
   11. Inspection and acceptance of equipment put into service during construction period.

D. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at intervals required by the General Conditions or as appropriate. Virtual meetings are acceptable.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Agenda:
   1. Review minutes of previous meetings.
   2. Review of work progress.
   3. Field observations, problems, and decisions.
   4. Identification of problems that impede, or will impede, planned progress.
   5. Review of submittals schedule and status of submittals.
   6. Review of off-site fabrication and delivery schedules.
   7. Maintenance of progress schedule.
   8. Corrective measures to regain projected schedules.
   9. Planned progress during succeeding work period.
   10. Maintenance of quality and work standards.
   11. Effect of proposed changes on progress schedule and coordination.
   12. Other business relating to work.

D. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect, participants, and those affected by decisions made.

3.05 CONSTRUCTION PROGRESS SCHEDULE

A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

B. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
   1. Include written certification that major contractors have reviewed and accepted proposed schedule.

C. Within 10 days after joint review, submit complete schedule.
   1. Coordinate schedule with the Respiratory Therapy - Scope of work document.

D. Submit updated schedule with each Application for Payment.

3.06 PROGRESS PHOTOGRAPHS

A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.

B. Photography Type: Digital; electronic files.

C. Provide photographs of construction throughout progress of Work and at all major phases of construction produced by a member of Contractor's staff.

D. Views:
   1. Provide factual presentation.
   2. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

E. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
   1. Delivery Medium: Via email with project record photo CD.
   2. File Naming: Include project identification, date and time of view, and view identification.
   3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
   4. Photo CD(s): Provide 1 copy including all photos cumulative to date and PDF file(s), with files organized in separate folders by submittal date.

3.07 COORDINATION DRAWINGS

A. Provide information required by the construction documents, including drawings and specifications, for preparation of coordination drawings.

B. Procedure (when not using a BIM model to support construction activities):
   1. In areas where more than one subcontractor's work is involved, subcontractors shall superimpose their drawings of the area over those supplied by the other subcontractors.
   2. Coordinate structural, mechanical, fire protection, plumbing, and electrical work with the building structure.
   3. Wherever interferences occur, before any work is done at the places in question,consult among affected subcontractors and come to agreement as to the exact locations and elevations of piping, ductwork, conduit, structural elements, or other work which might cause interference.
   4. Deviations from intended layouts as shown on the Contract Document drawings must be reviewed by the Architect/Engineer.
   5. Conflicts between subcontractors shall be resolved by the Contractor in cooperation with the Architect.
   6. Coordinate mechanical and electrical work with building structure. Indicate required sleeves and openings on structural shop drawings. Do not drill, core or cut structural elements without approval from Architect/Engineer.

C. Procedure (when using a BIM model to support construction activities):
   1. In areas where more than one subcontractor's work is involved, all subcontractors shall superimpose their Building Information Modeling information in the Construction Model described by Section 01 1019 - Contract Considerations.
   2. Coordinate structural, mechanical, fire protection, plumbing, and electrical work with the building structure, and input all coordinated elements into the Construction Model.
   3. Wherever interferences occur, before any work is done at the places in question, the Contractor and involved subcontractors shall, working with the Construction Model, consult among themselves and shall come to agreement as to the exact locations and elevations of piping, ductwork, conduit, structural elements, or other work which might cause interference.

4. Deviations from intended layouts as shown on the Contract Document drawings must be reviewed by the Architect/Engineer.
5. Conflicts between subcontractors shall be resolved by the Contractor in cooperation with the Architect/Engineer.
6. Indicate required sleeves and openings in structural members in Construction Model.

D. Field coring, drilling, or cutting of structural elements will not be allowed without approval by the Architect/Engineer.

E. Review drawings prior to submission to Architect.

F. Provide drawings prior to any fabrication.

3.08 REQUESTS FOR INFORMATION (RFI)

A. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
   a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
   b. Do not forward requests which solely require internal coordination between subcontractors.
2. Prepare using software provided by the Electronic Document Submittal Service.

B. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Unacceptable Uses for RFIs: Do not use RFIs to request the following:
   a. Approval of submittals (use procedures specified elsewhere in this section).
   b. Approval of substitutions (see Section - 01 6000 - Product Requirements)
   c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).

C. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
2. Owner's, Architect's, and Contractor's names.
3. Discrete and consecutive RFI number, and descriptive subject/title.
4. Issue date, and requested reply date.
5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.

D. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.

E. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
2. Note dates of when each request is made, and when a response is received.
3. Highlight items requiring priority or expedited response.
4. Highlight items for which a timely response has not been received to date.

F. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs

received after 12:00 noon will be considered as having been received on the following regular working day.

1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.

3.09 SUBMITTAL SCHEDULE

A. Submit to Architect for review a schedule for submittals in tabular format.
   1. Within 10 days after the date of the Agreement, or at the Preconstruction Meeting (whichever is earlier), submit submittal schedule showing all submittals proposed for project, including submittals listed as:
      a. Submittals for review.
      b. Quality control submittals
      c. Closeout submittals.
   2. Format schedule to allow tracking of status of submittals throughout duration of construction.
   3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
   4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
      a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.
   5. Submit one copy or one electronic copy in Adobe PDF format.

3.10 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings: Original drawings prepared by the Contractor, Subcontractor, Supplier or Distributor which illustrate some portion of the Work; showing fabrication, layout, setting, or erection details.
      a. Prepared by a qualified detailer.
      b. All drawings shall be "scale drawings".
      c. Reproductions of Architect's drawings shall not be submitted or accepted.
      d. All shop drawings shall bear Contractor's stamp of approval certifying that they have been checked prior to submission to Architect/Engineer. Obvious omissions, errors, or discrepancies not flagged by the Contractor shall be cause for immediate rejection and return of submittal. Consequences of all schedule delays will be the responsibility of the Contractor.
      e. The Contractor shall be responsible for all quantities that appear on shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

3.11 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.

5. Manufacturer's instructions.
6. Manufacturer's field reports.
7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.12 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 7800 - Closeout Submittals:
1. Project record documents.
2. Operation and maintenance data.
3. Warranties.
4. Bonds.
5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.13 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
1. Retained samples will not be returned to Contractor.

3.14 SUBMITTAL PROCEDURES

A. General Requirements:
1. Use a separate transmittal for each item.
2. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
3. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
4. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
   a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
5. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
   a. Upload submittals in electronic form to Electronic Document Submittal Service website.
6. Schedule submittals to expedite the Project, and coordinate submission of related items.
   a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
   b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
   c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
7. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
8. Provide space for Contractor and Architect review stamps.
9. When revised for resubmission, identify all changes made since previous submission.
10. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.

11. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
12. Submittals not requested will be recognized, and will be returned "Not Reviewed",

B. Product Data Procedures:
1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Do not submit (Material) Safety Data Sheets for materials or products.

C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
2. Do not reproduce Contract Documents to create shop drawings.
3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.

D. Samples Procedures:
1. Transmit related items together as single package.
2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.

E. Do not submit reproductions of Architect's drawings.

END OF SECTION

SECTION 01 3553
SECURITY PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Security measures including entry control and personnel identification.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Contractor use of premises and occupancy.

B. Respiratory Therapy - Scope of Work document.

1.03 SECURITY PROGRAM

A. Protect Work , existing premises and Owner's operations from theft, vandalism, and unauthorized entry.

B. Initiate program in coordination with Owner's existing security system at project mobilization.

C. Maintain program throughout construction period until directed by Owner.

1.04 ENTRY CONTROL

A. Restrict entrance of persons and vehicles into Project site and existing facilities.

B. Allow entrance only to authorized persons with proper identification.

C. Owner will control entrance of persons and vehicles related to Owner's operations.

D. Comply with Owner's Covid access and safety protocols.

1.05 PERSONNEL IDENTIFICATION

A. Provide identification badge to each person authorized to enter premises.

B. Badge To Include: Personal photograph, name , expiration date and employer.

C. Maintain a list of accredited persons, submit copy to Owner on request.

D. Require return of badges at expiration of their employment on the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 4000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Submittals.

B. References and standards.

C. Testing and inspection agencies and services.

D. Control of installation.

E. Manufacturers' field services.

F. Defect Assessment.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.

B. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
   1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

D. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
   1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.04 REFERENCES AND STANDARDS

A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Obtain copies of standards where required by product specification sections.

C. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

D. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

1.05 TESTING AND INSPECTION AGENCIES AND SERVICES

A. Owner will employ and pay for services of an independent testing agency to perform certain specified testing and inspection.
   1. Refer to individual sections for details.

B. The costs of initial testing as listed in this Section will be paid by the Owner provided the items tested are in accordance with the Contract Documents. The Contractor shall pay the cost for all tests which indicate the tested items are not in accordance with the Contract Documents and for all additional testing required to ensure the items tested are in compliance with the Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Have work performed by persons qualified to produce required and specified quality.

F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.02 TESTING AND INSPECTION

A. Testing Agency Duties:
   1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
   2. Perform specified sampling and testing of products in accordance with specified standards.
   3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
   5. Perform additional tests and inspections required by Architect .
   6. Submit reports of all tests/inspections specified.

B. Limits on Testing/Inspection Agency Authority:
   1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency may not approve or accept any portion of the Work.
   3. Agency may not assume any duties of Contractor.
   4. Agency has no authority to stop the Work.

C. Contractor Responsibilities:
   1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
   2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
   3. Provide incidental labor and facilities:
      a. To provide access to Work to be tested/inspected.
      b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
      c. To facilitate tests/inspections.
      d. To provide storage and curing of test samples.
   4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
   5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
   6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.

E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.03 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.

B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.04 DEFECT ASSESSMENT

A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

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SECTION 01 5000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary utilities.

B. Temporary telecommunications services.

C. Temporary Controls: Barriers, enclosures, and fencing.

D. Security requirements.

E. Vehicular access and parking.

F. Waste removal facilities and services.

G. Field offices.

1.02 RELATED REQUIREMENTS

A. Section 01 3530 - Health Care Facility Controls.

B. Section 01 3553 - Security Procedures

C. Section 01 7000 - Execution and Closeout Requirements: Protection of installed work.

D. Respiratory Therapy - Scope of Work document.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).

1.04 TEMPORARY UTILITIES

A. Owner will provide the following:
   1. Water supply, consisting of connection to existing facilities.

B. Provide and pay for all electrical power, lighting, heating and cooling, and ventilation required for construction purposes.

C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.05 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office.

B. Telecommunications services shall include:
   1. Personal computers dedicated to project telecommunications, with necessary software and laser printer.
   2. Telephone Mobile Lines with Handsets: One line per each member of Contractor's staff.
   3. Internet Connections: Of sufficient bandwidth to accommodate Contractor's operations.
   4. Email: Account/address - one for each member of Contractor's staff.

1.06 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Use of Owner's existing facilities as designtated by the Owner is not permitted.

C. Maintain daily in clean and sanitary condition.

1.07 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to and egress from existing buildings.

C. Provide protection for all materials and plants designated to remain. Replace damaged plants and materials.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.08 FENCING

A. Construction: Commercial grade chain link fence with top and bottom rails and green fiberglass visual screening.

B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.09 INTERIOR ENCLOSURES

A. Provide temporary partitions as indicated to separate work areas from Owner-occupied areas, to separate phased construction areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:
   1. Minimum one-hour fire rated separation.
   2. STC rating of 35 in accordance with ASTM E90.
   3. Maximum flame spread rating of 75 in accordance with ASTM E84.

C. Paint surfaces exposed to view from Owner-occupied areas and install vinyl base.

1.10 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Existing parking areas as designated by Owner shall be used for construction parking. Do not allow construction parking in other locations.

1.11 WASTE REMOVAL

A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

C. Provide containers with lids. Remove trash from site periodically.

D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

1.12 FIELD OFFICES

A. Office:
   1. Coordinate with Owner.

1.13 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 6000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Re-use of existing products.

B. Transportation, handling, storage and protection.

C. Product option requirements.

D. Substitution limitations.

E. Procedures for Owner-supplied products.

F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 01 4000 - Quality Requirements: Product quality monitoring.

C. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

D. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.03 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.

B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.

C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.02 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Use of products having any of the following characteristics is not permitted:

C. Where other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 01 6116.
   2. If wet-applied, have lower VOC content, as defined in Section 01 6116.

2.03 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 2500 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

A. See equipment list on drawings for identification of Owner-supplied products.

B. Owner's Responsibilities:
   1. Arrange for and deliver Owner reviewed shop drawings, product data, and samples, to Contractor.
   2. Arrange and pay for product delivery to site.
   3. On delivery, inspect products jointly with Contractor.
   4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
   5. Arrange for manufacturers' warranties, inspections, and service.

C. Contractor's Responsibilities:
   1. Review Owner reviewed shop drawings, product data, and samples.
   2. Receive and unload products at site; inspect for completeness or damage jointly with Owner.
   3. Handle, store, install and finish products.
   4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 7419.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

G. Comply with manufacturer's warranty conditions, if any.

H. Do not store products directly on the ground.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

K. Prevent contact with material that may cause corrosion, discoloration, or staining.

L. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

M. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

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SECTION 01 6001
SUBSTITUTION REQUEST FORM (DURING BIDDING/NEGOTIATION)

1.01 IDENTIFICATION

Project: _____	Substitution Request Number: _____
_____	From: _____
To: _____	Date: _____
_____	A/E Project Number: _____
Re: _____	Contract For: _____
Specification Title: _____	Description: _____
Section: _____ Page: ____	Article/Paragraph: _____

1.02 DESCRIPTION OF SUBSTITUTION

Proposed Substitution: _____ _____
Manufacturer: _____
Address: _____ Phone: _____
Trade Name: _____ Model No: _____

A. Attached data includes product description, specifications, drawings, photographs, and performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.

B. Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

C. The Undersigned Certifies:
   1. Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
   2. Same warranty will be furnished for proposed substitution as for specified product.
   3. Same maintenance service and source of replacement parts, as applicable, is available.
   4. Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
   5. Proposed substitution does not affect dimensions and functional clearances.
   6. Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: _____
Signed by: _____
Firm: _____ Phone: _____

1.03 A/E REVIEW AND ACTION

□ Substitution approved - Make submittals in accordance with Specification Section 01 6000 - Product Requirements
□ Substitution approved as noted - Make submittals in accordance with Specification Section 01 6000 - Product Requirements.
□ Substitution rejected - Use specified materials.
□ Substitution Request received too late - Use specified materials.
Signed by: Date:

END OF SECTION

SECTION 01 6002
SUBSTITUTION REQUEST FORM (AFTER BIDDING/NEGOTIATING)

1.01 IDENTIFICATION

Project: _____	Substitution Request Number: _____
_____	From: _____
To: _____	Date: _____
_____	A/E Project Number: _____
Re: _____	Contract For: _____
Specification Title: _____	Description: _____
Section: _____ Page: ____	Article/Paragraph: _____

1.02 DESCRIPTION OF SUBSTITUTION

Proposed Substitution: _____

_____

Manufacturer: _____

Address: _____ Phone: _____

Trade Name: _____ Model No: _____

Installer: _____

Address: _____ Phone: _____

History: □ New product □ 1-4 years old □ 5-10 years old □ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

□ Point-by-point comparative data attached - REQUIRED BY ARCHITECT

1.03 EXPLANATION FOR SUBSTITUTION

Reason for not providing specified item: _____

_____

Similar Installations: (Project name, Architect, address, Owner, date installed:

_____

_____

_____

_____

Proposed substitution affects other park 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

1.04

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

Submitted by: _____

Signed by: _____

Firm: _____ Phone: _____

Attachments: _____

_____

_____

_____

1.05 A/E REVIEW AND ACTION

□ Substitution approved - Make submittals in accordance with Specification Section 01 6000 - Product Requirements.

□ Substitution approved as noted - Make submittals in accordance with Specification Section 01 6000 - Product Requirements.

□ Substitution rejected - Use specified materials.

□ Substitution Request received too late - Use specified materials.

Signed by: Date:

1.06 ADDITIONAL COMMENTS

Additional Comments by:

□ Contractor □ Subcontractor □ Supplier □ Manufacturer □ Architect/Engineer □ Owner

_____

_____

_____

_____

_____

_____

END OF SECTION

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SECTION 01 6116
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Requirements for VOC-Content-Restricted products.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittal procedures.

B. Section 01 4000 - Quality Requirements: Procedures for testing and certifications.

C. Section 01 6000 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.

1.03 DEFINITIONS

A. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
   1. Interior paints and coatings applied on site.
   2. Interior adhesives and sealants applied on site, including flooring adhesives.

B. Interior of Building: Anywhere inside the exterior weather barrier.

C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.

D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings 2005 (Reapproved 2018).

C. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2007.

D. SCAQMD 1113 - Architectural Coatings 1977 (Amended 2016).

E. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

1.06 QUALITY ASSURANCE

A. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
   1. Evidence of Compliance: Acceptable types of evidence are:
      a. Report of laboratory testing performed in accordance with requirements.
      b. Published product data showing compliance with requirements.
      c. Certification by manufacturer that product complies with requirements.

B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.

B. VOC-Content-Restricted Products: VOC content not greater than required by the following:
   1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
   2. Joint Sealants: SCAQMD 1168 Rule.
   3. Paints and Coatings: Each color; most stringent of the following:
      a. 40 CFR 59, Subpart D.
      b. SCAQMD 1113 Rule.
      c. CARB (SCM).
      d. State of Illinois.

PART 3 EXECUTION - NOT USED

3.01 FIELD QUALITY CONTROL

A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.

B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 01 7000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.

B. Requirements for alterations work, including selective demolition.

C. Pre-installation meetings.

D. Cutting and patching.

E. Cleaning and protection.

F. Starting of systems and equipment.

G. Demonstration and instruction of Owner personnel.

H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

I. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.

B. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.

C. Section 01 4000 - Quality Requirements: Testing and inspection procedures.

D. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.

E. Section 01 7419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.

F. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.

G. Section 02 4100 - Demolition: Demolition of building elements.

H. Section 07 8400 - Firestopping.

I. Respiratory Therapy - Scope of Work document.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project or existing construction.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

1.04 PROJECT CONDITIONS

A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

B. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
   1. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.

C. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.

1. Indoors: Limit conduct of especially noisy interior work to hours as determined by Owner.

1.05 COORDINATION

A. See Section 01 1000 for occupancy-related requirements.

B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

C. Notify affected utility companies and comply with their requirements.

D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of work of separate sections.

H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.

B. Require attendance of parties directly affecting, or affected by, work of the specific section.

C. Notify Architect four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of examination, preparation and installation procedures.
   2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.05 ALTERATIONS

A. Drawings showing existing construction and utilities are based on existing record documents only.
   1. Verify that construction and utility arrangements are as indicated.
   2. Report discrepancies to Architect and Program Manager before disturbing existing installation.
   3. Beginning of alterations work constitutes acceptance of existing conditions.

B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
   1. Provide, erect, and maintain temporary one-hour rated dustproof partitions of construction specified in Section 01 5000 .

C. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.
   2. Relocate items indicated on drawings.
   3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
   4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
   2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
   3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready

for service.
   a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
   b. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.

E. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.

F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.

G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.

H. Refinish existing surfaces as indicated:
   1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
   2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

I. Clean existing systems and equipment.

J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.

K. Do not begin new construction in alterations areas before demolition is complete.

L. Comply with all other applicable requirements of this section.

3.06 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. See Section 02 4100 - Demolition, for additional requirements.

C. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

E. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

F. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

G. Restore work with new products in accordance with requirements of Contract Documents.

H. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.

J. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.07 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.08 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.09 SYSTEM STARTUP

A. Coordinate schedule for start-up of various equipment and systems.

B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.

C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

D. Verify that wiring and support components for equipment are complete and tested.

E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.10 DEMONSTRATION AND INSTRUCTION

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.

3.11 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Testing, adjusting, and balancing HVAC systems: See Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

3.12 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
   1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.

B. Use cleaning materials that are nonhazardous.

C. Clean interior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.

D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

F. Replace filters of operating equipment.

G. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.13 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect and Owner.

B. Accompany Owner on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect and Owner when work is considered ready for Substantial Completion.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
   1. Architect will determine the date of Substantial Completion.

E. Owner will occupy all of the building as specified in Section 01 1000.

F. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

G. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

H. Notify Architect and Owner when work is considered finally complete.

I. Complete items of work determined by Architect's final inspection. The date of Final Completion shall be determined on the basis of the completion of the Punch List.

J. Should Architect be required to perform additional inspections because of failure of work to comply with original certifications of Contractor, the Architect's costs for reinspections will be invoiced to the Owner as Additional Services and shall be deducted from the Contract Sum still due the Contractor.

3.14 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

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SECTION 01 7419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
   1. Attain a minimum recycling rate of 50 percent.

D. Owner may decide to pay for additional recycling, salvage, and/or reuse based on Landfill Alternatives Proposal specified below.

E. Recycling, Salvage, and Reuse: Attain minimum rate through the recycling and reuse of the following waste materials:
   1. 2” Minus Material: Dirt, sheetrock dust, wood shavings, glass cuttings, asphalt shingle granules, small/broken aggregate.
   2. Metals: Metal scrap - Iron, steel, copper, brass, and aluminum from the following sources: structural members, piping, fasteners, steel studs, siding, wiring, ductwork and sheet metal goods.
   3. "Dirty" Wood: Painted wood and trim, plywood, particle board, oriented strand board, masonite, wood doors, wood cabinets and furniture.
   4. "Clean" Wood: Unpainted, untreated dimensional lumber, timber beams & engineered wood products, wood shipping pallets, crates.
   5. Fiber: Cardboard – clean, corrugated cardboard used for packaging.
   6. Plastic: Construction related plastic sheeting and HDPE.

F. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.

G. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.

H. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.
   2. Burying on the project site.
   3. Dumping or burying on other property, public or private.
   4. Other illegal dumping or burying.
   5. Incineration, either on- or off-site.

I. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. Section 01 5000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

C. Section 01 6000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

D. Section 01 7000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

E. Respiratory Therapy - Scope of Work document.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Landfill Alternatives Proposal: Within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner, submit a projection of trash/waste that will require disposal and alternatives to landfilling, with net costs.
   1. Submit to Architect for Owner's review and approval.
   2. If Owner wishes to implement any cost alternatives, the Contract Sum will be adjusted as specified elsewhere.
   3. Include an analysis of trash/waste to be generated and landfill options as specified for Waste Management Plan described below.
   4. Describe as many alternatives to landfilling as possible:
      a. List each material proposed to be salvaged, reused, or recycled.
      b. List the proposed local market for each material.
      c. State the estimated net cost resulting from each alternative, after subtracting revenue from sale of recycled or salvaged materials and landfill tipping fees saved due to diversion of materials from the landfill.
   5. Provide alternatives to landfilling for at least the following materials:
      a. Aluminum and plastic beverage containers.
      b. Corrugated cardboard.

c. Wood pallets.
d. Clean dimensional wood.
e. Concrete.
f. Concrete masonry units.
g. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
h. Glass.
i. Gypsum drywall and plaster.
j. Plastic buckets.
k. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (http://flooring.dupont.com) and Interface (www.interfaceinc.com) conduct reclamation programs.
l. Paint.
m. Plastic sheeting.
n. Rigid foam insulation.
o. Plumbing fixtures.
p. Mechanical and electrical equipment.
q. Fluorescent lamps (light bulbs).
r. Acoustical ceiling tile and panels.

C. Once Owner has determined which of the landfill alternatives addressed in the Proposal above are acceptable, prepare and submit Waste Management Plan; submit within 10 calendar days after notification by Architect.

D. Waste Management Plan: Include the following information:
1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
a. List each material proposed to be salvaged, reused, or recycled.
4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.

E. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
2. Submit Report on a form acceptable to Owner.
3. Landfill Disposal: Include the following information:
a. Identification of material.
b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.

4. Recycled and Salvaged Materials: Include the following information for each:
    a. Identification of material, including those retrieved by installer for use on other projects.
    b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
    c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
    d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
    e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
5. Material Reused on Project: Include the following information for each:
    a. Identification of material and how it was used in the project.
    b. Amount, in tons or cubic yards.
    c. Include weight tickets as evidence of quantity.
6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.

C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.

D. See Sections 01 7000 and 02 4100 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
    1. Prebid meeting.
    2. Preconstruction meeting.
    3. Regular job-site meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
    1. As a minimum, provide:
        a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
        b. Separate dumpsters for each category of recyclable.
        c. Recycling bins at worker lunch area.
    2. Provide containers as required.
    3. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.

4. Provide adequate space for pick-up and delivery and convenience to subcontractors.
5. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

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SECTION 01 7800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project Record Documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

E. Respiratory Therapy - Scope of Work document.

1.03 SUBMITTALS

A. Project As-Built Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
   2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   4. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Field test records.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Record Documents and Shop Drawings: Legibly mark each item to record actual construction, including:

1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
2. Field changes of dimension and detail.
3. Details not on original Contract Documents

D. Delete Architect/Engineer title block and seal from all documents.

E. Store record documents separate from documents used for construction.

F. Record information concurrent with construction progress.

G. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

H. Record Drawingsand Shop Drawings: Legibly mark each item to record actual construction including:
1. Field changes of dimension and detail.
2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. For Each Product, Applied Material, and Finish:
1. Product data, with catalog number, size, composition, and color and texture designations.
2. Information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional information as specified in individual product specification sections.

E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

A. For Each Item of Equipment and Each System:
1. Description of unit or system, and component parts.
2. Identify function, normal operating characteristics, and limiting conditions.
3. Include performance curves, with engineering data and tests.
4. Complete nomenclature and model number of replaceable parts.

B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.

D. Include color coded wiring diagrams as installed.

E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

G. Provide servicing and lubrication schedule, and list of lubricants required.

H. Include manufacturer's printed operation and maintenance instructions.

I. Include sequence of operation by controls manufacturer.

J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

K. Provide control diagrams by controls manufacturer as installed.

L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

O. Include test and balancing reports.

P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

A. Assemble operation and maintenance data into durable manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.

B. Submit as-built documents in electronic format as PDF and AutoCAD files to Architect and Owner with final application for payment.
   1. Include Project Directory with title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
   2. Divide documents into related items.
      a. Organize related items into subdirectories.

C. Arrangement of Contents: Organize each volume in parts as follows:
   1. Project Directory.
   2. Table of Contents, of all volumes, and of this volume.
   3. Operation and Maintenance Data: Arranged by system, then by product category.
      a. Source data.
      b. Product data, shop drawings, and other submittals.
      c. Operation and maintenance data.
      d. Field quality control data.
      e. Photocopies of warranties and bonds.

3.06 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

SECTION 02 4100
DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.
   1. Removal of construction as designated on the drawings at all areas of interface between new and existing construction.
   2. Demolition drawings are included for the convenience of the Contractor. It is the Contractors responsibility to determine the total extent of Project Demolition by reviewing all Contract Documents, visiting the site and determining Construction Sequencing. The total amount of demolition is not indicated on the Demolition Drawings.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

D. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2019.

1.04 EXISTING CONDITIONS

A. Obvious existing conditions and installation obstructing new work shall be removed, the same as though they were completely shown or described. Bidders shall visit existing project site prior to Bid and familiarize themselves with all conditions.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
   1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
   2. Identify demolition firm and submit qualifications.
   3. Include a summary of safety procedures.

C. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.06 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of five years of documented experience.

1.07 GENERAL REQUIREMENTS

A. Provide temporary barricades and other types of protection required.

B. Do not store or stockpile demolished materials on site.

C. Provide fire protection in accord with local Fire Department requirements and Owner's policy.

D. Protect existing construction to remain. Replace if damaged. Existing construction is to remain in saved condition without cracks, displacement or damage. Terminate demolition in neat horizontal and vertical lines.

E. Do not close or obstruct fire exits or walkways.

F. Work of this Section requires careful coordination with the Owner and the sequencing of the new Work. To prevent disruption to the Owner's facility operation, some items of work may need to be deferred until later in the overall Project Schedule.

G. Carefully assess each item to be removed for potential detrimental concealed conditions. Perform exploratory demolition to determine methods of attachments, utility interfaces, interconnections and other concealed conditions prior to demolition.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 EXECUTION REQUIREMENTS

A. Schedule with Owner and receive approval for all work of this Section significantly prior to commencing work. Review affect on existing areas, operations and utilities.

B. Provide all shoring and bracing required to support the structural elements of the building. Material used shall be adequate to safely support anticipated loads.

C. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.
   2. Dismantle existing construction and separate materials.
   3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

D. Remove existing construction only to the extent necessary to accomplish the intended results. Cut back finished surfaces to straight, plumb or level lines as required.

E. Where openings are cut over-size or in improper location, replace the excess removed material at no cost to Owner.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain permits if required.
   2. Comply with applicable requirements of NFPA 241.
   3. Use of explosives is not permitted.
   4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   5. Provide, erect, and maintain temporary barriers and security devices.
   6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   8. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   9. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
   10. Cutting:
      a. Precast Concrete & Masonry: Saw cut. Jack hammering with electric or pneumatic equipment or other impact demolition is not acceptable. Cut back masonry to joint lines and remove old mortar allowing space for repairs to backing.
      b. Items indicated for relocation in the new Work, or to be retained by the owner: Carefully remove to avoid damage, thoroughly clean and reinstall as indicated, or store as directed by the Owner.
      c. Structural Elements: Remove only as shown. If not specifically shown, but removal is required, perform such removal or alteration only upon written approval of the Architect.

d. Mechanical & Electrical Work: Remove as required to provide for new work. Store at Owner's direction.
e. Miscellaneous Items: Work not mentioned to be removed that interferes with new construction shall be cut and removed in a manner to provide for new construction, or patching and repair, as required.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Do not begin removal until built elements to be salvaged or relocated have been removed.

D. Protect existing structures and other elements that are not to be removed.
1. Provide bracing and shoring.
2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.

E. If hazardous materials are discovered during removal operations, stop work and notify Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

3.03 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Existing on-site utilities to be removed or abandoned: Arrange with the Utility Company concerned for their removal or protection as required.

C. Protect existing utilities to remain from damage.

D. Do not disrupt public utilities without permit from authority having jurisdiction.

E. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

F. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

G. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

H. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

I. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
1. Verify that construction and utility arrangements are as indicated.
2. Report discrepancies to Architect before disturbing existing installation.
3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.

B. Separate areas in which demolition is being conducted from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.

C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

D. Remove existing work as indicated and as required to accomplish new work.

E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.

1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
3. Verify that abandoned services serve only abandoned facilities before removal.
4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
3. Repair adjacent construction and finishes damaged during removal work.
4. Protect from all damage. Use barricades, tarpaulins, temporary walls, plywood, planking, masking, or other suitable means and methods.
5. Unnecessary or careless damage to work to remain in place: Restore to a condition as good or better than existed before work was commenced at no additional cost to the Owner.
6. Patch as specified for patching new work.

3.05 PATCHING, REPAIRING AND FINISHING

A. Matching Existing Work: Except where otherwise indicated or specified, the new patch work shall match the existing materials and finishes in all respects.

3.06 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 - Waste Management.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Floors and slabs on grade.

C. Concrete reinforcement.

D. Concrete curing.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete 1991 (Reapproved 2009).

B. ACI 301 - Specifications for Structural Concrete 2016.

C. ACI 302.1R - Guide to Concrete Floor and Slab Construction 2015.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete 2000 (Reapproved 2009).

E. ACI 306R - Guide to Cold Weather Concreting 2016.

F. ACI 308R - Guide to External Curing of Concrete 2016.

G. ACI 318 - Building Code Requirements for Structural Concrete and Commentary 2014 (Errata 2018).

H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.

I. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.

J. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens 2020.

K. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.

L. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete 2010a (Reapproved 2016).

M. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete 2019.

N. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete 2019.

O. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2018a.

P. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017.

Q. Illinois Department of Transportation Standard Specifications for Road and Bridge Construction; 2016.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

C. Mix Design: Submit proposed concrete mix design.

1. Indicate historical concrete strength data based on data within 24 months.
2. Provide chloride ion content certification.

D. Shop Drawings: Submit plans indicating locations and details of construction and contraction (control) joints.

E. Samples: Submit samples of underslab vapor retarder to be used.

F. Test Reports: Submit report for each test or series of tests specified.

1.05 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

B. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

A. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
1. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.

B. Lumber: Douglas Fir or Spruce-Pine-Fir species; construction grade or better; with grade stamp clearly visible.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
1. Type: Deformed billet-steel bars.
2. Finish: Unfinished, unless otherwise indicated.

B. Steel Welded Wire Reinforcement (WWR): Plain type, ASTM A1064/A1064M.
1. Form: Flat Sheets.

C. Fiber Reinforcement: Synthetic Macro Fibers engineered and designed for use in concrete, complying with ASTM C1116, Type III.
1. Minimum Dosage Rate: 4.0 lb/CY.
2. Manufacturers:
a. The Euclid Chemical Company; TUF-STRAND SF.
b. Propex Concrete Systems Corporation; Fibermesh 650.
c. W.R. Grace & Company, Construction Products Division; STRUX 90/40.

2.03 ADMIXTURES

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. Mid-Range Water-Reducing Admixture: ASTM C494, Type A.
1. Manufacturers:
a. BASF; Master Polyheed Series.
b. Euclid Chemical Company; Eucon MR or Plastol Series.
c. W.R. Grace; Daracem or ADVA Series.

C. Air Entrainment Admixture: ASTM C260/C260M.
1. Manufacturers:
a. Axim Italcementi Group.
b. BASF Admixtures, Inc.
c. The Euclid Chemical Company.

2.04 ACCESSORY MATERIALS

A. Underslab Vapor Retarder:
1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. Single ply polyethylene is prohibited.

2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
3. Manufacturers:
   a. Henry Company; Fortifiber Moistop Ultra 15: www.henry.com.
   b. Stego Industries, LLC; Stego Wrap 15 mil: www.stegoindustries.com/#sle.
   c. W. R. Meadows, Inc; PERMINATOR Class A - 15 mils (0.38 mm): www.wrmeadows.com/#sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.

B. Form Release Agent: Colorless material which will not stain concrete, absorb moisture or impair natural bonding or color characteristics of coating, intended for use on concrete.
1. Manufacturers:
   a. BASF Construction Chemicals, LLC - Building Systems: MasterFinish RL 100.
   b. Dayton Superior - Clean Strip Ultra (J-3).
   c. W.R. Meadows - Duogard.

C. Asphalt-Impregnated Fiberboard Expansion Joint Filler: ASTM D1751.
1. W.R. Meadows; Fibre Expansion Joint.
2. Nomaco; Nomaflex.
3. J.D. Russell; Fiberflex.

D. Thermal Insulation Below Slab: ASTM C578, Type IX EPS (25 psi).
1. Owens Corning.
2. Dow.
3. Insulfoam.

E. Rigid Cellular Polystyrene (for tiered seating in classrooms): ASTM 6817.
1. AFM Corporation; Foam Control EPS Geofoam.
2. Styrotech; EPS Geofoam.
3. Universal Foam Products; EPS Geofoam.

2.05 CURING MATERIALS

A. Curing and Sealing Compound, Moisture Emission-Reducing, Membrane-Forming: Liquid, membrane-forming, clear sealer, for application to newly-placed concrete; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.
1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
2. Comply with ASTM C309 and ASTM C1315 Type I Class A.
3. VOC Content: Less than 100 g/L.
4. Solids Content: 25 percent, minimum.
5. Manufacturers:
   a. BASF; Kure 1315.
   b. Euclid Chemical Company; Super Diamond Clear VOX.
   c. Creteseal; CS2000.

B. Water: Potable, not detrimental to concrete.

2.06 CONCRETE MIX DESIGN

A. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

B. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch.
2. Air Entrainment: 0 - 3 percent.
3. Water-Cement Ratio: Maximum 48 percent by weight.
4. Synthetic Macro Fibers Required: 4.0 lb/CY.
5. Mid-Range Water Reducer required.
6. Maximum Aggregate Size: 3/4 inch.

7. Slump:
    a. Before addition of mid-range water reducer - not greater than 3 inches.
    b. After addition of mid-range water reducer - 9 inches maximum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean before applying release agent.

C. Interior Slabs on Grade: Install vapor retarder over insulation and under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Install welded wire reinforcement in maximum possible lengths, and offset end laps in both directions. Splice laps with tie wire.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

3.05 FLOOR FLATNESS, LEVELNESS AND CONCRETE FINISHING

A. Correct the slab surface if tolerances are less than specified.

B. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

C. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
    1. Surfaces to Be Left Exposed or to Be Covered with VCT or Carpet: Trowel as described in ACI 302.1R, minimizing burnish marks and other appearance defects.
        a. Finish surface to overall value of SOFf = 25 and SOFl = 20.
    2. Surfaces to receive concrete floor topping (tiered seating in classrooms):
        a. Scratch finish - finish surface to overall value of SOFf =- 20 and SOFl = 15.
        b. After levelling, roughen surface before final set with stiff brushes, rakes or brooms.

3.06 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.07 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.

D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.

F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.08 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

3.09 PROTECTION

A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

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SECTION 05 5000
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel and aluminum items.

B. Aluminum grilles for fin tube enclosures.

1.02 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.

C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.

D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.

G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2014.

H. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes 2019a.

I. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire 2019.

J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

K. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.

M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.

N. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).

O. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.

P. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.

Q. AWS D1.2/D1.2M - Structural Welding Code - Aluminum 2014, with Errata.

R. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).

S. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

T. SSPC-SP 2 - Hand Tool Cleaning 2018.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized to ASTM A153/A153M where connecting galvanized components.

F. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.

B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.

D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.

E. Bolts, Nuts, and Washers: Stainless steel.

F. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

A. Aluminum Grilles for Fin Tube Enclosures.
   1. Continuous aluminum grilles, surface mounted. Match existing grilles in adjacent rooms.
      a. 1/8 inch wide fixed position bars.
      b. 7/16 inch centerline bar spacing.
   2. Finishes:
      a. Match existing curtain wall, verify color.
         1) Upper grilles: 70% Ultra-Escent II Champagne Gold 399C232.
         2) Lower grilles: White.
   3. Manufacturers:
      a. Raymon Donco Air Distribution Equipment; DBG-100 1/2" Deep Bar Grille: www.raymon-hvac.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 FINISHES - STEEL

A. Prime paint steel items unless noted otherwise.
   1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.

B. Prepare surfaces to be primed in accordance with SSPC-SP2.

C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

D. Prime Painting: One coat.

E. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.06 FINISHES - ALUMINUM

A. Interior Aluminum Surfaces: Class II natural anodized unless noted otherwise.

B. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils thick.

2.07 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components as indicated on shop drawings.

D. Perform field welding in accordance with AWS D1.1/D1.1M.

E. Obtain approval prior to site cutting or making adjustments not scheduled.

F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

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SECTION 05 7000
DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Railing and guardrail assemblies.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2014, with Editorial Revision (2017).

C. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing 2016.

D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

E. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2013, with Editorial Revision.

F. AWS C3.4M/C3.4 - Specification for Torch Brazing 2016.

G. AWS C3.5M/C3.5 - Specification for Induction Brazing 2016 (Amended 2017).

H. AWS C3.9M/C3.9 - Specification for Resistance Brazing 2009.

I. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.

J. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel 2017.

K. IAC - Illinois Accessibility Code 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Submit manufacturer's product data, including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.

C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Calculations for railing assemblies, signed and sealed by a professional structural engineer licensed in the State of Illinois.
   3. Include the design engineer's seal and signature on each sheet of shop drawings.

D. Delegated Design:
   1. Guard and handrail assemblies.

E. Delegated Design Data: As required by authorities having jurisdiction.

F. Samples: Submit one (1) of each item below for each type and condition shown.
   1. Railing: 12 inch long section of handrail illustrating color, finish and connection detail.

G. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Installer Qualifications: Company specializing in installing decorative railing systems and acceptable to manufacturer.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.

B. Protect materials against damage during transit, delivery, storage, and installation at site.

C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

D. Prior to installation, store materials and components under cover in a dry location.

1.07 FIELD CONDITIONS

A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F and maximum 95 degrees F.

B. Maintain ambient temperature of space at minimum 65 degrees F and maximum 95 degrees F for 24 hours before, during, and after railing installation.

PART 2 PRODUCTS

2.01 RAILING SYSTEMS

A. Railing Systems - General: Factory- or shop-fabricated in design indicated, to suit specific project conditions, and for proper connection to building structure, and in largest practical sizes for delivery to site.
   1. Performance Requirements: Design and fabricate railings and anchorages to resist the following loads without failure, damage, or permanent set; loads do not need to be applied simultaneously.
      a. Lateral Force: 75 lb minimum, at any point, when tested in accordance with ASTM E935.
      b. Distributed Load: 50 lb/ft minimum, applied in any direction at the top of the handrail, when tested in accordance with ASTM E935.
      c. Concentrated Loads on Intermediate Rails: 50 psf, minimum.
      d. Concentrated Load: 200 lbs minimum, applied in any direction at any point along the handrail system, when tested in accordance with ASTM E935.
      e. Handrails: Comply with applicable accessibility requirements of ADA Standards and IAC.
   2. Assembly: Join lengths, seal open ends, and conceal exposed mounting bolts and nuts using slip-on non-weld mechanical fittings, flanges, escutcheons, and wall brackets.
   3. Joints: Tightly fitted and secured, machined smooth with hairline seams.
   4. Field Connections: Provide sleeves to accommodate site assembly and installation.
   5. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
      a. Ease exposed edges to a small uniform radius.
      b. Welded Joints:
         1) Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.
         2) Stainless Steel: Perform welding in accordance with AWS D1.6/D1.6M.
      c. Brass/Bronze Brazed Joints:
         1) Perform torch brazing in accordance with AWS C3.4M/C3.4.
         2) Perform induction brazing in accordance with AWS C3.5M/C 3.5.
         3) Perform resistance brazing in accordance with AWS C3.9M/C3.9.

B. Metal Railing: Engineered, post-supported railing system without infill and wall-mounted handrail.
   1. Configurations: Guardrail where top rail is also a handrail and handrail only.
   2. Top Rails and Support Posts: 2 inch maximum outside diameter pipe or tube.
   3. Material: Stainless steel; No. 4 satin finish

4. Decorative Flanges for Embedded Posts: Circular, collared cover plate without screw holes.
5. Wall Mounted Components: Components necessary to support railing with 1-1/2 inch clearance from wall, and as follows:
   a. Wall return without support: Terminates 1/4 inch from side wall.
6. Handrail Brackets: Same metal as railing.
7. Fasteners: Concealed.

2.02 MATERIALS

A. Stainless Steel Components:
   1. ASTM A666, Type 304.
   2. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.

2.03 ACCESSORIES

A. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.

B. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete for bolt anchors.
   2. Exposed Fasteners: No exposed bolts or screws.

C. Carbon Steel Bolts and Nuts: ASTM A307.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.02 PREPARATION

A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.

B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

A. Comply with manufacturer's drawings and written instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

C. Anchor securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

3.05 CLEANING

A. Remove protective film from exposed metal surfaces.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances.

3.06 PROTECTION

A. Protect installed components and finishes from damage after installation.

B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
   1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

SECTION 06 1000
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire retardant treated wood materials.

B. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Steel sheet blocking.

1.03 REFERENCE STANDARDS

A. ANSI/SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

C. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

E. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.

F. PS 20 - American Softwood Lumber Standard 2020.

G. WWPA G-5 - Western Lumber Grading Rules 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on lumber and construction panels.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Western Wood Products Association; WWPA G-5.

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: S-dry or MC19.

D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.04 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

B. Fire Retardant Treatment:
   1. Manufacturers:
      a. Lonza Group; Dricon FRT: www.wolmanizedwood.com/#sle.
      b. Hoover Treated Wood Products, Inc; Pyro-Guard: www.frtw.com/#sle.
      c. Koppers, Inc; FirePro: www.koppersperformancechemicals.com/#sle.
      d. Viance, LLC; D-Blaze: www.treatedwood.com/#sle.
   2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
      b. Treat rough carpentry items as indicated .
      c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. Fire treat wood blocking.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

E. Provide the following specific nonstructural framing and blocking:
   1. Cabinets and shelf supports.
   2. Wall brackets.

3. Wall-mounted door stops.
4. Marker board trays.
5. Wall paneling and trim.
6. General blocking as required.

3.04 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.05 CLEANING

A. Waste Disposal: See Section 01 7419 - Construction Waste Management and Disposal.
1. Comply with applicable regulations.
2. Do not burn scrap on project site.
3. Do not burn scraps that have been pressure treated.
4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

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SECTION 06 2000
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.

B. Hardware and attachment accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 09 2116 - Gypsum Board Assemblies: Steel sheet blocking.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).

D. PS 1 - Structural Plywood 2009.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on fire retardant treatment materials and application instructions.

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
   3. Design and show all joints to accommodate movement on shop drawings.
      a. Accommodate movement of wood, wood products and related materials caused by seasonal changes in humidity and temperature, or site conditions over the life of the product.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect from moisture damage.

B. Do not deliver wood materials to project site until the following conditions are met:
   1. Wet-work is complete.
   2. HVAC system is operating.
   3. Temperature and relative humidity are maintained at levels designed for building occupants and are maintained for the remainder of the construction period.
      a. Temperature and relative humidity levels to be maintained for the remainder of the construction period.

C. Verify that interior temperature and humidity are in accordance with recommendations of AWI/AWMAC/WI (AWS).
   1. Notify Architect prior to delivery if temperature and/or humidity vary from recommendations of AWI/AWMAC/WI (AWS).

D. Prior to installation, allow wood materials to acclimate to the environment of the enclosed and conditioned building for 72 hours minimum.

1.07 FIELD CONDITIONS

A. During and after installation of finish carpentry, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

2.02 LUMBER MATERIALS

A. Hardwood Lumber: Species and cut as indicated on drawings, maximum moisture content of 6 percent, of quality suitable for transparent finish.

2.03 SHEET MATERIALS

A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.

B. Medium Density Fiberboard (MDF): ANSI A208.2; Composed of cellulosic fibers; Thermal Resistance: Class I or A. Flame spread 15, smoke developed 95 as per ASTM E84.

C. Cellulose Based Fiber Wall Board: Molded, recycled post-consumer paper, cellulose fiber structural panel; Density: 34-40 pcf (544-640 kg/cu. m) tested in accordance with ASTM C209; Thermal Resistance: Class I or A. Flame spread 25, fuel contributed 0, smoke developed 20 as per ASTM E84.
   1. Products:
      a. Homasote Company; N.C.F.R. Homasote: www.homasote.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 FASTENINGS

A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.

2.05 ACCESSORIES

A. Lumber for Shimming and Blocking: Softwood lumber of any compatible species.

2.06 WOOD TREATMENT

A. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.

B. Provide identification on fire retardant treated material.

C. Redry wood after pressure treatment to maximum 6 percent moisture content.

2.07 FABRICATION

A. In the fabrication and assembly of all wood casework, paneling, trim and other wood components, accommodate movement of wood, wood products and related materials caused by seasonal changes in humidity and temperature, or site conditions over the life of the product.

B. Shop assemble work for delivery to site, permitting passage through building openings.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.08 SHOP FINISHING

A. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.

B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

1. Transparent:
    a. System - 5, Varnish, Conversion.
    b. Stain: As selected by Architect.
    c. Sheen: Flat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

C. See Section 06 1000 for installation of recessed wood blocking.

3.02 INSTALLATION

A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

D. Wood Base, Rails and Running Trim:
1. Fabricate with integral corners and returns. Fabricate in straight runs of maximum length. All joints to be splined, hairline tight.
2. Use single, unjointed lengths for runs of less than 10 feet. Stagger joints, cope and miter at corners.
3. Distribute any allowed defects to the best overall advantage.
4. Provide for thermal and building movements in finished work.

END OF SECTION

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SECTION 06 2614
MINERAL COMPOSITE PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Light weight composite mineral profile paneling and seam finishing materials to create a monolithic sculptured wall surface.

1.02 RELATED REQUIREMENTS

A. Section 09 2116 – Gypsum Board Assemblies.

1.03 REFERENCE STANDARDS

A. Reference Standards:
   1. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010 (Reapproved 2018).
   2. ASTM D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30°C with a Vitreous Silica Dilatometer 2016.
   3. ASTM E 84 -Standard Test Methods for Surface Burning Characteristics of Building Materials 2020.
   4. NFPA 286 - Standard Methods of Fire Test for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.
   5. GA-214 - Recommended Levels of Finish - Gypsum Board, Glass Mat and Fiber-Reinforced Gypsum Panels 2015.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings:
   1. Convene meeting at project site within one week of scheduled start of installation with representatives of the following in attendance: Owner, Architect, General Contractor, Installer, Finisher, and Painter.
   2. Review substrate conditions, requirements of related work, installation instructions, seam finishing, and painting instructions, storage and handling procedures, and protection measures.
   3. Keep minutes of meeting including responsibilities of various parties and deviations from specifications and installation instructions.

1.05 SUBMITTALS

A. Product Data: Each product specified.

B. Shop Drawings: Show standard and project specific details including termination at adjacent surfaces.

C. Samples: Two samples, minimum 15 by 15 inch panel of specified design(s).

D. Manufacturer's installation instructions.

E. Qualification Statements: Proof of manufacturer, installer, and finisher qualifications.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Minimum five years experience in producing mineral profile paneling.
   2. Installer: Minimum three years experience in finish carpentry/architectural woodwork installation.
   3. Finisher: Minimum three years experience in executing Level 5 finish in accordance with GA-214.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Store panels in fully enclosed space, protected against damage from moisture, direct sunlight, and surface contamination.

2. Store panels vertically, in shipping crates, until ready to be installed. Loosen crate lids to allow for venting. Do not stack or lean against walls.
3. Store panels in area of installation minimum 24 hours prior to installation.

1.08 FIELD CONDITIONS

A. Ambient Conditions:
1. HVAC: Operate HVAC system to maintain occupancy level temperature and relative humidity conditions (35 to 67 percent) in the area of installation from 24 hours prior to delivery of panels to the installation area through remainder of construction period.
2. Lighting: Permanent project lighting, including any special lighting used to highlight the profiled panels, must be operational prior to seam finishing.

PRODUCTS

2.01 MANUFACTURER

A. Modular Arts, Inc.: www.modularArts.com.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COMPONENTS

A. Profile Panel: Smooth surface mineral composite panel with light weight plant-based foam back.
1. Size: 32 by 32 by 1.5 inch maximum profile relief.
2. Physical Properties:
a. Izod Impact Strength; ASTM D256: 9.4 ft-lb/in2
b. Thermal Expansion; ASTM D696: 3.8x10-7in/in °F.
c. Compressive Strength; ASTM D696: 2.3 ksi.
d. Room Corner Burn Test; NFPA 286: Pass.
e. Flame Spread Index; ASTM E84: 0.
f. Smoke Development Index; ASTM E84: 50.
g. Weight (for all designs excluding MUDD formerly YUMA): 1.5 psf.
h. Weight (for MUDD design only): 3 psf.
3. Design: As indicated on drawings.

B. Installation Kit: Item quantities in parenthesis denote quantities for (Small Kit—up to 50 panels/Large Kit—up to 100 panels). (Not applicable to EZ-Seam™ Designs.)
1. Item quantities in parenthesis denote quantities for (Small Kit—up to 50 panels/Large Kit—up to 100 panels).
2. Dry Mix Joint Compound: One 18 lb. bag SHEETROCK® brand EASY SAND™ 45, or BEADEX® brand SILVER SET™ 40.
3. Acrylic Fortifier: (One/Two) quart MasterEmaco® A 660.
4. Construction Adhesive: (12/24) 10.2 oz tubes PL® Polyurethane Premium Construction Adhesive.
5. Countersink Drill Bit with Depth Stop-Collar: (One/Two) No. 7.
6. Flexible Spreader: (One/Two) MUDTOOLS SMT-Y2
7. Sandpaper: (15/30) sheets No-Load 220G, (10/20) sheets No-Load 150G.
8. Plastic Container: One 100 oz.
9. Measuring Cup: One 8 oz.

2.03 ACCESSORIES

A. Anchors: 30 lb. self-drilling, drywall anchor.

B. Screws: Coarse thread, drywall type, length as required by panel design and in accordance with Manufacturer's Installation Instructions.

2.04 SOURCE QUALITY CONTROL

A. Fabrication Tolerances:
1. Dimensions, length and width: ± 1/16 inch.
2. Thickness: ± 1/16 inch.

3. Weight: ± 1/2 lb.

2.05 EXECUTION

A. Examination
   1. Examine substrates upon which profile paneling will be installed.
      a. Verify that substrate is a material listed as an acceptable substrate by the profile paneling manufacturer.
   2. Verify that permanent project lighting is in place and operational prior to start of seam finishing.
   3. Coordinate with responsible entity to correct unsatisfactory conditions.
   4. Commencement of work by installer is acceptance of substrate conditions.
   5. Finish in accordance with manufacturer's instructions and as indicated on drawings.

B. INSTALLATION
   1. Install profile paneling in accordance with manufacturer's installation instructions.

C. Cleaning
   1. Waste Disposal: Comply with the requirements of Section 01 7419 - Construction Waste Management and Disposal.

D. Protection
   1. Protect finished work from damage during remainder of construction period.

END OF SECTION

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SECTION 06 4100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Hardware.

C. Wall shelving, standards and brackets.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 12 3600 - Countertops.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).

C. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.

D. IAC - Illinois Accessibility Code 2018.

E. UL (DIR) - Online Certifications Directory Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
   1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
   2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
   3. Indicate grain orientation for all elements, including that made from wood-grain plastic laminate.
   4. Design and show all joints to accommodate movement on shop drawings.
      a. Accommodate movement of wood, wood products and related materials caused by seasonal changes in humidity and temperature, or site conditions over the life of the product.

C. Product Data: Provide data for hardware accessories.

D. Samples:
   1. Submit samples of finish materials for verification purposes.
   2. Submit two samples of laminate materials, illustrating specified color and finish. Submit large enough samples to demonstrate entire pattern repeat, but no smaller than 3 x 2 inches in size.
   3. Submit two samples of finished plywood, 12 x 12 inches in size, illustrating wood grain and specified finish.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

B. Competence: The approved woodwork manufacturer must have a reputation for doing satisfactory work on time and shall have successfully completed comparable work. The Architect and Owner reserve the right to approve the woodwork manufacturer selected prior to commencement of work.

C. Single Source Responsibility: A single manufacturer shall provide and install the work described in this Section and Section 12 3600 Countertops.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

B. Do not deliver wood materials to project site until the following conditions are met:
   1. Wet-work is complete.
   2. HVAC system is operating.
   3. Temperature and relative humidity are maintained at levels designed for building occupants and are maintained for the remainder of the construction period.
      a. Temperature and relative humidity levels to be maintained for the remainder of the construction period.

C. Verify that interior temperature and humidity are in accordance with recommendations of AWI/AWMAC/WI (AWS).
   1. Notify Architect prior to delivery if temperature and/or humidity vary from recommendations of AWI/AWMAC/WI (AWS).

D. Prior to installation, allow wood materials to acclimate to the environment of the enclosed and conditioned building for 72 hours minimum.

1.07 FIELD CONDITIONS

A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), with the following exceptions.
   1. Wood Veneer Faced Elements: Premium Grade.

B. Cabinets:
   1. Grained Face Layout for Cabinet and Door Fronts: Flush panel.
      a. All Grades:
         1) Provide vertical run and match for doors, drawer fronts and false fronts within each cabinet unit.
         2) Provide well-matched doors, drawer fronts and false fronts across multiple cabinet faces in one elevation.
         3) Cathedral Grain: Point grain crown up and run in the same direction for entire project.

2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

2.03 LAMINATE MATERIALS

A. Provide specific products as indicated on Drawings.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications and as follows:
   1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color where indicated.
   2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color where indicated.
   3. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color where indicated, color as selected, finish as indicated.
   4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04 TACKABLE PANEL MATERIALS

A. Core: Mineral Fiber Board.
   1. Basis of Design: USG Corporation; Micore 160.
      a. Substitutions: See Section 01 6000 - Product Requirements.
   2. Thickness: 1/2 inch minimum.

B. Fabric facing: As indicated on drawings.

2.05 COUNTERTOPS

A. Countertops are specified in Section 12 3600.

2.06 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application, complying with VOC restrictions.

B. Plastic Edge Banding: 2 mm PVC, flat shaped; smooth finish; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range; unless otherwise indicated.
   2. Use at exposed cabinet, drawer, door and shelf edges.

C. Fasteners: Size and type to suit application.

D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

2.07 HARDWARE

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.

B. Adjustable Shelf Supports Inside Cabinets: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, satin chrome finish, for nominal 1 inch spacing adjustments.

C. Adjustable Shelf Supports - Supply Shelves: Standard back-mounted system using surface mounted metal shelf standards, double-slotted, and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.
   1. Product: 85/185 Series manufactured by Knape & Vogt: www.knapeandvogt.com.
   2. Shelves: Laminate covered with Plastic Edge Banding; 3/4 inch minimum thickness when unsupported length is 36 inches O.C. or less, 1” minimum thickness when

D. Fixed Specialty Workstation and Countertop Brackets:
   1. Material: Steel.
   2. Color: Selected by Architect from manufacturer's standard range.
   3. Manufacturers:
      a. A&M Hardware, Inc; Hybrid Brackets: http://www.aandmhardware.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

E. Drawer and Door Pulls: "U" shaped wire pull, Stainless Steel Look, Brushed/Satin Nickel Finish.
   1. Comply with ADA and IAC requirements.
      a. Product: 117.14.620 manufactured by Häfele. 1 per drawer/cabinet.
      b. Substitutions: See Section 01 6000 - Product Requirements.

F. Cabinet and Drawer Locks: Provide complete system for each lock, including removable lock core, cylinder body, and strike plates.
   1. Keyed cylinder, two keys per lock, master keyed, steel with satin finish.
      a. Interchangeable cores.
      b. Coordinate with existing lock system.

G. Drawer Slides:
   1. Type: Full extension with overtravel.
      a. Ball bearing slides.
   2. Static Load Capacity: Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide self closing/stay closed type.

H. Levelers: 1 inch diameter nickel-plated steel feet with threaded steel stem. Provide manufacturer's compatible recessed steel T-nut to receive threaded stem at each leveler.
   1. Product: 651.13.906 manufactured by Hafele.
   2. Substitutions: See Section 01 6000 - Product Requirements.

I. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
   1. Allow adjustment of cabinet door within hinge.
   2. Provide restriction chain or angle restriction clip at all cabinet doors adjacent to walls.

J. Cable Set Grommet: Plastic spring loaded cover and outer ring, 60mm.
   1. Provide at each computer or equipment location.
      a. Häfele: 429.99.
         1) Color: As selected from manufacturer's standard colors.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.08 SHOP TREATMENT OF WOOD MATERIALS

A. Provide UL (DIR) listed and approved identification on fire retardant treated material.

B. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

2.09 WOOD TREATMENT PROCESSES

A. Fire Retardant Treatment for Lumber and Substrate: Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, when tested in accordance with ASTM E 84.

B. Fire Retardant Finish for Veneer: Capable of providing flame spread index of 75 maximum, maximum and smoke developed of 450 maximum, when tested in accordance with ASTM E 84 or UL 723.

2.10 FABRICATION

A. In the fabrication and assembly of all wood casework, paneling, trim and other wood components, accommodate movement of wood, wood products and related materials caused by seasonal changes in humidity and temperature, or site conditions over the life of the product.

B. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

C. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

D. Shelving: Provide 1 shelf for every 12 inches of cabinet storage height.

E. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

F. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
   1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   2. Cap exposed plastic laminate finish edges with material of same finish and pattern.

G. Mechanically fasten back splash to countertops with steel brackets at 16 inches on center.

H. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.11 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.

C. Finish solid wood in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5 - Finishing for Grade specified and as follows:
   1. Transparent:

a. System - 5, Varnish, Conversion.
b. Stain: As selected by Architect.
c. Sheen: Satin.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.

B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.

C. Use fixture attachments in concealed locations for wall mounted components.

D. Use concealed joint fasteners to align and secure adjoining cabinet units and countertops.

E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. Secure cabinets to floor using appropriate angles and anchorages.

G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

A. Test installed work for rigidity and ability to support loads.

B. Adjust moving or operating parts to function smoothly and correctly.

C. Fill and retouch all nicks, chips, and scratches in the finish.

D. Replace damaged items that cannot be repaired.

3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures. Remove pencil and ink marks.

END OF SECTION

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SECTION 07 0553
FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Paint finish.

1.03 REFERENCE STANDARDS

A. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.

C. Samples: Submit two samples of each type of marking proposed for use, of size similar to that required for project, illustrating font, wording, and method of application.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.06 FIELD CONDITIONS

A. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Partition Identification Labels:
   1. Fire Wall Signs, Inc: www.firewallsigns.com/#sle.
   2. Safety Supply Warehouse, Inc: www.safetysupplywarehouse.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).

B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl sign with factory applied adhesive backing.

C. Applied Fire and Smoke Assembly Identification: Identification markings applied to partition with paint and a code compliant stencil. See Section 09 9123 for products.
   1. Lettering not less than 3 inches in height with a minimum 3/8 inch stroke in a contrasting color incorporating the suggested wording:
      a. FIRE BARRIER - "x" HOUR RATING
      b. SMOKE BARRIER
      c. FIRE AND SMOKE BARRIER - "x" HOUR RATING

D. Languages: Provide sign markings in English.

PART 3 EXECUTION

3.01 PREPARATION

A. See Section 09 9123 for substrate preparation for painted markings.

3.02 INSTALLATION

A. Locate markings as required by ICC (IBC).

B. Install adhered markings in accordance with manufacturer's instructions.
C. Install applied markings in accordance with Section 09 9123.
D. Install neatly, with horizontal edges level.
E. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

SECTION 07 2119
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. In exterior framed walls.
   2. At locations indicated on drawings.

B. Protective intumescent or cementitious coating.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.

B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics 2019.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.

E. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials 2013.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.

C. Certificates: Certify that products of this section meet or exceed specified requirements.

D. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

E. Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

F. Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing work of the type specified, factory trained and certified by the manufacturer, with minimum three years documented experience.

C. Air Barrier Association of America (ABAA) Evaluated Materials Program (EAP); www.airbarrier.org/#sle: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.05 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

B. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

2.01 MATERIALS

A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.

1. Thermal Resistance: R-value of 6.2, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.
2. Water Vapor Permeance: Vapor retarder; 1 perms or less, maximum, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
3. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
4. Air Permeance: 0.04 cfm per square foot, maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf.
5. Closed Cell Content: At least 90 percent.
6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
7. Manufacturers:
   a. BASF Corporation; WALLTITE US: www.spf.basf.com/#sle.
   b. Henry Company; Permax 2.0X: www.henry.com/#sle.
   c. Icynene-Lapolla; Icynene ProSeal HFO: www.icynene.com/#sle.
   d. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.
   e. Preferred Solutions, Inc. (PSI); Staycell 245-2.0: www.stayflex.com.

2.02 ACCESSORIES

A. Primer: As required by insulation manufacturer.

B. Protective Coating: Cementitious or intumescent type, spray applied; flame spread index (FSI) of 25 or less and smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify work within construction spaces or crevices is complete prior to insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.02 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.

B. Apply primer in accordance with manufacturer's instructions.

3.03 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

B. Apply to a minimum cured thickness of 2-1/2 inch or as indicated on drawings.

C. Apply overcoat monolithically, without voids to fully cover foam insulation, to achieve fire rating required.
   1. Comply with manufacturer's application instructions.

D. Patch damaged areas.

E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.

F. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.04 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 07 8400
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

A. Section 01 7000 - Execution and Closeout Requirements: Cutting and patching.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015.

C. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.

E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.

F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015.

G. ASTM E2174 - Standard Practice for On Site Inspection of Installed Fire Stops; 2010.

H. ASTM E2307 – Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-Story Test Apparatus; 2010.

I. ITS (DIR) - Directory of Listed Products current edition.

J. FM (AG) - FM Approval Guide current edition.

K. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.

L. UL (FRD) - Fire Resistance Directory Current Edition.

M. UL 1479 - Tests of Through-Penetration Firestops.

N. UL Accredited Contractors Program.

O. UL 2017 and ASTM E 1966 - Tests for Fire Resistance of Building Joint Systems; 2007.

P. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. System Drawings: Submit documentation from a qualified third-party testing agency that is applicable to each firestopping system configuration for construction, joint opening width and/or penetrating items.

D. Product Data: Provide data on product characteristics, performance ratings, and limitations.

E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with ASTM E814 or UL 1479, ASTM E1966 or UL 2079, ASTM E2307
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Submission of Firestop Systems Engineering Judgments, generated by the manufacturer and specifically applicable to each firestop situation, is required for assemblies for which none of the above substantiation exists.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Single-Source Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.

D. Installer Qualifications:
   1. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

1.06 COORDINATION

A. Coordinate construction of openings, curtain wall systems, joints, and penetrating items to ensure that firestopping systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes or cut openings to accommodate firestopping systems.

C. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

1.07 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products: www.3m.com/firestop.
   2. Hilti, Inc: www.us.hilti.com/#sle.
   3. Specified Technologies Inc: www.stifirestop.com/#sle.

2.02 MATERIALS

A. Mold and Mildew Resistance: Provide firestoppping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING, GENERAL

A. Provide firestopping products 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 firestopping products manufacturer based on testing and field experience.

B. Provide components for each firestopping system that are needed to install fill materials. Use only components specified by the firestopping manufacturer and approved by the qualified

testing agency for the designated fire-resistance-rated systems.

C. Use only firestopping products that have been tested for specific fire-resistance-rated construction conditions conforming to construction assembly type, penetrating item type or joint opening width and movement capabilities, annular space requirements, and fire-rating involved for each separate instance.

D. Performance Requirements:
   1. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during and after construction.
   2. Provide firestop sealants sufficiently flexible to accommodate motion such as pipe vibration, water hammer, thermal expansion and other normal building movement without damage to the seal.
   3. Pipe insulation shall not be removed, cut away or otherwise interrupted through wall or floor openings. Provide products appropriately tested for the thickness and type of insulation utilized.
   4. Provide fire-resistive joint sealants sufficiently flexible to accommodate movement such as thermal expansion and other normal building movement without damage to the seal.
   5. Provide fire-resistive joint sealants designed to accommodate a specific range of movement and tested for this purpose in accordance with a cyclic movement test criteria as outlined in Standards, ASTM E1966 or ANSI/ UL 2079.
   6. Provide T-Rating tested in accordance with ASTM E814 or ANSI/UL1479 for metallic pipe penetrations requiring T-Ratings per the applicable building code.

2.04 FIRESTOPPING SYSTEMS

A. Firestopping:
   1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

A. General Requirements: Install through-penetration firestop systems and fire-resistive joint systems in accordance with the conditions of testing and classification as specified in the published design.

B. Manufacturer’s Instructions: Comply with manufacturer’s instructions for installation of firestopping products:
   1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.
   2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of firestopping systems that might hamper the performance of fire dampers as it pertains to duct work.
   3. Protect materials from damage on surfaces subjected to traffic.
   4. Apply a suitable bond-breaker to prevent three-sided adhesion in applications where this condition might occur such as the intersection of a gypsum wallboard/steel stud wall to floor or roof assembly where the joint is backed by a steel ceiling runner or track.

C. Do not cover installed firestopping until inspected by authority having jurisdiction.

3.04 LABELLING

A. Identify through-penetration and fire resistive joint 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. Contractor's Name, address, and phone number.
   2. Firestop system designation of applicable testing and inspecting agency.
   3. Date of Installation.
   4. Firestop system manufacturer's name.
   5. Installer's Name.

3.05 FIELD QUALITY CONTROL

A. A manufacturer’s direct representative (not a distributor or agent) is to be on-site during initial installation of firestop systems to train the appropriate contractor personnel in the proper selection and installation procedures. Contractor must submit letter from manufacturer stating when, where, and the list the attendees that were trained.

3.06 FIELD QUALITY CONTROL

A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.

B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.07 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.08 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

3.09 INSPECTION

A. Special Inspection shall be paid for by owner, to ASTM E2174 and ASTM E2393 by a IAS AC 291 Accredited Special Inspection Agency and Special Inspectors that have successfully passed the FM or UL Firestop Exam.

END OF SECTION

SECTION 07 9200
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.

B. Section 07 8400 - Firestopping: Firestopping sealants.

C. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015.

B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants 2018.

C. ASTM C834 - Standard Specification for Latex Sealants 2017.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.

F. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.

H. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).

I. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015, with Editorial Revision (2017).

J. SWRI (VAL) - SWR Institute Validated Products Directory Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   6. Sample product warranty.
   7. SWRI Validation: Provide currently available sealant product validations as listed by SWRI (VAL) for specified sealants.

C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.

D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.

F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

G. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

H. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience.

B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Allow sufficient time for testing to avoid delaying the work.
   4. Deliver to manufacturer sufficient samples for testing.
   5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

C. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Name(s) of sealant manufacturers' field representatives who will be observing
   3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

D. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

E. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two;

then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.

3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation procedures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
   1. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   3. Sika Corporation: www.usa-sika.com/#sle.
   4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

B. Self-Leveling Sealants: Pourable or self-leveling sealant that has sufficient flow to form a smooth, level surface when applied in a horizontal joint.
   1. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   3. Sika Corporation: www.usa-sika.com/#sle.
   4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. Other joints indicated below.
   2. Do not seal the following types of joints.
      a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      c. Joints where installation of sealant is specified in another section.
      d. Joints between suspended panel ceilings/grid and walls.

B. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
   1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
   2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear.
   3. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
   4. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Wet Areas: Bathrooms and restrooms; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products with levels of volatile organic compound (VOC) content as indicated in Section 01 6116.

2.04 NONSAG JOINT SEALANTS

A. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
   1. Color: Clear.

B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 50 percent, minimum.
2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's standard range.

C. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
1. Color: Standard colors matching finished surfaces, Type OP (opaque).

2.05 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
3. Color: Gray.
4. Service Temperature Range: Minus 40 to 180 degrees F.

B. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
1. Composition: Multi-component, 100 percent solids by weight.
2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
3. Color: Concrete gray.
4. Joint Width, Minimum: 1/8 inch.
5. Joint Width, Maximum: 1/4 inch.
6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.

2.06 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
3. Open Cell: 40 to 50 percent larger in diameter than joint width.
4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

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

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

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.

2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
3. Arrange for sealant manufacturer's technical representative to be present during tests.
4. Record each test on Preinstallation Adhesion Test Log as indicated.
5. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
6. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.

C. Destructive Adhesion Testing: If there are any failures in first 1000 linear feet, notify Architect immediately.

D. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

E. Repair destructive test location damage immediately after evaluation and recording of results.

END OF SECTION

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SECTION 08 1213
HOLLOW METAL FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal frames for non-hollow metal doors.

B. Fire-rated hollow metal frames for non-hollow metal doors.

C. Interior glazed borrowed lite frames.

1.02 RELATED REQUIREMENTS

A. Section 08 1416 - Flush Wood Doors: Non-hollow metal door for hollow metal frames.

B. Section 08 7100 - Door Hardware: Hardware.

C. Section 08 8000 - Glazing: Glazed borrowed lites.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2011.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2011.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2020.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.

H. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.

I. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

J. ITS (DIR) - Directory of Listed Products current edition.

K. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.

L. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.

M. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.

N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.

O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.

P. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.

Q. UL (DIR) - Online Certifications Directory Current Edition.

R. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.

C. Shop Drawings: Details of each opening, showing elevations, frame profiles, and identifying location of different finishes, if any.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Frames with Integral Casings:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   3. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
   4. Steelcraft, an Allegion brand: www.allegion.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Door Frame Type: Provide hollow metal door frames with integral casings.

B. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.

C. Accessibility: Comply with ICC A117.1 and ADA Standards.

D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.

E. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

F. Frames for Interior Glazing or Borrowed Lites: Construction and face dimensions to match door frames, and as indicated on drawings.

2.03 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

A. Frame Finish: Factory primed and field finished.

B. Interior Door Frames, Non-Fire Rated: Face welded type.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
      c. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.

C. Fire-Rated Door Frames: Face welded type.
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
      a. Level 2 - Heavy-duty.
      b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
      c. Frame Metal Thickness: 18 gauge, 0.042 inch, minimum.
   2. Fire Rating: As indicated on Door and Frame Schedule, tested in accordance with {\rs\#2} or AA DAF-45 ("positive pressure fire tests").
   3. Provide units listed and labeled by ITS (DIR) or UL (DIR).
      a. Attach fire rating label to each fire rated unit.

2.04 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.05 ACCESSORIES

A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

B. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Comply with glazing installation requirements of Section 08 8000.

E. Install door hardware as specified in Section 08 7100.

F. Coordinate installation of electrical connections to electrical hardware items.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

END OF SECTION

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SECTION 08 1416
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood doors; flush configuration; fire rated and non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08 1213 - Hollow Metal Frames.

B. Section 08 7100 - Door Hardware.

C. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).

C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.

D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
   1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

D. Samples: Submit two samples of door veneer, 12 by 12 inch in size illustrating wood grain, stain color, and sheen.

E. Manufacturer's Installation Instructions: Indicate special installation instructions.

F. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging, and inspect for damage.

C. Protect doors with resilient packaging . Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. VT Industries: www.vtindustries.com.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS

A. Doors: See drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
   2. Wood Veneer Faced Doors: 5-ply.

B. Interior Doors: 1-3/4 inches thick; flush construction.
   1. Provide solid core doors at each location.
   2. Fire Rated Doors: Tested to ratings as indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc. (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: structural composite lumber core (SCLC), plies and faces as indicated above.

B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

A. Wood Veneer Facing for Transparent Finish: Anigre, plain quarter sliced, A grade, book matched, center balance assembly match.
   1. Vertical Edges: Same species as face veneer.
   2. Match existing doors.

B. Veneer Facing for Opaque Finish: Medium density overlay (MDO), in compliance with indicated quality standard.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge for hardware reinforcement.
   2. Provide solid blocking for other throughbolted hardware.

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 9.

2.06 FINISHES - WOOD VENEER DOORS

A. Standard factory finish: Clear.
   1. Match existing door appearance and finish.

B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Opaque:
      a. System - 5, Varnish, Conversion.
      b. Color: As selected by Architect.
      c. Sheen: Flat.

C. Factory finish doors in accordance with approved sample.

2.07 ACCESSORIES

A. Hollow Metal Door Frames: See Section 08 1213.

B. Glazing: See Section 08 8000.

C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
   1. Exception: Glazing stops for fire rated glass to be type required by glass manufacturer for rated assembly.

D. Door Hardware: See Section 08 7100.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.
   1. Install fire-rated doors in accordance with NFPA 80 requirements.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Field-Finished Doors: Trimming to fit is acceptable.
   1. Adjust width of non-rated doors by cutting equally on both jamb edges.
   2. Trim maximum of 3/4 inch off bottom edges.
   3. Trim fire-rated doors in strict compliance with fire rating limitations.

D. Use machine tools to cut or drill for hardware.

E. Coordinate installation of doors with installation of frames and hardware.

F. Coordinate installation of glazing.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING & TOUCH UP

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

C. Fill and retouch nicks, chips and scratches. Replace damaged items which cannot be repaired to Architect's satisfaction.

END OF SECTION

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SECTION 08 3100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall and ceiling mounted access units.

1.02 RELATED REQUIREMENTS

A. Section 09 9123 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

B. ITS (DIR) - Directory of Listed Products current edition.

C. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units:
   1. Location: As required.
   2. Size: 12 by 12 inches, minimum.
      a. Coordinate size with item(s) to be accessed.
   3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

B. Fire-Rated Wall-Mounted Units:
   1. Location: As required.
   2. Wall Fire-Rating: As indicated on drawings.
   3. Size: 12 by 12 inches, minimum.
      a. Coordinate size with item(s) to be accessed.
   4. Door/Panel: Insulated double-surface panel.

2.02 WALL AND CEILING MOUNTED ACCESS UNITS

A. Manufacturers:
   1. ACUDOR Products Inc: www.acudor.com/#sle.
   2. Babcock-Davis: www.babcockdavis.com/#sle.
   3. Bauco Access Panel Solutions Inc: www.accesspanelsolutions.com/#sle.
   4. Cendrex, Inc: www.cendrex.com/#sle.
   5. Karp Associates, Inc: www.karpinc.com/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

B. Wall and Ceiling Mounted Units, Public Locations: Factory fabricated door and frame, fully assembled molded glass fiber reinforced gypsum (GRG) units; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.

1. Flammability: Flame Spread & Smoke Development Index of 0 in accordance with ASTM E84 .
2. Style: As indicated above.
3. Hardware: Latch/Lock: Cylinder lock-operated cam latch, two keys for each wall mounted unit.

C. Wall and Ceiling Mounted Units, Back of House Locations: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Material: Steel.
2. Style: Exposed frame with door surface flush with frame surface.
   a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
3. Door Style: Single thickness with rolled or turned in edges.
4. Frames: 16 gauge, 0.0598 inch, minimum thickness.
5. Single Steel Sheet Door Panels: 1/16 inch, minimum thickness.
6. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
   a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
7. Steel Finish: Primed.
8. Hardware: Latch/Lock:
   a. Hardware for Fire-Rated Units: As required for listing.
   b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
   c. Handle: No handle.
   d. Latch/Lock: Screw driver slot for quarter turn cam latch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to proceeding with this work.

B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

D. Use joint-treatment materials to finish GRG parts and assemblies to produce surfaces ready to receive primers and paint finishes as detailed.

END OF SECTION

SECTION 08 4435
PROTECTIVE FRAMED GLAZING ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior protective framed glazing assembly.

1.02 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 08 8000 - Glazing.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site 2015.

B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.

E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.

F. ITS (DIR) - Directory of Listed Products current edition.

G. UL (DIR) - Online Certifications Directory Current Edition.

H. UL 263 - Standard for Fire Tests of Building Construction and Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide evidence of compliance with fire performance criteria and manufacturer's published product data on framing components, glazing, anchorage and fasteners, and doors, if any.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least ten years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.07 FIELD CONDITIONS

A. Do not install sealants when ambient temperature is less than 40 degrees F, and maintain above this minimum temperature during and for 48 hours after installation.

PART 2 PRODUCTS

2.01 INTERIOR PROTECTIVE FRAMED GLAZING ASSEMBLIES

A. Manufacturers:

1. SAFTIFIRST, a division of O'Keeffe's Inc; GPX Architectural Series: www.safti.com/#sle.
2. Technical Glass Products; Fireframes Heat Barrier Series: www.fireglass.com/#sle.
3. Vetrotech North America; VDS 60: www.vetrotechusa.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Provide factory fabricated, factory finished framing members with glazing and related flashings, anchorage and attachment devices.
   1. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

C. Fire Performance: Provide hourly fire-resistance-rating as indicated; tested as an assembly including glazing in compliance with ASTM E119 or UL 263 and requirements of local authorities having jurisdiction.
   1. Acceptable evidence of compliance includes listing by UL (DIR), ITS (DIR), or testing agency acceptable to authorities having jurisdiction.

2.02 COMPONENTS

A. Framing Members: Formed steel structural members with or without aluminum cladding and non-combustible thermally-resistive material as required for fire rating.
   1. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   2. Glazing Stops: Flush.
   3. Cross-Section: As indicated on drawings.
   4. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Structural Steel Sections: ASTM A36/A36M; shop primed.

C. Fasteners: Stainless steel.
   1. Arrange fasteners and attachments to conceal from view.

D. Sealants Within Fire-Rated Assembly: As required by fire-rating and manufacturer's assembly.

E. See Section 07 9200 for additional information on sealant requirements.

F. Glazing Gaskets: Type to suit application to achieve fire-rating, weather, moisture, and air infiltration requirements.

2.04 FINISHES

A. Finishing: Apply factory finish to surfaces that will be exposed in completed assemblies.
   1. Touch-up surfaces cut during fabrication so that no natural metal surfaces are visible in completed assemblies, including joint edges.

B. Pigmented Organic Coatings: AAMA 2603; polyester or acrylic baked enamel finish.

C. Color: As indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install wall system in accordance with limitations of fire rating and with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 1/16 inch every 3 feet non-cumulative or 1/2 inch per 100 ft, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

C. Sealant Space Between Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 CLEANING

A. Remove protective material from pre-finished surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.

3.05 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

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SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:

    a. Swinging doors.

2. Electronic access control system components, including:

    a. Electronic access control devices.

3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
4. Lead-lining door hardware items required for radiation protection at door openings.
5. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier’s responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
2. Section 10 2310 – Glazed Interior Wall and Door Assemblies: Additional door hardware.
3. Division 26 sections for connections to electrical power system and for low-voltage wiring.
4. Division 28 sections for coordination with other components of electronic access control system.

1.03 REFERENCES

A. UL - Underwriters Laboratories

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute

1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.04 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 requirements.
2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.

B. Action Submittals:

1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

a. Wiring Diagrams: For power, signal, and control wiring and including:
1) Details of interface of electrified door hardware and building safety and security systems.
2) Schematic diagram of systems that interface with electrified door hardware.
3) Point-to-point wiring.
4) Risers.

3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.

a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:

    a. Door Index; include door number, heading number, and Architects hardware set number.
    b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
    c. Quantity, type, style, function, size, and finish of each hardware item.
    d. Name and manufacturer of each item.
    e. Fastenings and other pertinent information.
    f. Location of each hardware set cross-referenced to indications on Drawings.
    g. Explanation of all abbreviations, symbols, and codes contained in schedule.
    h. Mounting locations for hardware.
    i. Door and frame sizes and materials.
    j. Name and phone number for local manufacturer's representative for each product.
    k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.
        1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:

    a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
    b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
    c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
    d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
    e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
        1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

    f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product data for electrified door hardware:

a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

3. Certificates of Compliance:

a. UL listings for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in “QUALITY ASSURANCE” article, herein.
c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in “QUALITY ASSURANCE” article, herein.

4. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Factory order acknowledgement numbers (for warranty and service)
d. Name, address, and phone number of local representative for each manufacturer.
e. Parts list for each product.
f. Final approved hardware schedule, edited to reflect conditions as-installed.
g. Final keying schedule
h. Copies of floor plans with keying nomenclature
i. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
j. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.05 QUALITY ASSURANCE

A. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.

a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
2. Can provide installation and technical data to Architect and other related subcontractors.
3. Can inspect and verify components are in working order upon completion of installation.
4. Capable of producing wiring diagrams.
5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

D. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.

G. Keying Conference

1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.

H. Pre-installation Conference

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

I. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.

2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.06 DELIVERY, STORAGE, AND HANDLING

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

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer’s original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:

1. Promptly replace products damaged during shipping.
2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

F. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.07 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.08 WARRANTY

A. 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. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.

a. Closers:
1) Mechanical: 30 years.

b. Exit Devices:
1) Mechanical: 3 years.
2) Electrified: 1 year.

c. Locksets:
1) Mechanical: 10 years.
2) Electrified: 1 year.

d. Continuous Hinges: Lifetime warranty.
e. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.09 MAINTENANCE

A. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to insure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: “No Substitute.”

1. Where “No Substitute” is noted, submittals and substitution requests for other products will not be considered.

B. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” are by substitution request only.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors: Hardwired Electronic Access Control Lockset and Exit Device Trim:

1. Data: 24AWG, 4 conductor shielded, Belden 9843, 9841 or comparable.
2. DC Power: 18 AWG, 2 conductor, Belden 8760 or comparable.
3. Provide type of data and DC power cabling required by access control device manufacturer for this installation.
4. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with sufficient number and wire gauge with standardized Molex plug connectors to accommodate electric function of specified hardware. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Ives 5BB series.

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

    a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
    b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

    a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

4. 2 inches or thicker doors:

    a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to hinge preparation present in existing door or existing frame.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

    a. Steel Hinges: Steel pins
    b. Non-Ferrous Hinges: Stainless steel pins
    c. Out-Swinging Exterior Doors: Non-removable pins
    d. Out-Swinging Interior Lockable Doors: Non-removable pins
    e. Interior Non-lockable Doors: Non-rising pins

8. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.

2.04 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:

    a. Scheduled Manufacturer: Ives.

2. Requirements:

    a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
    b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
    c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
    d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
    e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
    f. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with sufficient number and wire gage to accommodate electric function of specified hardware.

g. Install hinges with fasteners supplied by manufacturer.
h. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 ELECTRIC POWER TRANSFER

A. Manufacturers:

a. Scheduled Manufacturer: Von Duprin EPT-10.
b. Acceptable Manufacturers: No Substitute.

B. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires sufficient to accommodate electric function of specified hardware.

C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

2.06 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.07 COORDINATORS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

2.08 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage ND series.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

    a. Lever Design: Schlage Rhodes.

2.09 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 99 series.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer’s approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide electrified options as scheduled.
11. Top latch mounting: double or single tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
12. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.10 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Von Duprin 6000 Series.

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary-resistant.
3. Where required, provide electric strikes UL Listed for fire doors and frames.
4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.11 MAGNETIC LOCKS

A. Magnetic Locks – Surface Type:

1. Manufacturers and Products:

a. Scheduled Manufacturer and Product: Schlage M490 series.

2. Requirements:

a. Provide magnetic locks certified to meet ANSI/BHMA A156.23 classification criteria including minimum holding force of 1500 LBF. Provide magnetic locks equipped with SPDT Magnetic Bond Sensing device, where specified, to monitor whether sufficient magnetic holding force exists to ensure adequate locking and SPDT Door Status Monitor device, where specified, to monitor whether door is open or closed. Provide bond sensors fully concealed within electromagnet to resist tampering or damage.
b. Provide magnetic locks certified to meet UL10C, and UL1034 for burglary-resistant electronic locking mechanisms.
c. Provide fasteners, mounting brackets, and spacer bars required for mounting and details.
d. Provide power supply recommended and approved by manufacturer of magnetic locks.
e. Where magnetic locks are scheduled, provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of magnetic locks for each individual leaf. Switches control both doors simultaneously at pairs. Locate controls as directed by Architect.

2.12 PASSIVE INFRARED MOTION SENSORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage SCAN II Series.

B. Requirements:

1. Provide motion sensors as specified in hardware groups.

2.13 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: Schlage/Von Duprin PS900 series.
2. Acceptable Manufacturers and Products: Precision ELR series, Sargent 3500 series, Dynalock 5000 series, Securitron BPS series, Security Door Controls 600 series.

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:

   a. 12/24 VDC Output, field selectable.
   b. Class 2 Rated power limited output.
   c. Universal 120-240 VAC input.
   d. Low voltage DC, regulated and filtered.
   e. Polarized connector for distribution boards.
   f. Fused primary input.
   g. AC input and DC output monitoring circuit w/LED indicators.
   h. Cover mounted AC Input indication.
   i. Tested and certified to meet UL294.
   j. NEMA 1 enclosure.
   k. Hinged cover w/lock down screws.
   l. High voltage protective cover.

2.14 KEYING

A. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

C. Requirements:

1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.

   a. Master Keying system as directed by the Owner.

2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
3. Provide keys with the following features:

   a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
   b. Patent Protection: Keys and blanks protected by one or more utility patent(s) until the year, 2029.

c. Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.

4. Identification:

a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication “Keying Systems and Nomenclature” for identification. Do not provide blind code marks with actual key cuts.
b. Identification stamping provisions must be approved by the Architect and Owner.
c. Stamp cylinders/cores and keys with Owner’s unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with “DO NOT DUPLICATE” along with the “PATENTED” or patent number to enforce the patent protection.
d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

5. Quantity: Furnish in the following quantities.

a. Change (Day) Keys: 3 per cylinder/core.
b. Permanent Control Keys: 3.
c. Master Keys: 6.

2.15 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product: LCN 4040XP series.
2. Acceptable Manufacturers and Products: No Substitute.

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 11/16 inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).

10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.16 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.17 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:

    a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.18 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers: Glynn-Johnson.

B. Requirements:

1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.19 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.20 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer: Zero International.

B. Requirements:

1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.21 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.22 DOOR POSITION SWITCHES

A. Manufacturers:

1. Scheduled Manufacturer: Schlage.

B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.23 COAT HOOKS

A. Manufacturers:

1. Scheduled Manufacturer: Ives.

B. Provide coat hooks as specified.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.

C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying section.
2. Furnish permanent cores to Owner for installation.

I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect’s opening number.

J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3.03 FIELD QUALITY CONTROL

A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.

1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.04 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. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer's Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.05 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

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

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.06 DOOR HARDWARE SCHEDULE

A. Hardware items are referenced in the following hardware. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

Hardware Group No. 02
1019E

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 (NRP @ OUT-SWING LOCKING DOORS)	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER

Hardware Group No. 05.1

1019H

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 (NRP @ OUT-SWING LOCKING DOORS)	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	SET	CONST LATCHING BOLT	FB52	630	IVE
1	EA	STOREROOM LOCK	ND80TD RHO LLL (LESS STRIKE)	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6223 FSE DSLC CON 12/16/24/28 VAC/VDC	630	VON
1	EA	COORDINATOR	COR X FL X MB	628	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	ASTRAGAL	OVERLAPPING DOOR ASTRAGAL BY DOOR MANUFACTURER		B/O
1	EA	WIRE HARNESS	CON-XXP (IN DOOR)		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
2	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		VON

Hardware Group No. 06.1

1015 1019DA 1019F 1102A 1110

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP @ OUT-SWING LOCKING DOORS)	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO LLL (LESS STRIKE)	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE DSLC CON 12/16/24/28 VAC/VDC	630	VON
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
1	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		VON

Hardware Group No. 07.1

1019J

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP @ OUT-SWING LOCKING DOORS)	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO LLL (LESS STRIKE)	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE DSLC CON 12/16/24/28 VAC/VDC	630	VON
1	EA	SURFACE CLOSER	4040XP HW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
1	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		VON

Hardware Group No. 08.1

1013 1019B 1019GA 1019GB

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP @ OUT-SWING LOCKING DOORS)	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO LLL (LESS STRIKE)	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE DSLC CON 12/16/24/28 VAC/VDC	630	VON
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
1	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		VON

Hardware Group No. 09.1

1018M 1019A 1019K

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 (NRP @ OUT-SWING LOCKING DOORS)	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO LLL (LESS STRIKE)	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE DSLC CON 12/16/24/28 VAC/VDC	630	VON
1	EA	OH STOP & HOLDER	100H	630	GLY
1	EA	SURFACE CLOSER	4040XP HW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
1	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		VON

Hardware Group No. 10.1

1019DB

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5 (NRP @ OUT-SWING LOCKING DOORS)	652	IVE
1	EA	STOREROOM LOCK	ND80TD RHO LLL (LESS STRIKE)	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE DSLC CON 12/16/24/28 VAC/VDC	630	VON
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
1	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		VON

Hardware Group No. 11.1

1019CC

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 (NRP @ OUT-SWING LOCKING DOORS)	652	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	CONST LATCHING BOLT	FB51T	630	IVE
1	EA	STOREROOM LOCK	ND80TD RHO LLL (LESS STRIKE)	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6223 FSE DSLC CON 12/16/24/28 VAC/VDC	630	VON
1	EA	COORDINATOR	COR X FL X MB	628	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	ASTRAGAL	OVERLAPPING DOOR ASTRAGAL BY DOOR MANUFACTURER		B/O
1	EA	WIRE HARNESS	CON-XXP (IN DOOR)		SCH
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
2	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		VON

Hardware Group No. 12.1

1019CA 1019CB

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	PANIC HARDWARE	99-L-06-LS-SNB	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC	630	VON
1	EA	SURFACE CLOSER	4040XP SCUSH TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
1	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 120/240 VAC		VON

Hardware Group No. 13.1

1019

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	FIRE EXIT HARDWARE	99-L-F-06-LS-SNB	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	PERMANENT CORE	23-030/20-740 AS REQ MATCH EXISTING KEYWAY	626	SCH
1	EA	ELECTRIC STRIKE	6300 FSE 12/24 VAC/VDC	630	VON
1	EA	SURFACE CLOSER	4040XP RW/PA TBSRT X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
1	EA	GASKETING	488S-BK (OMIT @ NON RATED OPENINGS USE SILENCERS)	BK	ZER
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
1	EA	DOOR CONTACT	679-05 TYPE AS REQUIRED	BLK	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-FA 120/240 VAC		VON

Hardware Group No. 14
1102B

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MAGNETIC LOCK	M490P HDB490 ATS/LED 12/24 VDC	628	SCE
1	EA	LONG DOOR PULL	PR 9266F 36" P	630-316	IVE
1	EA	CREDENTIAL READER	PROXPOINT (COORDINATE WITH DIV. 28)		HID
1	EA	PUSH BUTTON	625RDEX DA 12/24 VDC	630	SCE
1	EA	MOTION SENSOR	SCANII 12/24 VDC	WHT	SCE
1	EA	POWER SUPPLY	PS902 900-FA 120/240 VAC		VON
			REMAINDER OF HARDWARE BY GLASS DOOR MANUFACTURER		

Refer to Section 10 2310 – Glazed Interior Wall and Door Assemblies for hinges and door stop.

END OF SECTION

SECTION 08 8000
GLAZING

TYPE	DESCRIPTION
G-1	SAFETY GLASS, 1/4 INCH, CLEAR LOW IRON
G-2	SAFETY GLASS, 1/4 INCH, ETCHED
G-3	ONE WAY MIRROR GLAZING, 1/4 INCH
G-4	FIRE PROTECTIVE GLAZING, 45 MINUTES, CLEAR
G-5	FIRE RESISTANCE GLAZING, 60 MINUTES, CLEAR
G-6	LAMINATED TEMPERED SAFETY GLAZING, 1/2 INCH NOMINAL, CLEAR

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glazing units.

B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 08 1213 - Hollow Metal Frames: Glazed sidelites and borrowed lites.

B. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.

C. Section 08 4435 - Protective Framed Glazing Assemblies: Glazing fire-tested as part of the wall assembly.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015.

C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2015).

D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

E. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

F. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2015.

G. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.

H. GANA (SM) - GANA Sealant Manual 2008.

I. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. ITS (DIR) - Directory of Listed Products current edition.

K. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.

L. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies 2017.

M. UL (DIR) - Online Certifications Directory Current Edition.

N. UL 9 - Standard for Fire Tests of Window Assemblies Current Edition, Including All Revisions.

O. UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.

P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

Q. UL 263 - Standard for Fire Tests of Building Construction and Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 12 by 12 inch in size of glass units.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience.

1.06 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

2.02 GLAZING UNITS

A. Type G-1 - Monolithic Interior Vision Glazing (Safety Glazing):
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered safety glass.
   3. Tint: Clear, Low-Iron.
   4. Thickness: 1/4 inch, nominal.
   5. Glazing Method: Dry glazing method, gasket glazing.

B. Type G-2 - Monolithic Interior Vision Glazing, Etched:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Fully tempered safety glass.
   3. Tint: Clear.
   4. Finish: Etched and Sealed.
   5. Thickness: 1/4 inch, nominal.
   6. Glazing Method: Dry glazing method, gasket glazing.

C. Type G-5 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 45 minutes.

1. Applications:
   a. Glazing in fire-rated window assembly.
2. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
3. Safety Glazing Certification: 16 CFR 1201 Category II.
4. Fire-Rating Period: As indicated on drawings.
5. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
   a. "W" - meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
   b. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
   c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
   d. "T" - meets temperature rise of not more than 450 degrees F above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
   e. "XXX" - placeholder that represents fire-rating period, in minutes.
6. Manufacturers:
   a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL 60: www.safti.com/#sle.
   b. Technical Glass Products; Pilkington Pyrostop 60: www.fireglass.com/#sle.
   c. Vetrotech North America; Contraflam 60: www.vetrotechusa.com/#sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.

D. Type G-4 - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve fire-doors indicated fire-rating period of 45 minutes or less.
   1. Applications:
      a. Glazing in fire-rated door assembly.
      b. Other locations as indicated on drawings.
   2. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
   3. Safety Glazing Certification: 16 CFR 1201 Category II.
   4. Glazing Method: As required for fire rating.
   5. Fire-Rating Period: As indicated on drawings.
   6. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction
      a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
      b. "OH" - meets fire window assembly criteria including hose stream test of NFPA 257, or UL 9 fire test standards.
      c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
      d. "XXX" - placeholder that represents fire-rating period, in minutes.
   7. Manufacturers:
      a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperClear 45-HS: www.safti.com/#sle.
      b. Technical Glass Products; Firelite Plus Premium: www.fireglass.com/#sle.
      c. Vetrotech North America; Pyroswiss: www.vetrotechusa.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

E. Type G-3 - Transparent One-Way Mirror: Mirror quality float glass with pyrolytic (hard coat) type coating located on high light level surface of glass; ASTM C1376.
   1. Applications: Locations as indicated on drawings.
   2. Thickness: 1/4 inch.
   3. Glass Tint: Grey.

4. Glass Type: Fully tempered.
5. Glazing Method: Gasket glazing.

F. Type G-6 - Laminated Tempered Safety Glazing.
1. Application: Reception enclosure, including door.
2. Glass Typr: Fully tempered safety glass.
3. Tint: Clear.
4. Thickness: 1/2 inch, nominal.
5. Outer Lite: 1/4 inch tempered glass.
6. Interlayer: Polyvinyl butyral (PVB), thickness as required to meet performance criteria.
7. Inner Lite: 1/4 inch tempered glass.
8. Glazing Method: Dry glazing method, gasket glazing.
9. Machine glass for hardware prior to tempering.

2.03 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Silicone, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
1. Width: As required for application.
2. Thickness: As required for application.

D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 FIELD QUALITY CONTROL

A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

B. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

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SECTION 09 0561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
   1. Resilient tile and sheet.
   2. Carpet tile.

B. Preparation of existing concrete floor slabs for installation of floor coverings.

C. Testing of concrete floor slabs for moisture and alkalinity (pH).
   1. Testing included in Contractor costs. Contractor to schedule and coordinate testing.

D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
   1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.

E. Patching compound.

F. Remedial floor coatings.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.

1.03 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) 2020b.

B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete 2020.

C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2019, with Editorial Revision (2020).

D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.

E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2019a.

1.04 SUBMITTALS

A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.
   2. Manufacturer's required bond/compatibility test procedure.

B. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity (pH) test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Product data for recommended remedial coating.
   7. Submit report to Architect.
   8. Submit report not more than two business days after conclusion of testing.

C. Adhesive Bond and Compatibility Test Report.

1.05 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, handle, and protect products in accordance with manufacturer’s instructions and recommendations.

B. Deliver materials in manufacturer’s packaging; include installation instructions.

C. Keep materials from freezing.

1.07 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
   1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
   2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.

C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
   1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
   2. Use product recommended by testing agency.

a. If testing agency does not recommend a particular product, the following are acceptable systems:

3. Products:
   a. ARDEX Engineered Cements; ARDEX MC RAPID: www.ardexamericas.com/#sle.
   b. Koster American Corporation; VAP I 2000 with Koster SL Premium overlay: www.kosterusa.com/#sle.
   c. LATICRETE International, Inc; LATICRETE SUPERCAP Moisture Vapor Control with LATICRETE SUPERCAP Underlayment: www.laticrete.com/#sle.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.

B. Perform following operations in the order indicated:
   1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
      a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
      b. Removal of existing floor covering.
   2. Preliminary cleaning.
   3. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
   4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
   6. Specified remediation, if required.
   7. Patching, smoothing, and leveling, as required.
   8. Other preparation specified.
   9. Adhesive bond and compatibility test.
   10. Protection.

3.02 PRELIMINARY CLEANING

A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.

B. Do not use solvents or other chemicals for cleaning.

3.03 MOISTURE VAPOR EMISSION TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F1869 and as follows.

D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.

F. Report: Report the information required by the test method.

3.04 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

C. Test in accordance with ASTM F2170 Procedure A and as follows.

D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

F. Report: Report the information required by the test method.

3.05 ALKALINITY TESTING

A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
   1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
   2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
   3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.

C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.06 PREPARATION

A. See individual floor covering section(s) for additional requirements.

B. Comply with requirements and recommendations of floor covering manufacturer.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

A. Comply with requirements and recommendations of coating manufacturer.

3.09 PROTECTION

A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 2116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Steel sheet blocking for equipment mounting.

D. Acoustic insulation.

E. Gypsum wallboard.

F. Joint treatment and accessories.

G. Stud Wall Isolation Strip.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.

B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.

C. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.

D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.

E. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2018.

F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2018.

G. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base 2019.

H. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

I. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.

J. ASTM D3678 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Interior-Profile Extrusions 2014.

K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).

L. ASTM E413 - Classification for Rating Sound Insulation 2016.

M. GA-216 - Application and Finishing of Gypsum Panel Products 2016.

N. UL (FRD) - Fire Resistance Directory Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 3 years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
   1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
   2. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
   1. Fire Rated Partitions: Ratings as indicated on drawings.
   2. Head of Fire-Resistance-Rated Partitions: Match fire rating of partition.
   3. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
   2. Runners: U shaped, sized to match studs.
   3. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
   4. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.

B. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

C. Partition Head to Structure Connections: Provide option 1 or 2, specified below. Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
   1. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
   2. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
   3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.

D. Steel Sheet Blocking: 0.036 inch thick, galvanized.

2.03 BOARD MATERIALS

A. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.

4. Thickness: 5/8 inch.
5. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
6. Mold Resistant Paper Faced Products:
    a. American Gypsum Company; M-Bloc Type X: www.americangypsum.com/#sle.
    b. CertainTeed Corporation; M2Tech 5/8" Type X Moisture & Mold Resistant Drywall: www.certainteed.com/#sle.
    c. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com/#sle.
    d. National Gypsum Company; Gold Bond XP Gypsum Board: www.nationalgypsum.com/#sle.
    e. USG Corporation; USG Sheetrock Brand EcoSmart Panels Mold Tough Firecode X: www.usg.com/#sle.
    f. Substitutions: See Section 01 6000 - Product Requirements.

B. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
2. Paper-Faced Products:
    a. American Gypsum Company; M-Bloc Shaft Liner: www.americangypsum.com/#sle.
    b. CertainTeed Corporation; M2Tech Type X Shaftliner: www.certainteed.com/#sle.
    c. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gpgypsum.com/#sle.
    d. National Gypsum Company; Gold Bond Fire-Shield Shaftliner XP: www.nationalgypsum.com/#sle.
    e. USG Corporation; Sheetrock Brand Gypsum Liner Panels.
    f. Substitutions: See Section 01 6000 - Product Requirements.

2.04 GYPSUM WALLBOARD ACCESSORIES

A. Acoustic Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Thickness: 2 inch unless noted otherwise.
2. Manufacturers:
    a. ROCKWOOL; AFB evo: www.rockwool.com/#sle.
    b. Thermafiber, Inc; SAFB FF: www.thermafiber.com/#sle.
    c. Substitutions: See Section 01 6000 - Product Requirements.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Stud Wall Isolation Strip: Resilient isolation pad and neoprene bushing assemblies.
1. Products:
    a. Kinetics Noise Control, Inc.; Wallmat: www.kineticsnoise.com.
    b. Substitutions: See Section 01 6000 - Product Requirements.

D. Acoustical Fire Rated Outlet Backer Pad:
1. At fire rated assemblies provide backer pads UL 1479 or ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, and fire-rating involved.
2. Manufacturers:
    a. Hilti North America; CFS-P PA Firestop Putty Pad: www.hilti.com.
    b. Kinetics Noise Control; IsoBacker: www.kineticsnoise.com.
    c. QuietRock; QuietPutty: www.quietrock.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.

E. Finishing Accessories: ASTM C1047, rigid PVC, mud set beads, unless otherwise indicated.
1. PVC: ASTM D3678, Class 2.
2. Types: As detailed or required for finished appearance.

3. Control Joints Basis of Design: "Hideaway Expansion" low profile joint manufactured by Trim-Tex.
4. Manufacturers:
   a. Trim-tex, Inc: www.trim-tex.com/#sle.
   b. Vinyl Corp: www.vinylcorp.com.
   c. Substitutions: See Section 01 6000 - Product Requirements.

F. Joint Accessories and Other Trim: ASTM C1047, rigid plastic, unless noted otherwise.
1. Rigid Corner Beads: Low profile, for 90 degree outside corners.
   a. Products:
      1) Trim-Tex, Inc: www.trim-tex.com/#sle.
      2) Substitutions: See Section 01 6000 - Product Requirements.
2. Architectural Reveal Beads:
   a. Reveal Depth: As indicated on drawings .
   b. Reveal Width: As indicated on drawings.
   c. Shapes: As indicated on drawings.
   d. Finish: As indicated on drawings.
   e. Products:
      1) Fry Reglet Corporation: www.fryreglet.com.
      2) Substitutions: See Section 01 6000 - Product Requirements.

G. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Tape: 2 inch wide, creased paper tape for joints and corners, for use on paper-faced gypsum board.
2. Joint Compound: Drying type, vinyl-based, ready-mixed.

H. Screws for Attachment to Steel Members Less Than 0.03 inch In Thickness, and to Gypsum Board: ASTM C1002; self-piercing tapping type.

I. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

J. Top of Wall (Metal Deck Flute) at Smoke Partitions and Smoke Barriers: Smoke and Acoustic Spray. Fill deck flutes with mineral wool sealing pads. Do not use these products in fire rated partitions.
1. Manufacturers:
   a. Hilti; Smoke and Acoustic Spray CP 572: www.hilti.com.
   b. Hilti; Speed Plug CP 777 and Speed Strip CP 767: www.hilti.com.
   c. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
1. Install studs at spacing required to meet performance requirements.

B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.
2. Seal perimeter of shaft wall and penetrations with acoustical sealant.

3.03 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Studs: Space studs at 16 inches on center.
1. Extend partition framing to structure where indicated and to ceiling in other locations.

2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure. Brace studs according to the method selected in Part 2.

C. Blocking: Use wood blocking or mechanically-fastened steel sheet blocking secured to studs. Provide blocking for support of chair rails, plumbing fixtures, wall cabinets, toilet accessories, and equipment indicated to be wall mounted.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic and Fire Blanket Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
1. Install acoustic insulation above walls and ceilings as indicated in drawings.

B. Top of Wall Acoustical and Smoke Seal: Pack deck flutes with mineral wool; apply barrier spray both sides of partition to depth recommended by spray manufacturer.

C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
1. Place one bead continuously on substrate before installation of perimeter framing members.
2. Place continuous bead at perimeter of each layer of gypsum board.
3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

D. Stud Wall Isolation Strip: Install in accordance with manufacturer's instructions for application between top and bottom tracks and non-isolated structure.
1. Provide isolation strip assembly at sound rated walls.

E. Acoustical Fire Rated Outlet Backer Pads: Install ain accordance with manufacturer's instructions.
1. Install Outlet Backer Pads on electrical boxes in fire rated partition assemblies.
a. Install backer pads in accordance with UL Fire Resistance Directory.
2. Install Outlet Backer Pads on electrical boxes in partition assemblies with a listed STC rating.

F. Smoke and Acoustic Spray: Install in accordance with manufacturer's instructions.

3.05 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
1. Exception: Tapered edges to receive joint treatment at right angles to framing.

C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.

D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
2. At exterior soffits, not more than 30 feet apart in both directions.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.07 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, mechanical rooms, data or electrical closets, behind cabinetry, and on backing board to receive tile finish.
   3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
   4. Level 0: Temporary partitions.

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling, and sanding are not required at surfaces behind adhesive applied ceramic tile.

3.08 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09 5100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system and perimeter trim.

B. Acoustical units.

1.02 RELATED REQUIREMENTS

A. Mechanical Sections - Sprinklers and air diffusion devices in ceiling systems.

B. Electrical Sections - Light fixtures in ceiling system.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2017.

C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2013.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2019.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on suspension system components and acoustical units.

C. Samples: Submit two samples illustrating material and finish of acoustical units. Samples of grid are not required.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Products and sizes as indicated on drawings.

2.02 SUSPENSION SYSTEM(S)

A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   1. Materials:
      a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

B. Exposed Suspension System: Hot-dipped galvanized steel grid and cap.
   1. Structural Classification: Heavy-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 9/16 inch face width.
   3. Finish: Baked enamel.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.

D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M and ASTM C636/C636M and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Locate system according to reflected plan.
   1. Minimum tile size: 3 inches. Eliminate smaller tiles by either of the two options below:
      a. Shift ceiling grid in room.
         1) Obtain Architect's approval before shifting grid. Provide drawing of proposed layout.
      b. Provide 2x4 tile cut to fit when a tile results in a width less than 3 inches. Adjust grid runners as required.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Do not use double grid at perimeter.
   2. Use longest practical lengths.
   3. Overlap and rivet corners.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Cut to fit irregular grid and perimeter edge trim.
   2. Make field cut edges of same profile as factory edges.
   3. Double cut and field paint exposed reveal edges.
      a. Field cut tegular tiles for reveal edge.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

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SECTION 09 6500
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet flooring.

B. Resilient tile flooring.

C. Resilient base.

D. Resilient stair accessories.

E. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs, cleaning, and preparation.

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate floor patterns.

D. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.

E. Field Sample: Submit assembled sample showing resilient sheet flooring, welded seam and integral base with cap.

F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Floor, Wall Base Materials: Quantity equivalent to 5 percent of each type and color.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

D. Protect adhesives from freezing.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 SHEET FLOORING

A. Materials, Manufacturers, Colors, Textures and Patterns: As indicated on drawings.
   1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648.

2.02 TILE FLOORING

A. Manufacturers, Colors, Textures and Patterns: As indicated on drawings.

B. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.

2.03 STAIR COVERING

A. Stair Nosings: As indicated on drawings.
   1. Material: Rubber.
   2. Color: To be selected by Architect from manufacturer's full range.

2.04 RESILIENT BASE

A. Materials, Manufacturers, Colors, Textures and Patterns: As indicated on drawings.
   1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648.

2.05 ACCESSORIES

A. Subfloor Filler: White premix latex; Type recommended by adhesive material manufacturer.

B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
   1. VOC Content Limits: As specified in Section 01 6116.

C. Moldings, Transition and Edge Strips: As indicated on drawings.
   1. Coordinate molding/edge strip height with finish materials.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561.
   2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

A. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

B. Prohibit traffic until filler is fully cured.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions and tech support guidelines.

3.04 INSTALLATION - SHEET FLOORING

A. Install per manufacturer’s tech support guidelines.

B. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.

C. Cut sheet at seams in accordance with manufacturer's instructions.

D. Seal seams by heat welding where indicated.

3.05 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. Install square tile to ashlar pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

D. Install and prep VCT floors in a wax ready condition.
   1. Owner will provide the material and labor of waxing the flooring.

3.06 INSTALLATION - RESILIENT BASE

A. Apply wall base adhesive to back surface of wall base with square-notched trowel.
   1. Cover 80 percent of back surface with adhesive.
   2. Leave 1/4 inch uncovered space at top of base to prevent adhesive from oozing onto the wall above the base when installed.

B. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

C. Miter internal corners. At external corners, use premolded units.

D. Install base on solid backing. Bond tightly to wall and floor surfaces.

E. Scribe and fit to door frames and other interruptions.

F. Replace sections of base if adhesive telegraphs to surface.

3.07 INSTALLATION - STAIR COVERINGS

A. Adhere over entire surface. Fit accurately and securely.

B. Secure nosings to the floor using manufacturer's recommended contact cement.

C. Adhere mitered seams with cyanoacrylate adhesive (super glue).

D. Cold weld horizontal to vertical seam intersections.

3.08 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

3.09 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

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SECTION 09 6813
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.
   1. Carpet will be tile provided by Owner, installed by Contractor.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 7419 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap.

C. Section 09 0561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.

D. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics and method of installation.

C. Shop Drawings: Indicate layout of joints.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

A. Tile Carpeting: Manufactured in one color dye lot.
   1. Carpet furnished by Owner, installed by contractor.

2.02 ACCESSORIES

A. Edge Strips: As specified in Section 09 6500.

B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
   1. Test in accordance with Section 09 0561.
   2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions.

C. Blend carpet from different cartons to ensure minimal variation in color match.

D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

E. Lay carpet tile in pattern indicated on drawings.

F. Trim carpet tile neatly at walls and around interruptions.

G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
   1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
   2. Mechanical and Electrical:
      a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
      b. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
      c. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Rating stamps on plywood for electrical and telecom equipment, which must be visible for inspection.
   5. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   6. Floors, unless specifically indicated.
   7. Ceramic and other tiles.
   8. Glass.
   9. Acoustical materials, unless specifically indicated.
   10. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 05 5000 - Metal Fabrications: Shop-primed items.

1.03 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
3. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.

D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
2. Provide 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.
3. Supply each paint material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content: Comply with Section 01 6116.

C. Flammability: Comply with applicable code for surface burning characteristics.

D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

E. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
      a. Products:
         1) PPG Paints Speedhide Zero Interior Latex, 6-4110XI Series, Flat. (MPI #143)
         2) PPG Paints Speedhide Zero Interior Latex, 6-4310XI Series, Eggshell.
         3) Benjamin Moore; Eco Spec® WB Interior Flat Finish N373.
         4) Benjamin Moore; Eco Spec® WB Interior Eggshell N374.
         5) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat.
         6) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Low Sheen. (MPI #144)
   3. Top Coat Sheen:
      a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
      b. Eggshell: MPI gloss level 3; use this sheen at all other locations.
   4. Primer: Provide paints and finishes used in any individual system from the same manufacturer.
      a. Benjamin Moore; Eco Spec® WB Interior Primer N372.
      b. PPG; Speedhide Zero Interior Latex Primer, 6-4900XI.
      c. Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Primer, B28W2600.

B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
   1. Medium duty applications include doors and door frames.
   2. Two top coats and one coat primer.
   3. Top Coat(s): Interior Alkyd, Water Based; MPI #157, 167, 168, or 169.
      a. Products:
         1) Sherwin-Williams Sher-Cryl HPA, Semi-Gloss.
   4. Top Coat Sheen:
      a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
   5. Primer: Provide paints and finishes used in any individual system from the same manufacturer.
      a. Sherwin Williams; Pro Industrial Pro-Cryl Primer.

2.04 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or repair existing paints or finishes that exhibit surface defects.

D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

E. Seal surfaces that might cause bleed through or staining of topcoat.

F. Existing Finishes to be Repainted: Prepare surface as recommended by top coat manufacturer.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 10 1100
VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Markerboards

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Blocking and supports.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's data on markerboard, trim, and accessories.

C. Shop Drawings: Indicate wall elevations, dimensions, joint locations .

D. Samples: Submit two samples 2 by 2 inch in size illustrating materials and finish, color and texture of markerboard and tray.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. 3M; Post-it Super Sticky Dry Erase Surface: www.3m.com.

B. Substitutions: See Section 01 6000 - Product Requirements.

2.02 VISUAL DISPLAY UNITS

A. Markerboards: Flexible dry erase whiteboard, adhered to wall.
   1. Color: White.
   2. Height: 48 inches.
   3. Length: As indicated on drawings.

2.03 ACCESSORIES

A. Marker Tray: Aluminum, style as indicated on drawings, manufacturer as indicated on drawings, manufacturer's standard fastening method, finish as indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

C. Verify flat wall surface for frameless adhesive-applied boards.

3.02 PREPARATION

A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Secure units level and plumb.

C. Butt Joints: Install with tight hairline joints.

3.04 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 10 2123
PRIVACY CURTAIN TRACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface mounted overhead curtain track and guides.

B. Cubicle curtains.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Blocking and supports for track.

B. Section 09 5100 - Acoustical Ceilings: Suspended ceiling system to support track.

1.03 SUBMITTALS

A. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.

B. Samples: Submit 12 by 12 inch sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Carriers: Ten.

PART 2 PRODUCTS

2.01 TRACKS AND TRACK COMPONENTS

A. Manufacturer:
   1. Inpro Corp; Ultra Cube Track System: www.inprocorp.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Track: Extruded aluminum sections; one piece per cubicle track run.
   1. Track End Caps: Molded plastic end caps to fit track section.
   2. Track Bends: Minimum 12 inch radius; fabricated without deformation of track section or impeding movement of carriers.
   3. Finish on Exposed Surfaces: White smooth finish.

C. Curtain Carriers: Track manufacturer's compatible type, white. Provide quantity recommended by track manufacturer for length of track.

D. Installation Accessories: Types required for specified mounting method and substrate conditions.

E. Curtain Tracks and Components: Supplied and installed by Contractor.

2.02 CURTAINS

A. Cubicle Curtains:
   1. Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   2. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
   3. Material: Close weave polyester; anti-bacterial, self deodorizing, sanitized, and preshrunk.
   4. Curtain: As scheduled on Drawings.
   5. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.

B. Curtains: Supplied and installed by Contractor.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

B. Verify that field measurements are as indicated.

3.02 INSTALLATION

A. Install curtain track to be secure, rigid, and true to ceiling line.

B. Secure track to ceiling system in accordance with manufactuer's instructions.

C. Install curtains on carriers ensuring smooth operation.

END OF SECTION

SECTION 10 2310
GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Frameless glazed interior wall and door assemblies.

1.02 RELATED REQUIREMENTS

A. Section 08 7100 - Door Hardware.

B. Section 08 8000-Glazing.

1.03 REFERENCE STANDARDS

A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's descriptive literature for each component in partition assembly.

C. Shop Drawings: Drawings showing layout, dimensions, identification of components, and interface with adjacent construction.
   1. Include field measurements of openings.
   2. Include Elevations Showing:
      a. Locations and identification of manufacturer-supplied door hardware and fittings.
      b. Locations and sizes of cut-outs and drilled holes for other door hardware.
   3. Include Details Showing:
      a. Installation details.
      b. Appearance of manufacturer-supplied door hardware and fittings.

D. Verification Samples: Two samples, minimum size of 2 inch by 3 inch, representing actual material and finish of exposed metal.

E. Certificates: Contractor to certify that installer of partition assemblies meets specified qualifications.

1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: Minimum three years of experience designing, assembling, and installing partition assemblies similar to those specified in this section.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

PART 2 PRODUCTS

2.01 FRAMELESS GLAZED INTERIOR WALL AND DOOR ASSEMBLIES

A. Frameless Glazed Interior Wall Assembly: Fabricated assemblies consisting of full-width and partial height glass panels fastened with U-channel fittings on top and bottom edge of glass wall.
   1. Configuration: As indicated on drawings.
   2. U-Channel Fittings: Stainless steel, No. 4 brushed finish, dry glazed, and with matching end caps. Configurations and sizes as indicated on drawings.
   3. Glass: Type G-6, specified in section 08 8000 - Glazing.
   4. Designed to withstand normal operation without damage, racking, sagging, or deflection.
   5. Coordinate wall and door assembly preparation and provide hardware as necessary for fully operable installation.
   6. Finished metal surfaces protected with strippable film.
   7. Factory assembled to greatest extent practical; may be disassembled to accommodate shipping constraints.

B. Glass Door: Dry glazed patch fittings.
   1. Door Configuration: As indicated on drawings.
   2. Door Hardware
      a. Hinges: Dormakaba; Tensor Double-Acting Hinges; www.dormakaba.com.
         1) Finish: As indicated on drawings.
         2) Substitutions: See Section 01 6000 - Product Requirements.
      b. Pull: As specified in Section 08 7100-Door Hardware.
      c. Mag Lock: As specified in Section 08 7100-Door Hardware.
      d. Stop: Dormakaba; Stop 892.950: www.dormakabe.com.
         1) Substitutions: See Section 01 6000 - Product Requirements.
   3. Provide accessories as required for complete installation.

2.02 FITTINGS AND HARDWARE

A. Locking Systems:
   1. Lockset with corresponding strike assembly; lockable with key on exterior; lockable on interior; lever always operates strike from interior.

2.03 MATERIALS

A. Sealant: One-part silicone sealant, complying with ASTM C920, clear.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Do not begin installation until supports and adjacent substrates have been properly prepared.

3.02 PREPARATION

A. Clean substrates thoroughly prior to installation.

B. Prepare substrates using the methods recommended by the manufacturer for achieving acceptable result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with glazed interior wall and door assembly manufacturer's instructions.

B. Fit and align glazed interior wall and door assembly level and plumb.

3.04 ADJUSTING

A. Adjust glazed interior wall and door assembly to operate smoothly from sliding or pivoting positions.

B. Conceal wiring to electric door control items. Utilize top channels and other concealing items.

C. Adjust swing door hardware for smooth operation.

3.05 CLEANING

A. Remove protective film from exposed metal surfaces.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

C. Glass and Glazing: Clean glazing surfaces; remove excess glazing sealant compounds, dirt, and other substances.

3.06 PROTECTION

A. Protect installed products until Date of Substantial Completion.

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

END OF SECTION

SECTION 10 2600
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bumper rails.

B. Corner guards.

C. Protective wall covering.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Blocking for wall and corner guard anchors.

1.03 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010 (Reapproved 2018).

B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents 2020.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

D. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies 2014.

E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.

C. Shop Drawings: Include plans, elevation, sections, and attachment details.

D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
   1. Submit two samples of protective wall covering, 6 by 6 inches square.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

B. Protect work from moisture damage.

C. Protect work from UV light damage.

D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.

E. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bumper Rails and Corner Guards:
   1. Inpro: www.inprocorp.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Protective Wall Covering:
   1. Inpro; IPC Palladium Rigid Sheet Wall Protection: www.inprocorp.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE CRITERIA

A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.

C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.03 PRODUCT TYPES

A. Bumper Rails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
   1. Material: High impact acrylic vinyl, color as indicated.
   2. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   3. Mounting: Surface.
   4. Projection From Wall to Outside of Rail: 1 inch.

B. Corner Guards - Flush Mounted:
   1. Material: High impact vinyl with full height extruded aluminum retainer.
   2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
   3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   4. Width of Wings: 2 inches.
   5. Corner: Square.
   6. Color: As indicated.
   7. Length: One piece.

C. Protective Wall Covering:
   1. Material: Polyethylene terephthalate (PET or PETG); PVC and PBTs-free.
   2. Thickness: 0.040 inch.
   3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
   4. Product and Color: As indicated on drawings.
   5. Accessories: Provide manufacturer's standard color-matched trim and moldings.
      a. Inside Corner Trim: Color matching sealant
   6. Mounting: Adhesive.

2.04 FABRICATION

A. Fabricate components with tight joints, corners and seams.

B. Pre-drill holes for attachment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that substrate surfaces for adhered items are clean and smooth.
   1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

C. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard 4 inches above finished floor to ceiling.

C. Position bumper rails as indicated on drawings.

D. Terminate rails 1 inch short of door openings and intersecting walls.

E. Position protective wall covering no less than 1 inch above finished floor to allow for floor level variation.
   1. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
   2. Apply adhesive with 1/8 inch V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.
   3. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement.
   4. Use a roller to ensure maximum contact with adhesive.
   5. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

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SECTION 10 4400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).

B. FM (AG) - FM Approval Guide current edition.

C. NFPA 10 - Standard for Portable Fire Extinguishers 2017, with Errata (2018).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Ansul, a Tyco Business: www.ansul.com.
   2. Potter Roemer: www.potterroemer.com.
   3. Pyro-Chem, a Tyco Business: www.pyrochem.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. Basis of Design: Potter-Roemer : www.potterroemer.com.
      a. Recessed: 1704.
      b. Semi-Recessed: 1724, 2 inch trim; 1734, 3 inch trim.
      c. Surface Mounted: 1754.
   2. Other Acceptable Manufacturers:
      a. Ansul, Inc.: www.ansul.com.
      b. Larsen's Manufacturing Co: www.larsensmfg.com.
      c. JL Industries, Inc: www.jlindustries.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire extinguishers to be furnished by Owner.

B. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

C. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size: 10 pound.
   3. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Cabinet Construction: Non-fire rated.
   1. Formed stainless steel sheet; 0.036 inch thick base metal.

C. Fire Rated Cabinet Construction: One-hour fire rated.
   1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.

D. Cabinet Configuration: Appropriate type.
   1. Coordinate cabinet and extinguisher sizes.
   2. Coordinate with wall configurations.
   3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

E. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with continuous piano hinges. Provide nylon catch.

F. Door Glazing: Full Glass, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.

G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

H. Fabrication: Weld, fill, and grind components smooth.

I. Finish of Cabinet Exterior Trim and Door: No. 4 satin finished type 304 stainless steel.

J. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

B. Cabinet Signage: Individual red block letters adhered to glass.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, at heights indicated from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

END OF SECTION

SECTION 12 2400
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior manual roller shades.

1.02 RELATED REQUIREMENTS

A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.

C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.

D. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.

E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience with shading systems of similar size and type.

1.07 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades: www.lutron.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ROLLER SHADES

A. General:
   1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
   2. Provide shade system that operates smoothly when shades are raised or lowered.

B. Roller Shades:
   1. Description: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.

a. Drop Position: Regular roll.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
3. Roller Tubes:
a. Material: Extruded aluminum or galvanized steel; as required for shade location.
b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
4. Hembars: Designed to maintain bottom of shade straight and flat.
5. Accessories:
a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
1) Color: As indicated on drawings.
2) Profile: Square.

2.03 SHADE FABRIC

A. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
1. Manufacturers:
a. Lutron Electronics Co., Inc; E Screen THEIA - 3%: www.lutron.com/#sle.
b. Substitutions: See Section 01 6000 - Product Requirements.
2. Performance Requirements:
a. Flammability: Pass NFPA 701 large and small tests.
3. Openness Factor: As indicated on drawings.
4. Color: As indicated on drawings.

2.04 ROLLER SHADE FABRICATION

A. Field measure finished openings prior to ordering or fabrication.

B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
3. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.

C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Installation Tolerances:
1. Inside Mounting: Maximum space between shade and jamb when closed of 1/16 inch.
2. Maximum Offset From level: 1/16 inch.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 12 3600
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.

B. Sinks molded into countertops.

1.02 RELATED REQUIREMENTS

A. Section 06 4100 - Architectural Wood Casework.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard 2016.

B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use 2016.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).

E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).

F. IAPMO Z124 - Plastic Plumbing Fixtures 2017.

G. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.

H. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

I. PS 1 - Structural Plywood 2009.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.

D. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

A. Quality Certification:
   1. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
   2. Provide designated labels on shop drawings as required by certification program.
   3. Provide designated labels on installed products as required by certification program.
   4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

B. Single Source Responsibility: A single manufacturer shall provide and install the work described in this Section and Section 06 4100 Architectural Wood Casework.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

B. Do not deliver wood materials to project site until the following conditions are met:
   1. Wet-work is complete.
   2. HVAC system is operating.
   3. Temperature and relative humidity are maintained at levels designed for building occupants and are maintained for the remainder of the construction period.
      a. Temperature and relative humidity levels to be maintained for the remainder of the construction period.

C. Verify that interior temperature and humidity are in accordance with recommendations of AWI/AWMAC/WI (AWS).
   1. Notify Architect prior to delivery if temperature and/or humidity vary from recommendations of AWI/AWMAC/WI (AWS).

D. Prior to installation, allow wood materials to acclimate to the environment of the enclosed and conditioned building for 72 hours minimum.

E. Store products in manufacturer's unopened packaging until ready for installation.

F. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) As indicated on drawings.
         2) Substitutions: See Section 01 6000 - Product Requirements.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124.
      d. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
      e. Color and Pattern: As indicated on drawings.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Exposed Edge Treatment: as indicated on drawings.
   5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
   6. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.

2.02 MATERIALS

A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
   1. Provide plywood substrate at sink areas and other locations indicated on drawings.

B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.

C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.

D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
   1. Join lengths of tops using best method recommended by manufacturer.
   2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
      a. Rout a 1/8 inch drip groove at underside of exposed overlapping edges, set back 1/2 inch from face of edge.
   3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
   1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
   2. Height: 4 inches, unless otherwise indicated.

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
   1. Integral sinks: Shop-mount securely to countertop with adhesives, using flush configuration, as per manufacturer's instructions, and as detailed on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.

B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

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

END OF SECTION

SECTION 20 0000
GENERAL MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 DESCRIPTION

A. Intent of drawings and Specifications is to obtain complete systems, tested, adjusted, and ready for operation.

B. Except as otherwise defined in greater detail, the terms "provide", "furnish" and "install" as used in Division 20, 21, 22 and 23 Contract Documents shall have the following meanings:
   1. "Provide" or "provided" shall mean "furnish and install".
   2. "Furnish" or "furnished" does not include installation.
   3. "Install" or "installed" does not include furnishing.

C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.

E. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions.

F. Where Architectural features govern location of work, refer to architectural drawings.

G. Contractor may install additional piping, fittings, and valves, not shown on drawings, for testing purposes or for convenience of installation. Where such materials are installed, they shall comply with specifications and shall be sized to be compatible with system design. Remove such installed materials when they interfere with design conditions or as directed by Architect.

1.03 RELATED WORK

A. Utility Services:
   1. Determine utility connection requirements and include in Base Bid all costs to Owner for utility service.
   2. Include costs for temporary service, temporary routing of piping or any other requirements of a temporary nature associated with utility service.

B. Temporary Services:
   1. Division 01 - Temporary Facilities and Controls.

C. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before any work is started.
   2. When interruption of services is required, Architect, Owner, and other concerned parties shall be notified and shall determine a time.

D. Demolition:
   1. Division 02 - Selective Demolition.

   2. Perform demolition as required to accomplish new work.
   3. Accomplish work in neat workmanlike manner to minimize interference, annoyance or inconvenience such work might impose on Owner or other Contractors.
   4. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.

5. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
6. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
7. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner and with other Contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such Work.

E. Concrete Work:
1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.
2. Concrete shall comply with Division 03 - Concrete.
3. Provide anchor bolts, metal shapes and templates required to be cast in concrete or used to form concrete for support of mechanical equipment.

F. Painting:
1. Painting of mechanical equipment will be done under Division 09 unless specified otherwise or unless equipment is to be furnished with factory applied finish coats.
2. Equipment
   a. Furnish equipment with factory applied prime finish unless otherwise specified.
   b. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Architect.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State and Local Authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

1.05 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:

1.	AGA	American Gas Association
2.	AMCA	Air Movement and Control Association
3.	ANSI	American National Standards Institute
4.	AHRI	Air-Conditioning, Heating and Refrigeration Institute
5.	ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
6.	ASPE	American Society of Plumbing Engineers
7.	ASSE	American Society of Sanitary Engineering
8.	AWS	American Welding Society
9.	AWWA	American Water Works Association
10.	ASME	American Society of Mechanical Engineers
11.	ASTM	American Society for Testing and Materials
12.	CDA	Copper Development Association
13.	CISPI	Cast Iron Soil Pipe Institute
14.	FMG	FM Global
15.	FS	Federal Specifications
16.	IEEE	Institute of Electrical and Electronics Engineers
17.	MCA	Mechanical Contractors Association
18.	MSS	Manufacturers Standardization Society
19.	NEC	National Electrical Code
20.	NEMA	National Electrical Manufacturers Association
21.	NFPA	National Fire Protection Association
22.	NIST	National Institute of Standards & Technology
23.	NSF	National Sanitation Foundation
24.	NSPI	National Spa and Pool Institute
25.	OSHA	Occupational Safety and Health Administration

26. PDI Plumbing and Drainage Institute
27. SMACNA Sheet Metal and Air Conditioning Contractors National Association
28. UL Underwriters Laboratories, Inc.
29. WQA Water Quality Association

B. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

1.06 SUBMITTALS

A. Shop Drawings (Product Data):
1. Refer to Division 01 - Submittal Procedures.
2. Note that for satisfying submittal requirements for Divisions 20, 21, 22 or 23, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, the expression "Shop Drawings" is generally used throughout Specification.
3. Submit shop drawings for equipment and systems as requested in the respective specification sections.
4. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.
5. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
6. When manufacturer's reference numbers are different from those specified, provide correct cross-reference numbers for each item. Clearly mark and note submittals accordingly.
7. Submit complete record of required components when fixtures, equipment and items specified include accessories, parts, and additional items under one designation.
8. Include composite wiring diagrams for electrically powered equipment and devices.
9. Where submittals cover products containing non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
10. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
11. Submittals that are not complete, not permanent, or not properly checked by Contractor will be returned without review.

B. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

C. Operation and Maintenance Manuals:
1. Refer to Division 01 - Operation and Maintenance Data.
2. Upon completion of Work but before final acceptance of system, submit to Architect for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2" thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.
3. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.
4. Fire protection system shall be separately bound.
5. Manuals shall include the following:
   a. Copies of Shop Drawings
   b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
   c. CD ROM's of O&M data with exploded parts lists where available
   d. Phone numbers and addresses of local parts suppliers and service companies
   e. Internet/WEB page addresses where applicable
   f. Wiring diagrams

g. Startup and shutdown procedures
h. Composite electrical diagrams
i. Flow diagrams
j. Lubrication instructions
k. Factory and field test records (Refer to Test and Balancing in Part 3 of this section.)
l. Air and water balance reports
m. Valve identification charts as specified in Section 20 0553 - Mechanical System Identification
n. Access panel identification charts as specified in Section 20 0553 - Mechanical System Identification
o. Additional information, diagrams or explanations as designated under respective equipment or systems specification sections.

6. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
7. Furnish O&M Manuals and instructions to Owner prior to request for final payment.

D. Record Documents:
1. Refer to General Conditions of Contract, and Division 01 - Project Record Documents. Prepare complete set of record drawings in accordance with Division 01.

1.07 JOB CONDITIONS

A. Building Access:
1. Arrange for necessary openings in building to allow for admittance of all apparatus.

B. Cutting and Patching:
1. Refer to General Conditions of the Contract, and Division 01 - Cutting and Patching.
2. Perform cutting and patching required for complete installation of systems, unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
3. Provide materials required for patching unless otherwise noted.
4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.

C. Housekeeping and Cleanup:
1. Refer to Division 01 - Closeout Procedures.
2. As work progresses and/or as directed by Architect, periodically remove waste materials from building and leave area of work broom clean. Upon completion of Work, remove tools, scaffolding, broken and waste materials, etc., from site.

1.08 WARRANTY

A. Refer to Division 01 for general warranty requirements.

B. Refer to technical sections for warranty requirement for each system.

C. Where no warranty requirements are called out, warrant equipment, materials, and workmanship to be free from defect as called out in Division 01**.**Warrant that systems will operate without objectionable noise, vibration, and uncontrolled expansion.

D. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.

E. In any case, wherein fulfilling requirements of any warranty, if this contractor disturbs any work warranted under another contract, this contractor shall restore such disturbed work to condition satisfactory to Architect and warranty such restored work to same extent as it was warranted under such other contract.

F. Warranty shall include labor, materials, and travel time.

PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. Refer to Division 01 - Product Requirements.

PART 3 EXECUTION

3.01 GENERAL

A. Verify elevations and dimensions prior to installation of materials.

3.02 DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Deliver products to the site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Store in clean, dry space.

D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions.

F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

G. Provide supplemental heat if required to prevent equipment from moisture contamination.

H. Protect openings in equipment until connected to system to prevent entry of foreign materials.

3.03 FLOOR, WALL, ROOF AND CEILING OPENINGS

A. Coordinate location of openings, chases, furred spaces, etc., with appropriate Contractors. Provide sleeves and inserts that are to be built into structure during progress of construction.

B. Remove temporary sleeves, if used to form openings, prior to installation of permanent materials. Utilize minimum 24 ga. galvanized sheet metal for permanent sleeves unless otherwise noted.

C. Provide Schedule 40 carbon steel pipe with integral water stop for steel sleeves required in interior floor slabs.

D. Submit to Structural Engineer for review and approval size and location of core-drilled holes prior to execution.

E. Submit product data and installation details for penetrations of building structure. Include schedule indicating penetrating materials (metal pipe, plastic pipe, conduit, etc.), sizes of each, opening sizes and sealant products intended for use.

F. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Section 20 0573 - Mechanical Systems Firestopping.

G. Provide minimum 1" clearance around penetration openings intended for pipe. Where fire resistant penetrations are required, size openings in accordance with written recommendations of firestopping systems manufacturer.

H. Openings for underground pipes passing through foundations or under footings shall have minimum clearance of 1-1/2" to concrete. Do not disturb footing bearing soil.

I. Openings for underground pipe passing through on grade concrete slabs shall have minimum 1/4" clearance to concrete. Seal openings with urethane caulk.

J. Openings for insulated piping shall be sized based on outside diameter of insulation when it is specified or detailed to be continuous through opening.

K. Openings for duct penetrations shall be no more than 1/2" larger on all sides than size of duct or duct including duct insulation, if applicable. Where firestopping systems are required at penetrations, size in accordance with recommendations of firestopping systems manufacturer, but opening shall not exceed 1" average clearance on all sides. Openings for ducts with fire dampers shall be in accordance with fire damper installation requirements.

L. Duct penetrations through concrete floors in mechanical rooms containing liquid heat exchangers and/or pumps shall have 2” high water stopped curbs surrounding openings. This applies to mechanical rooms above the lowest floor level.

M. Seal non fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.

N. Seal non fire-rated wall openings with urethane caulk.

O. In lieu of openings as specified herein penetration systems as manufactured by Pro Set may be used, including sleeve couplings and plug.

P. If total Pro Set system with Water Guard “CR” is used, opening shall not need additional water proofing or riser clamps.

Q. Finish and trim penetrations as shown on details and as specified.

R. Provide chrome or nickel plated escutcheons where piping passes through walls, floors or ceilings and is exposed in finished areas. Size escutcheons to fit pipe and pipe covering for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

S. Trim duct penetrations exposed in finished areas with 2” wide galvanized or aluminum trim collars properly sized to fit duct. Collars shall be same gauge as duct, prime finish unless noted otherwise. Finished areas shall not include mechanical rooms, janitors' closets, storage rooms, etc., unless suspended ceilings are specified.

3.04 EQUIPMENT SHUTOFF VALVES

A. Provide shutoff valves at equipment connected to piping system. Refer to valve section or system section for requirements of valve type.

3.05 EQUIPMENT ACCESS

A. Install piping, conduit, and accessories to permit access to equipment for maintenance. Relocate piping, equipment, or accessories to provide access at no additional cost to Owner.

B. Install equipment with sufficient maintenance space for removal, repair, or changes to equipment. Provide ready accessibility to equipment without moving other future or installed equipment (including light fixtures) or system components.

C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors for valves, shock stops, or other equipment shall provide access for servicing, repairs, and/or maintenance.

D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes, and rough-in dimensions.

3.06 EQUIPMENT SUPPORTS

A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

3.07 EQUIPMENT GUARDS

A. Provide equipment guards over belt driven assemblies, pump shafts, exposed fans, and elsewhere as indicated in this Specification or required by Code.

B. Paint equipment guards bright yellow.

C. Equipment guards shall comply with OSHA requirements.

3.08 SUPPORT PROTECTION

A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, guard certain equipment to protect personnel from injury.

B. Provide minimum 1/2” thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment and mechanical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

C. Protect threaded rod or bolts at supporting elements as described above. Trim threaded rod or bolts such that they do not extend beyond supporting element and devices.

3.09 MECHANICAL SYSTEMS IDENTIFICATION

A. Refer to Section 20 0553 - Mechanical Systems Identification

3.10 TEST AND BALANCING

A. Tests for equipment, ductwork and piping systems shall be performed as specified in their respective specification sections in accordance with technical requirements noted.

B. Provide equipment required for testing, including fittings for additional openings required for test apparatus.

C. All ductwork and piping inspections and testing shall be successfully completed and approved before application of covering materials.

D. When equipment or systems fail to meet minimum test requirements, replace, or repair defective work or material as necessary and repeat inspection and test until equipment or systems meet test requirements. Make repairs with new materials. Caulking of holes or threaded joints is not allowed.

E. Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria, test medium and pressure used, duration of test and name and title of person signing test certification document.

F. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

G. Balancing of various systems shall be in accordance with associated specification sections in addition to requirements noted herein.

3.11 START-UP

A. Systems and equipment shall be started, tested, adjusted, and turned over to Owner ready for operation. This includes "Owner-Furnished, Contractor-Installed" (OFCI) and "Contractor-Furnished, Contractor-Installed" (CFCI) systems and equipment.

B. Follow manufacturer's pre-start-up check-out, start-up, trouble shooting and adjustment procedures.

C. Contractor shall provide services of technician/mechanic knowledgeable in start-up and check-out of types of systems and equipment on project.

D. Provide start-up services by manufacturer's representative where specified or where Contractor does not have qualified personnel.

E. Coordinate start-up with all trades.

3.12 LUBRICATION

A. Upon completion of work and before turning over to Owner, clean and lubricate bearings except sealed and permanently lubricated bearings. Use only lubricant recommended by manufacturer.

B. Contractor is responsible for maintaining lubrication of mechanical equipment under this Contract until Work is accepted by Owner.

3.13 CLEANING

A. Clean systems after installation is complete.

B. Clean piping and ductwork both internally and externally to remove dirt, plaster dust or other foreign materials. When external surfaces of piping are rusted, clean and restore surface to original condition.

C. Clean pipeline strainers to restore them to original condition or replace with new strainer elements.

D. Clean equipment and plumbing fixtures as recommended by manufacturers.

E. Replace throwaway or replaceable media air filters used during construction period with new filters or new filter media after construction has been completed and before building is turned over to Owner. Filter replacement shall be as hereinafter specified.

F. Blow and clean dirt, plaster dust and other foreign matter from coils, terminal devices, diffusers, registers, and grilles.

G. Thoroughly clean equipment of stains, paint spots, dirt, and dust. Remove temporary labels not used for instruction or operation.

H. Provide additional cleaning of individual piping systems and apparatus as hereinafter specified.

END OF SECTION

SECTION 20 0529
PIPING AND EQUIPMENT SUPPORTING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 20 0700 - Mechanical Systems Insulation

B. Section 23 3114 - Ductwork (for duct supports requirements)

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Provide all supporting devices not provided as part of building structure or indicated on structural drawings or structural details, as specified, and as required for proper supporting, anchoring, and guiding of piping, equipment, materials, and systems.

B. Support for all conditions of operation, including variations in installed and operating weight of equipment, piping, and ductwork, to prevent excess stress and allow for proper expansion and contraction.

C. Support of fire protection pipe shall comply with NFPA 13 Standard for the Installation of Sprinkler Systems, 2013 Edition.

1.04 SUBMITTALS

A. Shop Drawings for each piping system for all pipe sizes and all applicable equipment including, but not limited to, the following:

1. Manufacturer's name
2. Model numbers
3. Materials of construction and load ratings (lbs)
4. Schedule of hangers and support devices with pipe support spacing
5. Insulated pipe supports along with application chart or table including pipe support spacing.
6. Insulation protection saddles and weight bearing insulation table
7. Details and calculations for sizing supplementary steel utilized for trapeze or specially designed supports
8. Structural attachments, inserts, and concrete anchors. Submit ICC-ES Evaluation Report for each type of anchor.
9. Calculations and drawings for concrete inserts and anchors for each application
10. Drawings showing specific locations of any weld attachments to structure, including weight supported by such attachments
11. Drawings showing specific locations of any suspended loads which exceed 100 lbs within joist chord panel to be attached to open web steel joist structural members. Include weight supported by such attachments. (Panel is length of chord between two adjacent diagonal web members at point of connection to chord.)
12. Equipment mounting devices
13. Pipe guides and anchors
14. All other appropriate data

1.05 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall conform to the latest requirements of ANSI/ASME B31 Code for Pressure Piping and MSS Standard Practice SP-58-2018 (Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation), except as supplemented or modified herein.

B. Support materials shall be steel or stainless steel unless specifically indicated.

C. Support devices shall be factory fabricated and have published load ratings.

D. Unless otherwise indicated, design supports, anchors, and related components with safety factor in accordance with AISC Manual of Steel Construction, but not less than 2.0.

E. Determine maximum deflection using the following equation.

$$D = \frac{H \text{ or } L}{250}$$

Where D = Max deflection in inches
H = Member height in inches
L = Member length in inches

F. Unless otherwise indicated, hangers, support devices and hardware shall be steel and shall have hot-dipped galvanized finish. Coat cut edges, welds, or any damaged finish with galvanized paint.

G. Materials in contact with pipe shall be galvanically compatible with piping material to eliminate conductive path for galvanic corrosion. Where piping and support materials have galvanic potential, Provide galvanic separation, such as nonmetallic coating or inserts between piping and metallic supports. Pipe insulation is acceptable galvanic separation. Materials in contact with pipe shall be galvanically compatible with piping material to eliminate conductive path for galvanic corrosion. Where piping and support materials have galvanic potential, provide galvanic separation, such as nonmetallic coating or inserts between piping and metallic supports. Pipe insulation is acceptable galvanic separation. Galvanic potential shall be determined by table below:

	Galvanized Steel	Carbon Steel	Stainless Steel (Type 304 or 316)	Copper Brass Bronze
Copper, Brass, Bronze	Yes	Yes	No	NA
Stainless Steel (Type 304 or 316)	Yes Note (1)	Yes Note (1)	NA	
Carbon Steel	No	NA		
Galvanized Steel	NA			

(1) Required where stainless steel surface area near interface is equal or greater than steel surface area

H. Unless otherwise indicated, steel support devices exposed to ventilation air stream shall be stainless steel or steel with galvanized finish. Paint type shall be approved by Architect/Engineer.

I. This Contractor is responsible for proper placement and sizing of supporting devices to accommodate insulation thickness and pitching of pipe. Coordinate with Contractor performing work specified in Section 20 0700 - Mechanical Systems Insulation.

J. Piping connected to coils, which are in assembly mounted on vibration isolators, shall have vibration isolation hangers, or supports as indicated above. Piping connected to coils, which are in equipment where fan assembly is separately isolated by vibration isolators and flexible connections, does not require additional vibration isolation hangers or supports.

K. Where piping can be conveniently grouped to allow trapeze type supports, supporting steel shall be by means of standard structural shapes.

L. Hangers and rods shall be plumb when pipelines are at their normal operating temperatures.

M. Unless otherwise indicated, continuous insert channels are not allowed.

N. Punching, drilling, or welding of building structural steel is not allowed unless approved by Structural Engineer.

O. Refer to Structural Documents and ICC-ES Evaluation Report for application of concrete inserts and concrete anchors.

P. Lateral braces shall be designed and detailed to apply loads as directly as possible to structural floor slabs, roof decks, or other building lateral elements. Braces shall not be applied to bottom flanges of steel beams or bottom chords of open web steel joists.

Q. Coordinate with General Contractor for any proposed weld attachments to building structure. This may result in use of welding codes or standards, which may apply to "structural work". and may necessitate repair of fireproofing and/or extension of fireproofing to support members. Execution of this work may be assigned to General Trades responsible for building structural steel. Cost for this work, however, will remain the responsibility of this Contractor.

R. Top or bottom chords of open web steel joists may be used to support loads, provided total load within panel does not exceed 100 lbs and load is placed concentric to joist. (Panel is length of chord between two adjacent diagonal web members at point of connection to chord).

PART 2 PRODUCTS

2.01 STRUCTURAL SUPPORTS

A. Unless specifically indicated on structural drawings, design and provide all supporting devices including miscellaneous steel (angles, channels, beams, etc.), required for proper support of piping, equipment, and materials.

2.02 PIPE HANGERS AND SUPPORTS (METALLIC)

A. Manufacturers: Anvil, Erico, Tolco, PHD, National Pipe Hanger Corporation, or B-Line, equal to Anvil figures listed. Corresponding MSS Type is indicated where applicable.

B. Clevis and Roller Type Hangers:

System	Pipe Size	Clevis	Roller
Hot Pipes with Insulation (105°F and above)	2” and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2” to 6”	---	171 (MSS Type-41), 181 (MSS Type-43)
	8” and larger	---	171 (MSS Type-41)
Ambient Bare Pipes (61°F to 104°F)	2” and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2” and larger	260 (MSS Type-1), 216 (MSS Type-4)	---
Cold Pipes with Insulation (33°F to 60°F)	2” and smaller	65 (MSS Type-1), 260 (MSS Type-1)	---
	2-1/2” and larger	260 (MSS Type-1), 295 (MSS Type-1)	---

C. Flat Surfaces (Trapeze, Rack Type):

1. Use structural steel members such as struts, angles, channels, and beams to support pipes as required. Select members properly for pipe support types and loading conditions. Refer to Part 1 for design criteria. Submit support details with type of members selected and load calculations. Provide straps, clamps, rollers, or slides indicated below at each support point.

System	Pipe Size	Straps or Clamps	Rollers	Slides
Hot Pipes with Insulation (105°F and above)	2” and smaller	Anvil Klo-Shure	---	---
	2-1/2” and larger	---	171 or 177(MSS Type-41), 271 (MSS Type-45), 274 (MSS Type-46)	257 or 436 with 212 or 432 clamps, Type 1, 2 or 3 for longitudinal movement only. Type 4, 5 or 6 for both longitudinal and transverse movement
Ambient Bare Steel Pipes (61°F to 104°F)	6” and smaller 8” and larger	B-Line BVT Unistrut Cush-a-Clamp	---	---
Ambient Bare (Copper) pipes (61°F to 104°F)	all sizes	B-Line BVT Unistrut Cush-a – Clump		

D. Vertical Pipe within Wall Cavities
   1. Use clamps, straps, inserts or channels to support pipes concealed in wall cavity. Select members for pipe support types and loading conditions. Refer to Part 1 for design criteria.
   2. Provide clamps, strut channels, insulated supports, or brackets and inserts equal to manufacturer indicated below:

System	Pipe Size	Supports	Clamps, Brackets/Inserts	Pre-insulated Inserts
Hot and Cold Pipes with Insulation	All sizes	Anvil 137	HoldRite 260 series with SBIS bracket, Anvil 262	Anvil Klo-Sure, Pipe Shields A2000
Ambient Bare Steel Pipes (61°F to 104°F)	All sizes	Anvil 137, 138-R	Anvil 262	---
Ambient Bare Copper Pipes (61°F to 104°F)	All sizes	Anvil CT-138R	HoldRite 260 series with SBIS bracket	---

2.03 INSULATION PROTECTION SHIELDS

A. Anvil Fig. 167 (MSS Type-40) constructed of galvanized carbon steel. Per the latest edition of Standard MSS SP-58, select shield to accommodate outer diameter of insulation. Shield length and gauge for insulation compression strength not less than 15 psi, shall be as follows:

Pipe Size	Length	Gauge
1/4” thru 3”	12”	18
4”	12”	16
5” and 6”	18”	16
8” thru 14”	24”	14
16” thru 24”	24”	12

2.04 INSULATED PIPE SUPPORTS

A. Description:
   1. Products designed specifically for weight-bearing support of insulated pipes.

Apply products in accordance with manufacturer's recommendations and requirements indicated below:

2. Refer to PART 3 – EXECUTION for application of Type A, Type B, and Type C Insulated Pipe Supports specified below.

B. General:
   1. Supports shall be designed and rated for applied load, including weight of pipe, fluid, insulation, and any other imposed loads, with minimum 1.5 safety factor. Ratings shall be published by manufacturer and included in submittals.
   2. Load ratings shall be established by pipe support manufacturer based upon testing and analysis conforming to the latest editions of ASME B31.1 and MSS SP-58.
   3. High compressive strength inserts utilized to support loads shall encircle circumference of pipe. Block-style inserts are not allowed.
   4. Supports shall be suitable for hot or cold pipe service as applicable.
   5. Submit chart or table indicating selected model along with pipe sizes, rated loads, support device types and support spacing for each piping system.
   6. Pipe support spacing shall be in accordance with manufacturer's recommendations but shall not exceed maximum spacing indicated under Hanger and Support Spacing in Part 3 of this Section.
   7. Testing of insulation for compressive strength properties shall comply with ASTM D1621.
   8. Insulation thickness shall match adjacent pipe insulation thickness.
   9. Integrity of vapor barrier jacket shall be maintained continuously through support assembly.
   10. Insulated pipe support style shall be specifically selected for the application and shall consider the following criteria at minimum:
      a. Vertical, lateral, and axial support design load limits.
      b. Vertical, lateral, and axial support design travel limits
      c. Temperature of support, at pipe surface, and ambient conditions
      d. Test or pre-operational loads that may exceed normal operating conditions
      e. Material for any items that will be welded directly to the pipe
      f. Loading and displacements caused by seismic, hydraulic surge, or other forces
      g. Temperature at support steel
   11. All steel components shall have corrosion protection coating consisting of hot-dip galvanizing or zinc-rich primer coating.

C. Type A Insulated Pipe Supports (Light Duty)
   1. Description:
      a. Pipe insulation specified in Section 20 0700 – Mechanical Systems Insulation with insulation protection shields specified in this Section. Weight-bearing inserts are not required.
      b. Type B or Type C supports may be utilized in lieu of Type A supports.

D. Type B Insulated Pipe Supports (Standard Duty):
   1. Manufacturers:
      a. SNAPP ITZ insulation inserts by KB Enterprise, Tru-Balance Insulated Saddles by Buckaroos, Inc., Value Engineered Products, or approved equal.
      b. Klo-Shure insulation couplings may be used for cold pipes insulated with elastomeric insulation. Mount shall be 7 Series Strup Mount with metal clamps or Clevis System for clevis hangers.
      c. Type C supports may be utilized in lieu of Type B supports"
      d. Contractor may propose to utilize contractor-fabricated insulated pipe supports in lieu of manufactured Type B Supports. Use of contractor-fabricated assemblies is subject to approval of appropriate submittal data. Submit detail drawings of assemblies and product data showing equivalency to specified manufactured products for approval.
   2. Description:

a. Load-rated assembly consisting of high compressive strength insulation material completely encompassing circumference of pipe, vapor barrier jacket, and insulation protection shield.
b. Insulation protection shield shall conform to ANSI/MSS SP-58. Shield shall be G90 galvanized steel and shall span full circumference of pipe insulation. Half-shields spanning lower 180° arc of insulation outer circumference will be acceptable when used with clevis hangers.
c. Axial length of insulation material shall be not less than 9" or 2" longer than insulation protection shields (1" minimum on each end), whichever is longer.

3. Insulation Materials:
a. Hot Pipes 105°F to 250°F:
1) Rigid closed cell, polyisocyanurate or phenolic insulation by ITW, Resolco, or Kingspan. Minimum compressive strength shall be 100 psi.
b. Hot Pipes 251°F to 1200°F:
1) High-density calcium silicate insulation similar to Johns Manville Thermo-12 Gold. Minimum compressive strength shall be 100 psi.
c. Cold Pipes (60°F and below:
1) Rigid closed cell, polyisocyanurate, phenolic insulation similar to ITW, Resolco, Kingspan, or cellular glass insulation similar to Pittsburgh Corning Foamglas.

E. Type C Insulated Pipe Supports (Heavy Duty):
1. Manufacturers:
a. Pipe Shields, Inc., Bergen Pipe Supports, or Rilco equal to Pipe Shields models listed.
b. Unless otherwise indicated, pre-insulated pipe supports shall be as indicated in the following schedule. Model numbers are based on Pipe Shields, Inc.
1) Pipe supported on hangers: Model "A" Series and Model "D" Series
2) Pipe supported on flat surfaces and pipe rollers: Models "A" Series
3) Pipe supported on slides: Model "B" Series with lateral guide or restraint
4) Pipe anchors: Model "C" Series
5) Riser clamps: Model "E" Series with thrust plates. Select proper model for restraint for downward load or upward load.
c. Contractor may propose to utilize contractor-fabricated insulated pipe supports in lieu of manufactured Type C Supports. Use of contractor-fabricated assemblies is subject to approval of appropriate submittal data. Submit detail drawings of assemblies and product data showing equivalency to specified manufactured products for approval.

2. Description:
a. Load-rated assembly consisting of high compressive strength insulation material completely encircling circumference of pipe, vapor barrier jacket system incorporating structural inserts and insulation protection shield/casing where applicable.

3. Insulation Material:
a. Water-resistant high density calcium silicate with minimum density of 13 lb/ft^3 and compressive strength not less than 100 psi. Thermal conductivity shall be not more than 0.38 $Btu \cdot in/(hr \cdot ft^2 \cdot °F)$ at 75°F)
b. Structural Inserts:
1) Structural inserts used by manufacturer to reinforce between pipe and insulation jacket for clamping devices shall be water-resistant high compressive strength inorganic materials selected by manufacturer for desired combination of structural strength and insulating properties. Structural inserts shall have minimum compressive strength of 600 psi. Thermal conductivity shall be not more than 0.58 $Btu \cdot in/(hr \cdot ft^2 \cdot °F)$ at 75°F).
c. Jacket:

1) Jacket shall consist of G90 galvanized steel conforming to ASTM A-653 and shall provide complete vapor barrier around insulation and bearing surface for protection of insulation.
2) When recommended by manufacturer, use reinforced insulation protection shield at support bearing surface. Insulation shall extend 1" beyond insulation protection shield to maintain vapor barrier integrity.

2.05 HANGER RODS (METALLIC)

A. Rods shall conform to the latest MSS Standards except as modified herein. Furnish rods complete with adjusting and lock nuts.

B. Rods shall have electroplated zinc or hot dip galvanized finish.

C. Unless otherwise indicated, size rods for individual hangers and trapeze support as indicated in the following schedule. Rod size may be reduced one size for double rod hangers. Total weight of equipment, including valves, fittings, pipe, pipe content and insulation, shall not exceed limits indicated.

Max. Pipe Size With Single Rigid Rod	Rod Diameter (inches)	Max Load (lbs) of Hanger Rod (Not exceeding 650°F Service Temp.)
2"	3/8	730
3"	1/2	1350
5"	5/8	2160
8"	3/4	3230
12"	7/8	4480
18"	1	5900
30"	1-1/4	9500

D. Threaded rods are not allowed in clean rooms.

2.06 BOLTS, NUTS, STUDS AND WASHERS

A. ASTM A307, electroplated zinc finish

2.07 ROD ATTACHMENTS

A. Anvil Fig. 290 (MSS Type-17), galvanized finish

2.08 U-BOLTS

A. Anvil Fig. 137 (MSS Type-24), galvanized finish

2.09 BEAM CLAMPS

A. Beam Clamps: Anvil Fig. 133/134 (MSS Type-21), 218 (MSS Type-30), 228 (MSS Type-28 or 29) and 292 (MSS Type-28 or 29)

B. Top Beam Clamps: Anvil Fig. 227 (MSS Type-25)

C. C-Clamps: Anvil Fig. 86, 92 or 93 (MSS Type-19 or 23) with set screw and lock nut

2.10 ADJUSTABLE PIPE SADDLE SUPPORTS

A. Anvil Fig. 264 (MSS Type-38), galvanized finish. Provide Anvil Fig. 63 Type T stanchion with base, galvanized finish, where applicable.

2.11 RISER CLAMPS (BARE PIPE)

A. Anvil Fig. 261 (MSS Type-8), galvanized finish

B. B-Line B3373C, PVC coated carbon steel, in area at pipe contact, for bare copper tubing

C. Proset system, proseal plug and fire-fill for sleeved and cored holes.

2.12 RISER CLAMPS (INSULATED PIPE)

A. Unless otherwise indicated, insulated pipe riser clamps shall be Type C insulated pipe supports. Refer to Insulated Pipe Supports in Part 2.

B. Contractor may propose to utilize contractor-fabricated riser supports. Use of contractor-fabricated riser supports is subject to approval of appropriate submittal data. Submit support detail drawings, bearing stamp of Structural Engineer registered in project jurisdiction, for approval. Supports shall be engineered to withstand static and dynamic forces with minimum safety factor of 2.0. Submit insulation details addressing thermal break from building structure and vapor barriers.

2.13 CONCRETE INSERTS (WOODEN FORMED CONCRETE)

A. Anvil Fig. 281 or 282, or Hilti HCI-WF (MSS Type-18), suitable for rod diameter and weight supported.

2.14 CONCRETE INSERTS (METAL DECK FORMED CONCRETE)

A. Anvil Fig. 284, Tolco No. 109DD, B-Line Fig. B3019, DeWalt/Powers "Bang-It+", Hilti HCI-MD, or MSCO No. MX34.

2.15 METAL FRAMING SUPPORT SYSTEM (STRUT SYSTEM)

A. Manufacturers: Unistrut, B-Line Strut Systems, Anvil-Strut, Power-Strut, Erico, Superstrut, Kindorf, Hilti, and Hydra-Zorb

B. Channels shall have epoxy paint or electroplated zinc finish.

C. Channels shall not be lighter than 12 ga.

2.16 CASEWORK PIPE SUPPORTS

A. Hinged pipe clamp and Strutcatcher, nylon 12 Grilamid, Clic by Litchfield International.

B. Vibration isolation pipe clamp, yellow zinc chromate finish, B-Line BVT Series Vibraclamp or Kwik-Clip by B-Line.

2.17 FIXTURE SUPPLY SUPPORT

A. Galvanized steel stud support bracket, pre-drilled tube support mounting holes, adjustable stud width, Erico TSGB or equal.

B. UV resistant nylon tube support, rated for 0°F through 130°F, resealable locking mechanism, Erico TPC or equal.

C. Support bracket and tube support to be from same manufacturer.

PART 3 **EXECUTION**

3.01 INSTALLATION

A. Install supports to allow for free expansion of piping. Support piping from building structural members using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. At no time shall hangers and supports overload building structural members. Fasten ceiling plates and wall brackets securely to structure and test to demonstrate adequacy of fastening.

B. Select and size building attachments properly in accordance with MSS Standards and manufacturer's published load rating information.

C. Coordinate hanger and support installation to properly group piping of all trades.

D. Suspend piping hangers by means of hanger rods. Perforated band iron and flat wire (strap iron) are not allowed.

E. Piping and ductwork shall be supported independently from other piping or ductwork.

F. Pipe hangers and supports shall not penetrate vapor barrier of pipe insulation.

G. Do not support equipment, or piping from metal roof decking or ceiling grid.

H. Install adequate supports so as not to over stress either piping or equipment to which piping is connected.

I. Refer to Section 20 0000 - General Mechanical Requirements for requirements of personnel injury protection guards for supporting devices.

3.02 HANGER AND SUPPORT SPACING

A. Space pipe hangers and supports for horizontal pipe accordance with the following schedule, with exceptions as indicated herein:

B. Steel Pipe (Standard Weight and Extra Strong):

Pipe Size	Max Spacing
1-1/4" and smaller	7'-0"
1-1/2"	9'-0"
2"	10'-0"
2-1/2"	11'-0"
3"	12'-0"
4"	14'-0"
6"	17'-0"
8"	19'-0"
10" and larger	20'-0"

C. Steel Pipe (Standard Weight and Extra Strong):

Pipe Size	Max Spacing
1-1/4" and smaller	7'-0"
1-1/2"	9'-0"
2"	10'-0"
2-1/2"	11'-0"
3" and larger	12'-0"

D. Copper Tube (Unless Otherwise Noted):

Pipe Size	Max Spacing
3/4" and smaller	5'-0"
1" to 1-1/4"	6'-0"
1-1/2" to 2-1/2"	8'-0"
3" and larger	10'-0"

E. Copper Tube (Domestic Water):

Pipe Size	Max Spacing
1-1/4" and smaller	6'-0"
1-1/2" and larger	10'-0"

F. Copper Tube (Medical Gases):

Pipe Size	Max Spacing
1/4"	5'-0"
3/8" and 1/2"	6'-0"
3/4"	7'-0"
1"	8'-0"
1-1/4"	9'-0"
1-1/2" and larger	10'-0"

G. Plastic Pipe
1. PVC Pipe:

Pipe Size	Max Spacing
All sizes	4'-0"

H. Cast Iron Pipe:
1. Maximum hanger and support spacing shall be 10 ft for all pipe sizes. Provide minimum of one hanger per pipe section close to joint on barrel, at each pipe fitting, at change of direction and branch connections.

2. Support Cast Iron No-Hub pipe as recommended in CISPI Publication "Cast Iron Soil Pipe and Fittings Handbook, Chapter IV - Installation of Cast Iron Soil Pipe and Fittings."

I. Maximum spacing shown above may be restricted by strength of attachment to building structure. Submit data with calculations with published load ratings showing attachment to be utilized and maximum spacing allowable for that type of attachment and pipe size.

J. Spacing less than indicated above may be required to conform to building structure design or loading limitations.

K. Spacing less than indicated may be required depending on compressive strength of pipe insulation and insulated pipe supports.

L. If pipe size changes between support points, maximum spacing shall be based on the smaller pipe size.

M. If trapeze hangers are used to support multiple services, spacing shall be based on the most restrictive pipe size and material on trapeze hanger.

N. For non-metallic pipe, follow manufacturer's installation recommendations in addition to requirements noted herein.

O. Install supports for vertical piping and anchors as recommended by pipe manufacturer.

P. Place hangers and supports to meet requirements of Section 23 2116 - Pipe and Pipe Fittings or specific pipe system sections, with regard to pitch for drainage and venting and clearance between services.

Q. Hangers and supports shall bear on outside of insulation when pipes are to be insulated.

R. Place hangers and supports within 1 ft of each fitting, such as elbows and tees, and at each valve, strainer, and other piping specialty for piping 4” and larger.

S. Place hanger or support at first elbow upstream of pump inlet and first elbow downstream of pump outlet.

3.03 INSULATED PIPE SUPPORTS APPLICATION

A. Install insulated pipe support at each support point of insulated pipe.

B. Pipe Size 1-1/2” and Smaller:
1. Use Type A insulated pipe support. Pipe insulation specified in Section 20 0700 - Mechanical Systems Insulation shall be continuous through support points.
2. Use one shield (bottom) for clevis hanger.
3. Use 2 shields (top and bottom) for roller hanger/support or strap/clamp support. Apply 2 metal straps to hold top and bottom shields onto insulation jacket.
4. Type B or Type C insulated pipe supports may be used in lieu of Type A support.

C. Pipe Size 2” through 5”:
1. Use Type B insulated pipe supports. Refer to Part 2 for acceptable products.
2. Type C insulated pipe supports may be used in lieu of Type B supports.

D. Pipe Size 6” and Larger:
1. Use Type C insulated pipe supports. Refer to Part 2 for applicable products.

3.04 PIPE FLOOR SUPPORTS

A. Unless specifically shown otherwise, use adjustable pipe saddle supports with associated stanchion similar to Anvil Fig. 264/63. Select supports properly for weight and height of pipe stand.

3.05 BEAM CLAMPS

A. Provide locknut for hanging rod at clamp.

B. C-clamps are allowed for rod size 3/8” or smaller and only for static loading such as air piping, cold water piping, fire protection piping and, other similar piping. C-clamps are not allowed for hot water piping except hot water runouts to terminal heating devices.

C. C-clamps are not allowed for open web steel joist application.

3.06 TRAPEZE SUPPORTS

A. Construct trapeze supports with struts, angles, or channels and hang them by inserts or welded beam attachments and rods.

B. Determine trapeze supports spacing by the smallest pipe on trapeze.

END OF SECTION

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SECTION 20 0553
MECHANICAL SYSTEMS IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 SUBMITTALS

A. Product Data: For identification materials and devices

B. Valve Schedules: For each piping system

C. Samples: Of color, lettering style, and graphic representation required for each identification material and device.

PART 2 PRODUCTS

2.01 IDENTIFYING DEVICES

A. Marker System:
   1. Manufacturers: Brady USA, Marking Services Inc. (MSI), Kolbi, or Seton
   2. Manufacturer's standard, preprinted with color coding, lettering size and length of color field according to ASME A13.1.
   3. Use pressure-sensitive type or "snap-on" type.
   4. "Strap-on" type may be used for piping over 6” size including insulation.

B. Valve Tags:
   1. Minimum 1-1/2” diameter, 0.032” thick, polished brass or 316 stainless steel.

C. Laminated Plastic Nameplates:
   1. Nameplates shall be approximately 1-1/2" x 4", 1/16” thick, and have 1/2” high lettering. Face of plastic nameplates shall be black with white letters.
   2. Fasteners shall be self-tapping, stainless steel screws or contact type with permanent adhesive.

PART 3 EXECUTION

3.01 GENERAL

A. After painting and/or covering is completed, identify equipment and piping as indicated. Locate identification as conspicuously as possible except where such would distract from finished area.

B. Where markers are used in high heat applications or exposed to harsh chemical or acid environments, specifically select marker materials for those applications.

C. Coordinate, obtain and confirm mechanical systems identification criteria and requirements from Owner.

3.02 PIPING SYSTEM IDENTIFICATION

A. Install pipe identification on each system.

B. Place flow directional arrows at each pipe identification location.

C. Identify all piping)not less than once every 25 ft, not less than once in each room, at each branch, adjacent to each access door or panel, at each valve and where exposed piping passes through walls and floors.

D. Identify piping with marker system.
   1. For "strap-on" type, ensure marker is fitted snugly to pipe or pipe insulation surface with sufficient straps.

3.03 VALVE IDENTIFICATION

A. Identify valves with brass tags bearing system identification and valve sequence number in 1/2” black characters. Attach tag to valve body with brass jack chain and "S" hook for brass tag and SS jack chain or SS braided wires with swag sleeves and "S" hook for stainless steel tag. Non-metallic fasteners are not allowed.

B. Valve numbers shall be prefixed with corresponding piping system identification in 1/4” black letters.

C. Valve tags are not required at terminal devices unless valves are greater than 10 ft from device or located in another room not visible from terminal unit.

D. Furnish typewritten valve schedule indicating valve number, fixtures, equipment, or areas served by each numbered valve and incorporate in O&M Manuals.

3.04 EQUIPMENT IDENTIFICATION

A. Identify major equipment, including air terminal devices, chilled beams, etc.

B. Identify equipment with laminated plastic nameplates.

C. Identify control equipment and panels with laminated plastic nameplates.

D. Nameplate Markings:
   1. Identify model number, size, capacity, electrical characteristics, serial number, along with other items scheduled for equipment on drawings.
   2. Indicate motor horsepower, voltage, phase, cycles, RPM, full load amps, locked motor amps, frame size, manufacturer’s name and model number, Service Factor, Power Factor, efficiency, minimum circuit amps, minimum feeder conductor size, disconnect or fuse size, refrigerant, and other pertinent information.

E. Locate motor nameplates for easy reading. Relocate or provide new nameplates on motors if original nameplates are not located for easy reading.

END OF SECTION

SECTION 20 0573
MECHANICAL SYSTEMS FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 07 8413 - Penetration Firestopping

PART 2 PRODUCTS

2.01 NOT APPLICABLE TO THIS SECTION

PART 3 EXECUTION

3.01 NOT APPLICABLE TO THIS SECTION

END OF SECTION

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SECTION 20 0700
MECHANICAL SYSTEMS INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 20 0529 - Piping and Equipment Supporting Devices

B. Section 20 0130 – HVAC System Cleaning

C. Section 23 3114 - Ductwork (Duct Lining)

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Provide insulating materials and accessories as required for mechanical systems as specified below.

B. Insulating products delivered to construction site shall be labeled with manufacturer's name and description of materials.

1.04 DEFINITIONS

A. Concealed areas, where indicated in this Section, shall apply to shafts, furred spaces, and space above finished ceilings, inaccessible tunnels, and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

B. Unless otherwise indicated, unit of thermal conductivity is $Btu \cdot in/(h \cdot ft^{2} \cdot °F)$.

C. Interstitial spaces are considered as concealed areas.

1.05 SUBMITTALS

A. Shop Drawings for each piping system for all pipe sizes, each ductwork system, and all equipment including, but not limited to, the following:
   1. Manufacturer's name
   2. Schedule of insulating materials
   3. Insulation material and thickness
   4. Jacket
   5. Adhesives
   6. Fastening methods
   7. Fitting materials
   8. Intended use of each material
   9. Manufacturer's data sheets indicating density, thermal characteristics, temperature ratings
   10. Insulation installation details (manufacturer's installation instruction/details, Contractor's installation details, MICA plates where applicable)
   11. All other appropriate data

1.06 DELIVERY, STORAGE AND HANDLING

A. Insulation material shall be delivered to project site in original, unbroken factory packaging labeled with product designation and thickness. Shipment of materials from manufacturer to installation location shall be in weather-tight transportation. Protect insulation materials from moisture and weather during storage and installation. Protect insulation material against long exposure to UV light from sun.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Insulation:
   1. Owens Corning, Johns Manville, Manson, Knauf or CertainTeed similar to product indicated except where product of manufacturers not listed above is specifically identified for special type of insulation.

B. Coatings, Mastics, Sealants and Adhesives:
   1. Foster, Childers, Vimasco, Miracle or Pittsburgh Corning

2.02 MATERIALS

A. Products used for or related to air conditioning and ventilating systems shall conform to NFPA 90A possessing flame spread index of not over 25 and smoke developed index no higher than 50.

B. Unless otherwise indicated, all products, material itself or on composite basis, shall have flame spread index not more than 25 and smoke developed index not more than 50, when tested in accordance with ASTM E-84 or UL723.

C. Pipe insulation which is not located in air plenum may have flame spread rating not over 25 and smoke developed rating no higher than 450 when tested in accordance with UL 723 and ASTM E84.

D. Equipment, ductwork, and piping insulation, including interior we-applied adhesives, sealants, paints, coatings: Comply with low-emitting requirements in Division 01 Section “Sustainable Design Requirements – LEED” or UL Greenguard Gold certification, whichever is more stringent.

E. All products, material itself or on composite basis, shall have “Red List Free” or “LBC Compliant” or “Declared” labels per the International Living Future Institute’s Declare List.

2.03 INSULATION

A. Insulation materials shall be fire retardant, moisture, and mildew resistant, vermin proof, and suitable to receive jackets, adhesives and coatings as indicated.

B. Glass fiber insulation shall be of inert inorganic material, non-corrosive to mechanical surfaces.

C. Insulating cement shall be Quick-Cote by PK Insulation MFG Co. or Ryder GP, with dry density of no more than 38 lb/ft^3 thermal conductivity of 0.96 at 400°F mean temperature, and service temperature to 1200°F.

D. Filling and finishing cement shall be Super-Stik by PK Insulation MFG Co., or Ryder MW, with dry density of no more than 24 lb/ft^3, thermal conductivity of 0.74 at 500°F mean temperature, and service temperature to 1900°F.

E. Type A Insulation (Closed Cell Elastomeric Thermal Insulation):
   1. Minimum nominal density of 6 lb/ft^3, thermal conductivity not more than 0.25 at 75°F mean temperature, maximum water vapor transmission of 0.06 perm-inch and suitable for temperatures from -70 to 220°F, Armacell Model AP/Armaflex, K-Flex USA, or Aeroflex Model Aerocel.

F. Type F Insulation (Flexible Glass Fiber):
   1. Minimum density of 0.75 lb/ft^3 with thermal conductivity of not more than 0.29 at 75°F mean temperature, and suitable for temperatures to 250°F. Owens Corning "All Service Duct Wrap", Johns Manville Microlite EQ Type 75, Knauf Atmosphere Duct Wrap.

G. Type G Insulation (Cellular Glass):
   1. 100% cellular glass cells with no organic material, noncombustible, 0.00 perm-inch permeability, 7.5 lb/ft^3 average density, compression strength 90 psi, thermal conductivity of not more than 0.31 at 50°F mean temperature and service temperature of 900°F. Pittsburgh Corning Foamglas or approved equal.

H. Type P Insulation (Expanded Polyisocyanurate):
1. Continuously molded rigid polyisocyanurate foam insulation meeting requirements of ASTM C-591, with thermal conductivity of not more than 0.19 at 75°F mean temperature, minimum nominal density of 2 lb/ft^3, minimum compressive strength of 24 psi, maximum water vapor transmission of 4.0 perm-inch, maximum water absorption of 2% by volume, and suitable for temperature of plus 300°F down to -297°F. Insulation shall have factory-applied jacket with SSL. Trymer 2000 XP by ITW, Dyplast ISO-C1, or approved equal.

I. Type PP Insulation (Phenolic):
1. Rigid closed cell, minimum nominal density of 2.5 lb/ft^3, thermal conductivity of not more than 0.18 at 75°F, minimum compressive strength of 31 psi and maximum water vapor permeability 3.10 ng/s-m-Pa (2.14 perm-inch, maximum water absorption of .5% by volume, rated for service range of -290°F to 250°F, and flame spread index of not more than 25 and smoke developed index not more than 50.
2. Koolphen K phenolic foam insulation by Kooltherm Insulation, Resolco Insulphen rigid phenolic insulation by Resolco Inc., or Trymer Supercel Phenolic by ITW Insulation.

J. Type R Insulation (Rigid Glass Fiber):
1. Minimum nominal density of 3 lb/ft^3 with thermal conductivity of not more than 0.23 at 75°F mean temperature.
2. Pipe insulation shall be premolded type in accordance with ASTM C547 Type I, suitable for temperatures to 850°F, Johns Manville Micro-Lok, Owens Corning Fiberglas ASJ/SSL-II or Knauf Earthwool 1000° pipe insulation.
3. Duct and equipment insulation shall be in accordance with ASTM C612, Type IA and IB, suitable for temperatures to 450°F, Johns Manville Spin-Glas Type 814, Owens Corning Type 703, Knauf Insulation Board.
4. Pipe and tank wrap faced with specified jacket may be used for equipment and round ducts insulation, provided that it meets all insulation characteristics requirements stated above and maintains same R-value as specified.

2.04 JACKETS

A. Jacket puncture resistances shall be based on ASTM D-781 test methods. Vapor barrier permeance ratings shall be based on ASTM E-96 Procedure A.

B. Type D-2 Jacket:
1. Glass fiber reinforced foil Kraft laminate with permeance not exceeding 0.02 perm and beach puncture resistance 25 units minimum. Owens Corning "FRK", Johns Manville "FSK", Knauf “FSK”.

C. Type P-1 Jackets:
1. Heavy-duty, fire retardant material with glass fiber reinforcing and self-sealing lap. Jacket shall have neat, white Kraft finish suitable for painting, with burst strength of 1.5 Joules(50 beach units) minimum and tensile strength 45 lbs/in minimum. Vapor barrier shall be adhered to inner surface of jacket. Permeance shall not exceed 0.02 perm. Owens Corning "ASJ-SSL", Johns Manville "ASJ" and Knauf ASJ+.

2.05 ADHESIVES, MASTIC, COATINGS, SEALANTS, AND REINFORCING MATERIALS

A. Adhesives and sealants shall comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168; VOC limits shall comply with Indoor Environmental Quality Section, Credit IEQ-4.1.

B. Coatings and mastics shall comply with VOC limits set forth by Green Seal BS-11 and comply with the South Coast Air Quality Management District (SCAQMD) Rule #113; VOC limits shall comply with Indoor Environmental Quality Section, Credit IEQ-4.2.

C. Products shall be compatible with surfaces and materials on which they are applied, and shall be suitable for use at operating temperatures of systems to which they are applied.

D. Products shall be fire retardant, moisture resistant and mildew resistant and vermin proof.

E. Vapor Barrier Mastic: Below ambient insulation. Water vapor permeance shall be less than 0.08 perms at 45 mils dry film thickness per ASTM F1249.
   1. Foster 30-33
   2. Childers CP-33
   3. Vimasco 749

F. Weather Barrier Breather Mastic: Above ambient insulation. Permeance shall be greater than 1.0 perms at 1/16” dry film thickness per ASTM E96.
   1. Foster 46-50 Weatherite
   2. Childers CP-10/CP-11 Vi Cryl
   3. Vimasco WC-5

G. Lagging Adhesive/Coatings: Indoors applications used in conjunction with canvas/glass cloth.
   1. Foster 30-36
   2. Childers CP-50 AMV1
   3. Vimasco 713

H. Metal jacketing sealant for aluminum jacketing:
   1. Foster 95-44 Elastolar
   2. Childers CP-76 Chil Byl
   3. Pittsburgh Corning 727

I. Glass fiber fabric reinforcing shall be 10 x 10 mesh similar to Childers Chil Glas #10 or Foster Mast A Fab.

J. Wire mesh reinforcing shall be 22 ga., 1” galvanized.

K. Insulation cement shall be ANSI/ASTM C195, hydraulic setting mineral wool.

L. Finishing cement shall be ASTM C449.

M. Butt joint and longitudinal joint adhesive for Type A insulation shall be Armstrong 520, Rubatex 373, Childers CP-82 or Foster 85-75.

N. Weather-resistant protective finish for Type A insulation shall be equal to Armstrong WB Armaflex finish or Foster 30-64 elastomeric coating.

2.06 METAL BANDS AND WIRES

A. Aluminum bands shall be 0.5" x 0.020” up to 48” diameter and 0.75" x 0.020” over 48” diameter.

B. Stainless steel bands shall be 0.5" x 0.015” or 0.75" x 0.015”.

C. Stainless steel wires shall be 16 ga.

2.07 INSULATION FASTENERS

A. Insulation fasteners shall be cup head weld pins, galvanized low carbon steel, minimum 12 ga. (0.105”) pins.

B. Washer edge shall be beveled.

C. Fasteners shall be stainless steel for stainless steel ductwork application.

D. Insulation fasteners using adhesive are not allowed.

2.08 REMOVABLE INSULATING BLANKETS

A. Custom designed removable, reusable, flexible, blanket thermal insulation system.

B. Acceptable Manufacturers: Thermal Energy Products, Inc., Advanced Thermal Corp., Temptec and Remco Technology, Inc.

C. Removable insulation system shall be custom designed for each individual item to provide close contour fit. Overlapping seams and gaps are not acceptable.

D. Removable insulation shall be designed to overlap adjoining pipe insulation by 2".

E. Insulation: Minimum 2" thick, 2.4 lb/ft^3 density, 1000°F continuous service temperature thermal insulating wool; Owens Corning Fiberglass or equal.

F. Interior and Exterior Fabric: Minimum weight 17.5 oz/sq yd silicone rubber coated fiberglass cloth.

G. Securement: Blanket seams shall be closed with buckle and strap assembly (D ring closure).

H. Identification/Tagging: Label each removable insulation device with plastic or 304 stainless steel tag with raised letters. Tag as directed by Owner.

PART 3 EXECUTION

3.01 APPLICATION

A. Provide insulation and jackets as indicated in the following schedule. The schedule applies to both exposed and concealed applications unless noted otherwise:

Piping System

Service	Jacket Type	Insulation Type	Insulation Thickness According to Pipe Size				
			3/4" and less	1" - 1-1/4"	1-1/2" - 3"	4" - 6"	8" and Larger
Heating Hot Water (105-140°F)	P-1	R	1"	1"	1-1/2"	1-1/2"	1-1/2"
Chilled Water / Chilled Beam Chilled Water	P-1	R	1"	1"	1-1/2"	1-1/2"	2"
Cooling Coil Condensate Drain	P-1	R	1"	1"	1"	1"	1"
			Type A 3/4" thick insulation may be used.				
Domestic Cold Water	P-1	R	1"	1"	1"	1"	1"
	--	A	3/4"	3/4"	3/4"	3/4"	3/4"
			(Type A Insulation is an option)				
Domestic Hot Water and Hot Water Return (105-140°F)	P-1	R	1"	1"	1-1/2"	1-1/2"	1-1/2"
	--	A	1"	1"	1-1/2"	1-1/2"	NA
			(Type A insulation is an option.)				
Clearwater Waste	P-1	R	1"	1"	1"	1"	1"
	--	A	3/4"	3/4"	3/4"	3/4"	NA
			(Type A insulation is an option.)				

Ductwork/Equipment System

Service	Jacket Type	Insulation Type	Insulation Thickness
Supply Ducts Concealed	D-2	F	2"

3.02 INSTALLATION - GENERAL

A. All insulation installation methods shall be performed in accordance with the latest edition of National Commercial and Industrial Insulation Standards published by MICA (Midwest Insulation Contractors Association) and manufacturer's installation instructions, except as modified in this Section of specifications.

B. Install products with good workmanship, with smooth and even surfaces. Use full-length factory-furnished material where possible. Do not use scrap pieces.

C. Apply insulation only on clean, dry surfaces, after all rust and scale have been removed and testing of systems has been completed. Do not insulate any section of system that must be pressure tested until after it has been successfully tested. Any removal and reinstallation to correct system defects prior to end of guarantee period shall be accomplished at no expense to Owner.

D. Install insulating materials with necessary joints and terminations, to permit easy access and removal of equipment sections where inspection, service or repair is required, and to allow for expansion.

E. Where possible longitudinal joints in jackets shall face toward wall or ceiling.

F. Apply insulation to each pipe or duct individually. Common insulation applied to adjacent pipes or ducts will not be accepted.

G. Unless otherwise indicated, pipe and duct insulation shall be continuous through walls and floors.

H. Where multiple layers of insulation are used, stagger and secure each layer with metal bands.

I. Where penetrations occur through fire-rated walls, partitions, or floors, provide fire seal as specified in Section 20 0000 - General Mechanical Requirements and Section 20 0573 - Mechanical Systems Firestopping.

J. Insulate water piping within casework up to penetration of casework pipe chase at fixture stop. Insulate water piping within walls up to pipe penetration through the wall at fixture stop when serving wall-mounted fixtures. Termination of insulation shall be in neat and workman like manner with insulation jacket cap.

K. Insulate the following systems for complete vapor barrier protection:
   1. Chilled Water / Chilled Beam Chilled Water
   2. All insulated ductwork
   3. All equipment with surface temperature below 65°F

L. Apply Type A insulation for insulation and jackets requiring vapor barrier protection where specified insulations are cut for mounting sensors, control devices, parts of valves, devices or components which extend out from specified insulation to prevent condensation.

3.03 PIPING, VALVE AND FITTING INSULATION

A. Apply insulation to pipe, unions, flanges, fittings, valves and piping specialties with butt joints and longitudinal seams closed tightly. Valve insulation shall cover entire valve body including bonnets and packing nuts.

B. Laps on factory-applied jackets shall be 2" minimum width firmly cemented with lap adhesive, or shall be pressure sealing type lap.

C. Cover joints with factory furnished tape (3" minimum width) to match jacket. Cement firmly with lap adhesive. On systems requiring a vapor barrier (ASJ), vaporseal all longitudinal and butt joints ASJ/Saran seams with 4” wide coat of vapor barrier mastic or 3” minimum tape.

D. Where staples are used, they shall be on 6" maximum centers. When used for systems requiring vapor barrier, cover lap and staples with finish coat of vapor barrier mastic or 3" minimum tape.

E. For finishing of insulated pipe fittings and valves where surface temperature of insulation is not higher than 125°F, use one piece PVC fitting covers, minimum thickness of 20 mil, Fitting cover shall be Johns Manville Zeston 2000 PVC, PROTO Fitting Covers, or similar by other manufacturers listed. Where fitting and valve insulation requires vapor barrier, seal joints of PVC covers with vapor barrier adhesives. Insulation type, R-value and density of insulation used at fittings shall match insulation of adjacent piping. Install insulation at pipe fittings and valves completely prior to applying PVC covers.

1. For Type R (Rigid glass fiber) pipe insulation, PVC fitting covers with flexible mineral fiber blanket insulation inserts are acceptable, except those located in mechanical rooms within 6 ft above floor. For fitting covers located in mechanical room within 6 ft above floor, insulation inserts shall be pre-molded rigid fiber glass type wrapped around elbows.

F. Stove pipe style insulation on elbows (Detail A on Plate 2-200 of MICA 8th Edition) is not allowed. It may be used for closed cell elastomeric insulation.

G. Where terminations of pipe insulation are required, insulation shall have tapered ends, built up and finished as specified for fittings.

H. For pipes 1-1/2" and smaller, install specified pipe insulation and jacket continuous through hanger or support locations. Install insulation protection shields to protect insulation from compressing.

I. For pipes 2" and larger, where manufactured pre-insulated pipe supports are used at hanger or support locations, extend insulation to insulated pipe supports. Where vapor barrier is required, this Contractor shall be responsible for continuity of vapor barrier at insulated pipe supports. Use 3" wide vapor barrier tape on hot and cold systems at pipe supports.

J. For pre-insulated pipe supports and insulation protection shields, refer to Section 20 0529 - Piping and Equipment Supporting Devices.

K. For Contractor-fabricated anchors, secure insulation directly to pipe surface and extend insulation up anchor for distance of 4 times insulation thickness. For pre-insulated anchors, cover entire surface of anchors with Type A insulation. Where applicable, take special care to assure vapor seal at anchor.

L. Where mechanical grooved pipe connections are used in piping system, insulate couplings as specified for pipe.

M. Piping, fittings and valves not to be insulated:
1. Heating hot water piping inside fin tube radiation enclosures
2. Control valves and balancing valves for heating terminal devices
3. Valves furnished with removable insulation/jacket
4. Steam system traps

3.04 DUCTWORK AND COMPONENTS

A. Apply duct insulation evenly over duct surface. Unless otherwise indicated, insulation and jacket shall run continuously between duct and duct supports. Maintain insulation thickness specified over duct reinforcing members.

B. For support points of rectangular or oval ducts supported by trapeze hangers, place weight-supporting insulation at bottom of duct over trapeze. Weight supporting insulation inserts shall be minimum 6" long with same thickness as insulation specified and shall be Type G, H, P, or PP insulation. Size inserts based on compression strength and weight being supported.

C. Flexible glass fiber insulation (Type F) may be installed outside of support for rectangular or oval ducts having width 60" or smaller and supported with strap hangers, provided that vapor barrier integrity is maintained at strap penetration.

D. For support points of round ducts smaller than 16" diameter, weight-supporting insulation is not required for either rigid or flexible glass fiber insulation.

E. For support points of round ducts 16" diameter and larger, place weight-supporting insulation between duct and strap or trapeze. Weight-supporting insulation shall be minimum 6" long with same thickness as insulation specified and shall be Type G, H, P or PP insulation. Size inserts based on compression strength and weight being supported.

F. Flexible glass fiber insulation (Type F) may be installed outside of support for round ducts 24" diameter or smaller, provided that vapor barrier integrity is maintained at rod penetration.

G. Securing glass fiber insulation (Type F and R) for rectangular or oval ductwork.
1. Horizontal ductwork:
a. Secure to bottom of duct where duct width is 24" diameter or greater.

b. Secure to sides of duct where duct side is 24" diameter or greater.

2. Vertical ductwork:
   a. Secure to all sides where duct width is 18" diameter or greater.
3. Install fasteners as required to secure, but not over 18" on center and within 3" of butt joint or edge.
4. Fastener shall be weld pin mechanical type.

H. Fastening insulation anchors to ductwork with adhesives is not allowed. Where weld pin fasteners are used, install them without damage to interior galvanized surface. Where weld pin fasteners cannot be used, use other type of fasteners such as metal bands.

I. Where insulation is required for ductwork, provide insulation over entire ductwork system, including system components such as filters, mixing air chambers, sound attenuators, air measuring stations, reheat coils, etc. For fire dampers, smoke dampers and combination F/S dampers in ductwork requiring insulation, install insulation and jacket to wall and apply vapor barrier sealant to prevent condensation.

J. Provide insulation over supply air diffusers, grilles and unlined boots after termination point of flexible ducts or rigid duct insulation to prevent from sweating.

K. Where vapor barrier jackets are specified, pins and staples if used shall be jacketed over with matching material using 4" tape. Vaporseal insulation seams, punctures, and tears with two 4” wide tape.

L. Insulation without factory jacket shall be cut and mitered to suit surface. Build up voids, seams and joints with insulating cement, cover with glass fabric and 2 coats of vapor barrier mastic as specified herein and finish to smooth surface.

M. D-2 jackets:
1. Butt together joints and seams firmly, cover with glass fiber fabric 4" minimum width and finish with 2 coats of vapor barrier mastic. Use of pressure sensitive tape is not acceptable.

N. Ductwork not to be insulated:
1. Internally lined ductwork

3.05 TYPE P INSULATION (POLYISOCYANURATE)

A. Install Type P insulation with specified insulation jacket in accordance with manufacturer’s installation recommendations. Insulation shall be tightly butted and free of voids and gaps at joints. Use 3" wide tape at butt joints with minimum 1.25 times circumference wrapping. Apply insulation joint sealant in longitudinal and butt joints.

B. Install pre-fabricated tight fitting insulation pieces on fittings, elbows, tees and valves.

C. Insulation at fittings and valves shall be the same thickness as on pipe section.

D. Replace Type P insulation and jacket with Type R insulation of same thickness with Type P-1 jacket at penetration of fire rated walls and floor slabs where fire stopping system is required.

END OF SECTION

SECTION 21 0000
GENERAL FIRE SUPPRESSION REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specification requirements defined in Division 20 of this specification apply to and are in addition to the work associated with equipment, systems, materials, and installation requirements specified in Division 21. Contractor shall provide the requirements specified in Division 20 to obtain complete systems, tested, adjusted, and ready for operation.

1.02 RELATED WORK

A. Section 20 0000 - General Mechanical Requirements

B. Section 20 0529 - Piping and Equipment Supporting Devices

C. Section 20 0553 - Mechanical Systems Identification

D. Section 20 0573 - Mechanical Systems Firestopping

E. Section 21 1314 - Automatic Fire Sprinkler System

F. Section 26 0593 – Electrical Systems Firestopping

PART 2 PRODUCTS

2.01 NOT APPLICABLE TO THIS SECTION.

PART 3 EXECUTION

3.01 NOT APPLICABLE TO THIS SECTION.

END OF SECTION

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SECTION 21 1314
AUTOMATIC FIRE SPRINKLER SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section specifies materials, methods, and equipment to be used for automatic sprinkler system and related fire protection for Respiratory Therapy fit out.

B. Research indicates there is no documentation or indication that microbiologically influenced corrosion (MIC) exists in the area of the project.

C. NFPA 13's seismic requirements are not part of this project.

D. This is not a Factory Mutual Global (FMG) protected property.

E. As shown on drawings, existing fire protection system shall be renovated accordingly.

F. Engineer of Record:
   1. Contractor shall be Engineer of Record. Contractor shall produce stamped and sealed installation drawings, which are also referred to as shop drawings in this Section, based on design criteria listed in this Section and drawings furnished by Engineer. Contract drawings show zone and main piping layouts of fire protection systems as it relates to architecture, structure, and mechanical/electrical systems.

G. All work shall be installed in conformance with the governing codes, regulations, local ordinances, and requirements of Authorities Having Jurisdiction. It shall be the responsibility of the Fire Protection Contractor to familiarize themselves with all governing codes and requirements and report any noncompliance of the plans or specifications to the Construction Manager/Engineer, prior to entering into the contract. These requirements are minimum criteria and no reductions permitted by Code shall be allowed without written permission of the Engineer.

H. No additional compensation shall be granted for work which must be changed as a result of the work not originally complying with codes and standards or not in accordance with the multiple trade coordination design criteria set forth in the contract documents.

I. If code or other requirements exceed provisions indicated in the Contract Documents, the Construction Manager/Engineer shall be notified in writing. Where the work indicated on the Contract Documents exceeds code requirements, the installation shall be done in accordance with the Contract Documents. Any work done contrary to these requirements shall be removed and replaced at the expense of the responsible Contractor.

J. Fire Protection Contractor shall become familiar with all details of the work, verify dimensions in the field, and advise the Construction Manager/Engineer of any discrepancy prior to entering into the contract.

K. Fire Protection Contractor shall file all drawings, pay all fees, and obtain all permits and certificates of inspection related to this work. Fire Protection Contractor shall arrange inspection with proper Authorities Having Jurisdiction and include all costs associated with said inspections in their bid.

1.02 RELATED WORK

A. Section 20 0000 – General Mechanical Requirements

B. Section 20 0529 – Piping and Equipment Supporting Devices

C. Section 20 0553 – Mechanical Systems Identification

D. Section 20 0573 – Mechanical Systems Firestopping

E. Section 21 0000 – General Fire Suppression Requirements

F. Section 26 0593 – Electrical Systems Firestopping

1.03 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. This installation shall conform to the following:
      a. NFPA 13, Installation of Sprinkler Systems
      b. NFPA 25, Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
      c. NFPA 101, Life Safety Code
      d. International Building Code (IBC)
      e. International Fire Code (IFC)
      f. Local and State Building, Mechanical, and Fire Codes
      g. Underwriters Laboratories (UL) Fire Protection Equipment Directory
      h. Factory Mutual Research Corporation (FMRC) Approval Guide

B. Contractor Installation Program:
   1. Provide licensed persons employed by sprinkler contractor to perform planning, calculations, layout, installation, and testing of fire protection systems. The following are acceptable:
      a. Licensed Professional Engineer
      b. National Institute for Certification of Engineering Technologies (NICET) Level IV
      c. Certified sprinkler designer
   2. Provide journeyman sprinkler fitter(s) for installation and supervision.
   3. Contractor shall be licensed in the State of Illinois for installation of fire protection systems.
   4. Contractor shall submit pre-qualification evidence of at least 3 projects of comparable size successfully completed with their Bid.
   5. Distortion or misrepresentation of qualification evidence may result in contract cessation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. All materials shall be stored in a clean, dry space.

D. Promptly inspect shipments to insure material is undamaged and complies with Specifications. Storage and protection methods must allow inspection to verify products.

E. Furnish pipe with plastic end-caps/plugs on each end of pipe. Maintain end-caps/plugs through shipping, storage and handling, and installation to prevent pipe-end damage and to eliminate dirt and construction debris from accumulating inside of pipe. Protect fittings and unions by storage inside or by durable, waterproof, aboveground packaging.

F. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade.

G. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

1.06 SUBMITTALS

A. Shop Drawings on Items Specified:
   1. Pipe, Fittings, and Joints
   2. Valves
   3. Sprinklers
   4. Spare Sprinkler Cabinets
   5. Hanger Assemblies
   6. Drawings

7. Hydraulic Calculations

B. Submit fire pump certified shop test curves showing pressure rating and rated horsepower to Engineer.

C. Submit Material Safety Data Sheet (MSDS) for corrosion inhibitive paint.

D. Include items listed in product section and additional items required to provide complete installation.

E. Indicate by red marking or arrow, items that are to be provided, where more than 1 item appears on manufacturer's catalog sheet.

F. Submit stamped and sealed drawings, product datasheets, hydraulic calculations, and a signed copy of the Owner’s certificate to local Fire Department, Engineer, and Owner's insurance representative prior to installation or fabrication of system components.

G. Submit stamped and sealed drawings, product data sheets, and hydraulic calculations to local Fire Department prior to installation or fabrication of system components.

H. Include copy of Fire Department plan review letter in submission to Engineer.

I. Prior to installation or fabrication of system components, submit layout drawings and equipment submittals to Engineer of Record.

J. After review of layout drawings by Engineer of Record, submit drawings and calculations to Local Authority and Owner’s Insurance Representative.

K. Review of submittals does not relieve Contractor from coordinating installation of work with other trades, or from compliance with Codes and Standards.

L. At completion of acceptance tests:
1. Send copy of test log to Engineer
2. Send copy of Contractor’s Material and Test Certificates to:
   a. Engineer
   b. Owner
   c. Authority Having Jurisdiction
3. Provide Owner with following:
   a. Manufacturer's literature and instructions describing operation and maintenance of equipment and devices installed.
   b. Typewritten chart with identification and location of all access panels serving equipment and valves. Incorporate into Operation & Maintenance (O&M) manual.
   c. Typewritten valve schedule indicating valve number, fixture/equipment or areas served by each numbered valve. Incorporate into O&M manual.
   d. For additional O&M manual requirements, refer to Section 20 0000 – General Mechanical Requirements.
   e. Current copy of NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials and Equipment:
1. Materials and equipment in system shall be new and current products of manufacturer regularly engaged in production of such materials and equipment.
2. Where 2 or more pieces of equipment are required to perform interrelated functions, they shall be products of same manufacturer.
3. Clean and cap pipe after fabrication and prior to placing pipe in building.
4. Mark pipe with tags that can be removed during installation, so no permanent markings remain on unpainted pipe located in exposed areas.

B. Approval Guides:

1. Unless otherwise shown, products shall be UL Listed in the latest publication of the UL Fire Protection Equipment Directory or approved in the latest Factory Mutual Research Corporation Approval Guide for service intended.

2.02 PIPE

A. Above Ground:
   1. Carbon Steel, 2" and smaller:
      a. Pipe: Carbon steel pipe, Schedule 40, American Society for Testing of Materials (ASTM) A795 or A53
      b. Fittings:
         1). Malleable iron, threaded, Class 150, 300 psi Cold Water Pressure (CWP) rating, ASME B16.3
         2). Cast iron, threaded, Class 125, 175 psi CWP rating, ANSI B16.4
         3). Cast iron, flanged, Class 125, 175 psi CWP rating, ANSI B16.1
         4). Carbon steel butt weld, ASTM A234 Grade WPB/American Society of Mechanical Engineers (ASME) B16.9, standard weight, seamless
         5). Ductile iron or malleable iron, roll grooved for mechanical coupling, 175 psiCWP rating, malleable iron conforming to ASTM A47.
            a). Acceptable manufacturers: Anvil Gruvlok, Tyco Grinnell, Victaulic, Viking, or equal
            b). Fitting, gasket, and coupling shall be furnished by same manufacturer.
      c. Joints:
         1). Threaded, tapered pipe threads, ANSI B1.20.1
         2). Flanged, cast iron, 175 psi CWP rating, ANSI B16.1, square head machine bolts with semi-finished hexagon nuts, ASTM A183, neoprene gasket
         3). Welded, welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.
         4). Mechanical:
            a). Flexible mechanical, malleable iron, ASTM A47, equal to Victaulic Style 75
            b). Rigid mechanical, ductile iron, ASTM A-536, equal to Victaulic Style 009N
            c). Wet systems gasket: Grade E EPDM gasket per UL 157 and UL 213
            d). Dry systems gasket: Victaulic "FlushSeal" or equal
            e). Rigid or zero flex type couplings shall be provided when operating pressures cause piping to move out of place or sway on hangers. Flexible couplings may be used where pipe is braced or clamped into rigid position.
   2. Carbon Steel, larger than 2":
      a. Pipe: Carbon steel pipe, Schedule 10, ASTM A795, A53, or A135
      b. Fittings:
         1). Carbon steel butt weld, ASTM A234 Grade WPB/ASME B16.9, Schedule 10, seamless
         2). Ductile iron or malleable iron, roll grooved for mechanical coupling, 175 psi CWP rating, malleable iron conforming to ASTM A47.
            a). Acceptable manufacturers: Anvil Gruvlok, Tyco Grinnell, Victaulic, Viking, or equal
            b). Fitting, gasket, and coupling shall be furnished by same manufacturer.
      c. Joints:
         1). Welded, welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.
         2). Mechanical:
            a). Flexible mechanical, malleable iron, ASTM A47, equal to Victaulic Style 75
            b). Rigid mechanical, ductile iron, ASTM A-536, equal to Victaulic Style 009N
            c). Wet systems gasket: Grade E EPDM gasket per UL 157 and UL 213

d). Dry systems gasket: Victaulic “FlushSeal” or equal

e). Rigid or zero flex type couplings shall be provided when operating pressures cause piping to move out of place or sway on hangers. Flexible couplings may be used where pipe is braced or clamped into rigid position.

3. Provide metal pipe’s exposed threads with corrosion inhibitive paint, equal to Rust-Oleum.
4. Provide pipe identification system with flow directional arrows on fire protection pipe. For additional information about pipe identification, refer to Section 20 0553 – Mechanical Systems Identification.
5. Plain end couplings (Roust-A-Bouts, Plainloks or similar couplings) are not allowed on either new or existing sprinkler systems.
6. Adjustable drop nipples are not allowed on either new or existing sprinkler systems.
7. Shop welded joints:
   a. Welding electrodes shall be Lincoln or equal with coating and diameter as recommended by manufacturer for type and thickness of work being done.

2.03 VALVES

A. Ball Valve:
   1. Acceptable manufacturers: Milwaukee Valve Co., Mueller, Nibco, Stockham, Victaulic, or equal
   2. Bronze body and stem, full port design, brass ball with chrome plated finish, conforms to MSS SP-110 standard, Nibco Model KT-585-70-UL or equal.
   3. Provide high pressure valves and fittings when pressures exceed 300 psi water working pressure.

B. Globe/Drain Valve:
   1. Acceptable manufacturers: Milwaukee Valve Co., Mueller, Nibco, Stockham, Victaulic, or equal
   2. Bronze body, stem, bonnet, and packing nut; non-asbestos packing; nitrile seat disc; stainless steel handwheel screw or nut; Nibco Model KT-65-UL for valve sizes 1/2” to 1”, Nibco Model KT-211-W-UL for valve sizes 1-1/4” to 2”, or equal.
   3. Provide high pressure valves and fittings where pressures exceed 175 psi water working pressure.

C. Provide identification sign (enamel on metal) for valves per NFPA requirements. For additional information, refer to Section 20 0553 – Mechanical Systems Identification.

D. Valves in galvanized piping shall be bronze.

2.04 SPRINKLERS

A. Manufacturers:
   1. Unless otherwise noted below, shall be manufactured by Globe Fire Sprinkler, Reliable, Tyco Fire Products, Viking, or equal.

B. Automatic, having temperature and pressure rating suitable for location.

C. Light hazard occupancies shall utilize quick-response type sprinklers.

D. Architect will review deviations from specified styles for approval prior to installation.

E. Provide the following type of sprinklers.
   1. Type A: In areas without ceilings.
      a. Standard Coverage, Brass Upright or Pendent, ordinary temperature class, Globe Fire Sprinkler Model GL-QR, Tyco Fire Products Model TY-FRB, Viking Microfast, or equal.
   2. Type B: In areas with ceilings.

a. Standard Coverage, Concealed Pendent, ordinary temperature class, Globe Fire Sprinkler Model GL-QR/INCH, Tyco Fire Products Model RFII, Viking Mirage, or equal adjustable sprinkler with 139°F temperature class cover plate, mounted flush with ceiling. Cover plate color shall match ceiling color and shall be factory-painted (i.e. by manufacturer).

F. Submit samples for examination and approval when appearance is different than sprinkler specified.

G. Temperature class of sprinklers shall vary if installed close to heat sources in special hazard areas. Refer to NFPA 13 for requirements.

H. Provide high pressure sprinklers where pressures exceed 175 psi working water pressure.

I. Spare Sprinkler Cabinets:
1. Shall be complete with required number of spare sprinklers of each type and temperature rating per NFPA 13.
2. Shall be provided with at least one sprinkler wrench for each type of sprinkler installed.
3. Provide multiple cabinets to meet this requirement.
4. Coordinate cabinet locations with Owner's representative.

2.05 HANGERS

A. Acceptable manufacturers: Afcon, Anvil, Eaton, Pentair, Tolco, or equal

B. Concrete expansion hangers, when provided, are to be Hilti, Illinois Tool Works (ITW), Powers Fasteners, or equal

C. Hanger rods shall comply with Manufacturer Standardization Society (MSS) standards and manufacturer’s published load rating.

D. Provide hanger rod, hanger rod attachments, pipe stands, bolts, U-bolts, nuts, studs, and washers with electroplated zinc coating or with hot-dipped galvanized finish.

E. Riser clamps shall be electroplated zinc coated or have a hot-dipped galvanized finish and shall not protrude more than 2” beyond edge of hole, Anvil Fig. 261 or equal.

PART 3 EXECUTION

3.01 DESIGN CRITERIA

A. Basis of Design:
1. Classrooms, offices, corridors, exam rooms and general building spaces shall be hydraulically designed to provide minimum density of 0.10 gpm per sq ft over most hydraulically remote 1500 sq ft. Maximum spacing shall not exceed 225 sq ft per sprinkler.
2. General Storage areas shall be hydraulically designed to provide minimum density of 0.15 gpm per sq ft over most hydraulically remote 1500 sq ft. Maximum spacing shall not exceed 130 sq ft per sprinkler.

B. Hose Streams:
1. Add 100 gpm hose stream to sprinkler zone hydraulic calculations for Light Hazard Occupancies.
2. Add 250 gpm hose stream to sprinkler zone hydraulic calculations for Ordinary Hazard Occupancies.

C. Fire Protection System Layout and Installation Drawings:
1. Contractor shall review Design Drawings and Specifications, and shall provide installation drawings, calculations, and product datasheets.
2. Layout of fire protection system has been established as it relates to structure, and mechanical/electrical systems in building, and must be adhered to. Other layouts shall be produced by Contractor in coordination with building components.
3. Conceal sprinkler piping above ceilings where possible.

4. Contractor shall consult with Architect during development of piping layout to avoid conflicts with general appearance. Pipe routing is a critical issue due to attributes of this building.
5. Submit stamped and sealed installation drawings, calculations, and product data sheets for coordination review to: local Fire Department, Engineer, Architect, Owner's insurance representative, City of Joliet and other Authorities Having Jurisdiction prior to installation (see submittals).
6. Contractor shall be responsible to have examined "Reflected Ceiling" drawings as well as Mechanical, Electrical, Piping, Information Technology, Structural and Architectural building plans prior to system layout.
7. Contractor shall coordinate routing of piping with other trades and Architect.
8. Contractor shall participate in coordination process and shall not install piping prior to coordination with other trades.

3.02 INSPECTION

A. Investigate site conditions; verify utility locations and elevations before start of excavation. Forward discrepancies to Architect/Engineer before proceeding with construction.

3.03 INSTALLATION

A. Install hydraulically designed sprinkler system and associated accessories according to requirements of NFPA 13 and as shown on drawings.

B. Install pipe, fittings, couplings, and valves according to requirements of manufacturer.

C. Keep materials within listed temperature range to assure jointing in accordance with manufacturer's requirements.

D. Pipe and fittings shall be of corresponding materials when assembled.

E. Above Ground Pipe:
   1. Provide pipe identification system with flow directional arrows on fire protection pipe in accordance with manufacturer's installation instructions. For additional information, refer to Section 20 0553 – Mechanical Systems Identification.
   2. Coat exposed threads with corrosion inhibitive paint, equal to Rust-Oleum. Apply paint per manufacturer's instructions.

F. Provide readily removable fittings at end of cross-mains. Minimum size of flushing connection shall be 2".

G. Provide test connection for each flow switch.

H. Discharge test connections inside building to receptacles provided as part of plumbing system or to standpipe's drain riser.

I. Drain line detailed adjacent to standpipe/sprinkler risers shall be considered as part of Sprinkler System from combination test/auxiliary drain valve for each zone or sub-zone shown on plans to plumbing receptacle.

J. Provide auxiliary drains at low points of systems per requirements of NFPA 13.

K. Identify valve with brass tag denoting which flow switch is being tested when test valves are located remote from flow switch.

L. Clamp-on or saddle type fittings (i.e. mechanical tees) are not allowed. Outlet fittings inserted into holes drilled into piping or pipe-o-lets are not allowed.

M. Provide reducing fittings or provide shop fabricated weld-o-lets to change pipe sizes in sprinkler/standpipe systems. No bushings or grooved reducing couplings, such as Victaulic Style 750, are allowed.

N. Feed sprinklers, installed in finished ceilings, with swing joint, or return bend arrangement for final positioning in ceiling grid pattern during construction phases.

O. All arm-over and flexible sprinkler fittings shall be taken from the sides or top of the branch line. No arm-overs or flexible sprinkler fittings shall be connected to the bottom of the branch line.

P. Sprinklers are required to be installed in the center of ceiling tiles.

Q. Install sprinklers as recommended by manufacturer. Sprinklers shall be set level and at locations to avoid interference with spray pattern of sprinkler. When ducts and lights are obstructions to sprinkler distribution, provide additional sprinklers beneath obstruction.

R. Make joints of threaded pipe by cutting pipe square and reaming inside.

S. Use joint compound sparingly.

T. Install joints for mechanical coupled pipe according to manufacturer's recommendations. Use manufacturer’s gasket lubricant sparingly.

U. Pipe grooving shall be per coupling manufacturer’s instructions.

V. Welded joints shall be made in fabrication shop. No welding allowed at project site.

W. Hangers, Bracing, and Restraint of System Piping:
1. Provide hangers and associated parts to support piping in perfect alignment without sagging or interference, to permit free expansion and contraction, and meet requirements of NFPA 13 and manufacturer’s installation instructions.
2. Select and size building attachments per Manufacturer Standardization Society (MSS) standards and manufacturer’s published load rating.
3. Coordinate hanger support installation to group piping of all trades.
4. Hang pipe from building members using either concrete inserts for concrete construction or beam clamps for steel construction. Installation shall comply with manufacturer’s installation instructions. Expansion type inserts may be used for branch piping.
5. Restraining clips/clamps are required in locations where vibration may be a concern. Refer to Section 23 0550 – Vibration Isolation, for additional information regarding restraining clips/clamps.
6. Suspend hangers by means of electroplated zinc or hot-dipped galvanized finish hanger rods. Perforated band iron and flat wire straps (strap iron) are not allowed.
7. Mains parallel to joists shall not be supported from a single joist. Mains parallel to joists shall be supported by trapeze hanger and be positioned equally between two joists. Trapeze hangers shall be positioned to load joists at panel points only.
8. Support pipe from top flange of beams.
9. Where joists are used, locations of pipe supports shall be approved by the structural engineer prior to installation.
10. Do not support equipment or piping from metal roof deck.

3.04 CLEANING

A. Clean systems after installation is complete.

B. Clean piping both internally and externally to remove dirt, plaster dust, or other foreign materials. When external surfaces of piping are rusted, clean and restore surface to original condition. Replacement of heavily soiled and deteriorated materials shall be done at the Contractor’s expense.

C. Clean equipment as recommended by manufacturers. Thoroughly clean equipment of stains, paint spots, dirt, dust, and any other foreign materials. Remove temporary labels not used for instruction or operation.

3.05 TESTING

A. Refer to testing paragraph of Section 20 0000 – General Mechanical Requirements.

B. Coordinate fire pump test with Division 26 and Division 28 contractors.

C. Perform all NFPA required acceptance tests.

D. Test sprinkler system as entire system or partial system. System shall be hydrostatically tested at not less than 200 psi or 50 psi above static pressure in excess of 150 psi for 2 h. No leakage allowed. Replace defective joints with new materials. No caulking of defective joints allowed. Re-test system after defective joints are replaced, until satisfactory results are obtained.

E. Pipe shall not be concealed until satisfactorily pressure tested.

F. Conduct drain test. Record static pressure and residual pressure per NFPA 13.

G. Owner’s representative or engineer may witness tests. Contractor shall notify Owner and Engineer a minimum of 3 days in advance to allow for participation.

H. Log of tests shall be kept at job site and shall identify:
   1. Who performed test
   2. Time of test
   3. Date of test
   4. Section of system tested
   5. Results of test
   6. Completed Contractor's Material and Test Certification form(s) from NFPA 13

I. Operate flow switches to test that signals are transmitted to Fire Alarm Control Panel.

END OF SECTION

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SECTION 22 0000
GENERAL PLUMBING REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specification requirements defined in Division 20 of this Specification apply to and are in addition to the work associated with equipment, systems, materials, and installation requirements specified in Division 22. Contractor shall provide the requirements specified in Division 20 to obtain complete systems, tested, adjusted, and ready for operation.

1.02 RELATED WORK

A. Section 20 0000 - General Mechanical Requirements

B. Section 20 0529 - Piping and Equipment Supporting Devices

C. Section 20 0553 - Mechanical Systems Identification

D. Section 20 0573 - Mechanical Systems Firestopping

E. Section 20 0700 - Mechanical Systems Insulation

PART 2 PRODUCTS

2.01 NOT APPLICABLE TO THIS SECTION.

PART 3 EXECUTION

3.01 NOT APPLICABLE TO THIS SECTION.

END OF SECTION

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SECTION 22 0594
DOMESTIC WATER SYSTEMS BALANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 22 1118 – Water Distribution System

B. Section 22 2114 – Plumbing Specialties

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Plumbing Contractor shall be responsible for providing complete testing and balancing work of liquid fluid handling systems, such as domestic hot water return, laboratory hot water return, water mixing valves, and other processes included in this Project.

B. Work required shall consist of setting volume flow rates and adjusting speed controls, recording data, making tests, and preparing reports as specified herein.

C. Scope of work includes new work specified herein and includes all equipment, distribution systems, and terminal units connected.

D. Scope of work also includes existing liquid fluid handling systems as defined by drawings and/or schedules.

E. Procedures shall be in accordance with the latest edition of AABC or NEBB and as per detailed herein.

F. TAB work shall be performed by persons trained in TAB work and certified by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). Contractors who are members of AABC or NEBB and who have qualified personnel available to perform work may submit Quality Assurance Submittal for approval.

G. Contractors who are members of AABC or NEBB and who have qualified personnel available to perform Work may submit Quality Assurance Submittal for approval. Contractors who cannot meet these requirements shall subcontract with independent TAB Contractor. TAB subcontractor shall prepare Quality Assurance Submittal for Contractor who will submit it for approval.

H. Upon direction of Architect/Engineer or TAB subcontractor, Contractor shall provide (at no additional cost to Owner) any additional work and/or devices necessary to properly balance the system, including calibrated balancing valves, gauge tappings, flow sensors, and thermometer wells. Contractor shall be responsible for trimming and balancing pump impellers as necessary to obtain design pump flow rates at minimum pressure differential.

I. TAB work shall not proceed until all assigned personnel have been approved by, Engineer via Quality Assurance Submittal. Coordinate each phase of TAB work with overall project schedule. Each phase of TAB work shall be done in timely manner as detailed herein. Fieldwork must be complete before occupancy. Certificate of Substantial Completion shall not be issued until after Final Report is accepted by Engineer.

1.04 SUBMITTALS

A. General:

1. Make submittals in accordance with Section 01 3300 – Submittals. Submit minimum of 5 copies of all submittals unless otherwise directed.
2. Reports shall be assembled using a 3-ring hard cover binder with Project Name and location on the cover and the side panel. Information sheets shall be 8-1/2” x 11” white bond paper. Use pre-printed forms of NEBB or AABC wherever possible. Assemble report in the following order.
   a. Transmittal letter

b. Cover sheet with Project title, location, submittal date, and names and addresses of Owner, Contractor, TAB subcontractor, Architect, and Engineer
c. Index of numbered tabs listing major systems
d. Data organized by system in the following order:
1). Equipment data and measurement summary
2). Equipment measurement data
3). Branch main measurement data
4). Terminal device measurement data
e. Provide numbered tabs for each system.

B. Quality Assurance Submittal:
1. Within 30 days of signing Contract, Contractor shall submit the following information:
a. Firm resume
1). AABC or NEBB active membership required
2). Names of 3 recent relevant completed projects along with the project address, Owner's contact person, supervising design professional.
b. Supervisor resume
c. Balance technician(s) resume
2. Architect/Engineer and Owner reserve the right to contact previous project representatives and to reject persons whom Architect/Engineer and/or Owner feel are not qualified for this Project due to lack of relevant experience or problems on previous projects.

C. Planning Report:
1. Submit Planning Report as detailed in Part 3-EXECUTION of this Section to demonstrate to Engineer and Owner that proper procedures are being followed. Planning Report shall be submitted after Quality Assurance submittal and 30 days before fieldwork starts.

D. Initial Test Report:
1. Prior to starting Final Balance Phase, submit Initial Test Report as detailed in Part 3 of this Section to indicate to A/E and Contractor incomplete work or problem areas to be resolved before final balance is completed.

E. Final Report:
1. Within 30 days after fieldwork is completed, submit Final Report as detailed in Part 3 of this Section to assure design objectives are met and to assist Owner in future maintenance.

1.05 REFERENCE STANDARDS

A. Refer to the latest publications of the NEBB, the American Society of Plumbing Engineers (ASPE) and the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) for establishing required procedures.

PART 2 PRODUCTS

2.01 INSTRUMENTATION

A. Provide required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements shall be in accordance with requirements of NEBB or AABC Standards and instrument manufacturer's specifications.

B. Instruments used for measurements shall be accurate, and calibration histories for each instrument shall be available for examination by Architect/Engineer upon request. Calibration and maintenance of all instruments to be in accordance with requirements of NEBB or AABC Standards.

PART 3 EXECUTION

3.01 GENERAL

A. TAB work shall be done in separate phases as outlined herein. Project schedule shall allow ample time to complete TAB work before occupancy. Follow procedures outlined herein and as described in Planning Phase narratives.

B. Set point for individual branch balancing valves in domestic hot water return systems shall be 0.5 gpm unless otherwise noted on drawings or schedules.

3.02 PLANNING PHASE

A. Procedure:
1. Obtain latest contract documents including addenda and change orders. Obtain shop drawings and performance curves from Contractor for pumps, flow measuring devices, and terminal devices. Prepare Planning Report as detailed herein. Make adjustments in Planning Report and/or measuring instrument calibration.

B. Planning Report:
1. Planning Report shall contain the following minimum requirements.
   a. Narratives:
      1). Provide written narratives of procedures used. Provide separate narratives for each pump and liquid fluid handling system.
      2). Identify flow-measuring devices to be used at each pump and terminal device. Provide different narratives for constant and variable flow systems.
      3). For non-standard water systems, include narratives on how to measure and adjust for different viscosities.
      4). Narratives shall include references to published standards of NEBB or AABC. Narratives shall include measuring instruments to be used and ranges required for each procedure. Narratives shall include specified adjustment tolerances. For this Project, minimum acceptable is ± 10% of design flow.
   b. Prebalance Checklist: include, but not limited to:
      1). Check for completeness or work
      2). System cleaning
      3). System fill and air venting
      4). Place system into operation
      5). Check expansion tanks and fill pressures
      6). Pump bearings, alignment, starters, vibration isolators, rotation
      7). Setting valves to proper position including shutoff and bypass valves
      8). Set up of controls and control devices
   c. Measuring Instrument List: list measuring instruments to be used for each procedure. Indicate ranges required for each procedure. Provide data on each measuring instrument to be used. This data shall include:
      1). Manufacturer name and model number
      2). Measurement range
      3). Pressure/temperature limits
      4). Date put into service
      5). Date of last calibration
      6). Include certificate from calibration firm
2. Architect/Engineer reserves the right to request adjustments in any procedure and/or ask for recalibration of any measuring instrument, which has not been recalibrated within the past year.
3. Samples: Submit copies of TAB forms to be used.
4. Branch circuit and terminal measurements: indicate on pre-printed forms of AABC or NEBB measurements to be taken in the field. Include branch circuit or terminal identification, system, space served, location, design flows (include zone and system summaries), and flow measuring device size, type, Cv, and manufacturer. Indicate initial setpoint on forms.

3.03 SET-UP PHASE

A. Procedure:
   1. Perform prebalance checkout as per Planning Phase narrative.

B. Initial Test:
   1. Measure pump data and flows in "as found" condition after initial valve settings are made.

C. Initial Test Report:
   1. Submit report to Architect/Engineer and Contractor indicating measurements made and make notes of items, which are not complete or are not within design tolerance.

3.04 FINAL BALANCE PHASE

A. Procedure:
   1. Perform procedures as per Planning Phase narrative. Correct deficiencies and redo procedures as required before submitting Final Report.

B. Final Report:
   1. Submit report to Engineer and to Contractor indicating data and measurements as per requirements herein and per Planning Phase narrative. Do not submit partial or incomplete reports.

C. Final Report Adjustments:
   1. Architect/Engineer reserves the right to check any measurement made and to reject any portion of work not within the design tolerance of ± 10% of design flow. Contractor shall resubmit all or portions of Final Report as directed by Engineer.

END OF SECTION

SECTION 22 1118
WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section covers interior domestic cold water, domestic hot water (120°F), domestic hot water return and tempered water to a point 5 ft outside building wall.

B. All components shall comply with NSF-61 and NSF-372 to be compliant with requirement for lead content of ≤0.25% maximum weighted average.

1.02 RELATED WORK

A. Section 20 0529 - Piping and Equipment Supporting Devices

B. Section 20 0553 - Mechanical Systems Identification

C. Section 20 0700 - Mechanical Systems Insulation

D. Section 22 0594 - Domestic Water Systems Balance

1.03 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.04 QUALITY ASSURANCE

A. Order pipe with each length marked with manufacturer's name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier's name.

B. Installed material not meeting specification requirements must be replaced with material that meets these Specifications without additional cost to Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to ensure material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

E. Before shipping, piping shall be cleaned, free of rust and scale, and chemically treated to protect inside of pipe from rusting and furnished with end caps.

1.06 SUBMITTALS

A. Manufacturer's technical data for the following:
1. Pipe
2. Fittings
3. Joints
4. Valves
5. Unions and Flanges
6. Dielectric fittings
7. Water hammer arrestors

B. Shop Drawings on items specified herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials as specified shall be new unless otherwise noted.

B. Materials shall be provided from list of approved manufacturers. Home Market, Generic Broker, or Wholesaler's house brands are not acceptable.

2.02 PIPE, FITTINGS, AND JOINTS

A. Above Ground:
   1. Copper (2-1/2" and Smaller):
      a. Pipe: Copper tube, Type L, hard drawn, ASTM B88
      b. Fittings:
         1). Cast copper alloy, solder joint, pressure rated, ANSI B16.18
         2). Wrought copper, solder joint, pressure rated, ANSI B16.22
         3). [Copper, press fit joint, EPDM O-ring, ANSI B16.51, 0° - 250°F, maximum 200 psig. Propress by Viega, ApolloPress by Apollo Flow Controls or Pressystem by Nibco.]
      c. Joints:
         1). Lead free (<0.2%) solder, ASTM B32, flux, ASTM B813
         2). [Press fit joint, EPDM O-ring, made with electro-hydraulic crimping tool and jaw correct for pipe size.]
      d. Nipples: Red brass pipe, threaded
      e. Exposed tubing and fittings in kitchen and areas subject to chemical cleaning shall have chrome plated finish.

2.03 UNIONS AND FLANGES

A. General:
   1. Unions, flanges, and gasket materials to have pressure rating of not less than 150 psig at 180°F.

B. Copper (3" and Smaller):
   1. Wrought copper union, Nibco Figure 633-W. Mueller Brass equal.

2.04 VALVES

A. Shutoff Valves:
   1. Ball Valves (2" and smaller):
      a. Acceptable manufacturers: Apollo, Hammond, Milwaukee, Nibco, Stockham and Watts with indicated features and equal to model listed. Note that not all manufacturers make all sizes.
      b. Full Port, 2 Piece: Bronze body, ASTM B584, stainless steel ball and stem, teflon seats, stem extension with length according to installed system insulation thickness, 600 psi CWP pressure rating, Apollo Series 77CLF-240-01
      c. Full Port, 3 Piece: Bronze body, ASTM B584, stainless steel ball and stem, teflon seats, stem extension with length according to installed system insulation thickness, 600 psi CWP pressure rating, Apollo Series 82LF-240
      d. Insulated Handle: For insulated systems to prevent condensation on valve body with thermal and vapor seal, equal to Apollo Therma Seal.

B. Balancing Valves:
   1. Circuit Setter:
      a. Acceptable Manufacturers: Bell and Gossett, Watts or approved equal
      b. 2" and Smaller: Shall be of lead-free bronze construction with glass and carbon-filled TFE seat rings and have differential pressure read-out ports across valve seat area. Read-out ports to be filled with internal EPT insert and better connection with check valve. Valve bodies to have 1/4" NPT tapped drain/purge port. Valves to have memory stop feature and calibrated nameplate to assure specific valve setting.

Valve to be leak-tight at full-rated working pressure and temperature (300 psi/250°F). B&G Circuit Setter Model C, Watts LFCSM-61-S, or approved equal.

2.05 DIELECTRIC FITTINGS

A. Insulating nipple, metal casing, inert thermoplastic lining; Anvil Figure 7090, Clearflow dielectric fitting by Perfection Corporation or Victaulic Style 47.

B. Dielectric unions 2” and smaller; dielectric flanges 2-1/2” and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, and pressure rating of not less than 175 psig at 180°F. Watts Regulator Company, Lochinvar, Wilkins or Epco Sales, Inc.

C. Copper-silicon casting, UNS C87850, threaded or grooved end. UL classified in accordance with NSF-61 for potable water service. Victaulic Style 647

2.06 WATER HAMMER ARRESTORS

A. Mechanical Water Hammer Arrestors:
   1. Piston-compressed air column type, with sealed air chamber.
   2. Manufacturers: Watts, Sioux-Chief, and Precision Plumbing Products (PPP), Inc., equal to size shown. Provide access panels when mechanical shockstops are installed in non-accessible concealed locations.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations, and recognized industry practices.

B. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.

C. Include connections to plumbing fixtures, to equipment by others, and to equipment requiring water. Provide proper backflow and back siphonage protection to safeguard potable water system from contamination.

D. Lay out water system so as to conform to intent of drawings. Coordinate piping with building features and work of other trades. Install water piping plumb and square with building. Plans indicate, general routing, provide additional offsets as required. Install piping with necessary swing joints and offsets to allow for expansion.

E. Install shut-off valves on branch lines near mains to avoid long dead-leg branches when valves are closed.

F. Install shut-off valves where indicated and at base of risers to allow isolation of portions of system for repair.

G. Do not install water piping within exterior walls.

H. Provide protective sleeve covering of elastomeric pipe insulation where copper or steel piping is embedded in masonry or concrete.

I. Provide dielectric fittings between dissimilar piping materials.

J. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.

K. Install valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to equipment, fixtures and systems installed by others where same requires piping services indicated in this Section.

L. Install water pipe using proper pipe and fittings. Use reducing fittings for changes in pipe size.

3.02 COPPER TUBING

A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.

B. Soldered Copper Joints:
   1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
   2. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
   4. Apply heat carefully to prevent damage to pipe, fittings, and valves.
   5. Follow manufacturer's recommendations when heating valves and equipment for soldered connections.

C. Brazed Copper Joints:
   1. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
   2. Joints shall be cleaned and polished before brazing.
   3. Flux of any type shall not be used.
   4. Apply heat carefully to prevent damage to pipe, fittings, and valves. Disassemble valves where possible to prevent damage to seats during brazing.

D. Grooved Copper Joints:
   1. All grooved end piping products shall be supplied by single manufacturer. Grooving tools shall be supplied by same manufacturer as grooved fittings and components.
   2. Install rolled groove copper pipe and fittings using equipment specifically for copper tube by mechanical coupling manufacturer.
   3. Use only those couplings and gaskets so designated for copper tube.
      a. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified.
      b. Gaskets shall be supplied by the grooved coupling manufacturer.
   4. Flaring of tube and fitting ends to IPS dimensions is not permitted.
   5. Grooved end shall be clean and free from indentations, projections, and roll marks in area from pipe end to groove for proper gasket sealing.
   6. Factory-trained field representative shall provide on-site training for contractor’s field personnel in proper use of grooving tools, application of groove, and installation of grooved piping products. Factory trained representative shall periodically review product installation. Contractor shall remove and replace any improperly installed products.

3.03 WATER HAMMER ARRESTORS

A. Use water hammer arrestors to control water hammer. Installed devices shall be sized and located according to manufacturer's recommendations, PDI Standards, or as shown on drawings.

B. Use water hammer arrestors with flush valves and quick-closing valves. Provide access panels when water hammer arrestors are installed in non-accessible concealed locations.

3.04 DIELECTRIC UNIONS AND FLANGES

A. Install dielectric unions or flanges at points where copper-to-steel pipe connection is required in domestic water systems.

B. Install unions on equipment side of shutoff valves for items such as: water heaters, water softeners, pumps, filters, and similar equipment requiring periodic replacement.

3.05 CLEANING

A. Flush and clean piping prior to testing. Remove corrosion by mechanical or chemical means. Use chemicals that are non-toxic.

3.06 TESTING

A. Refer to Testing paragraph of Section 20 0000 - General Mechanical Requirements.

B. Water test system may be applied to system in its entirety or in sections. Test piping with water to pressure of 100 psi for 2 h. No decrease in pressure allowed. Provide pressure gauge with shutoff and bleeder valve at highest point of system tested. Inspect joints in system under test.

C. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

D. Do not conceal pipe until satisfactorily tested.

E. Testing with air will not be allowed.

3.07 BALANCING

A. Balance water distribution system. Adjust control valves for proper operation. Set balancing valves to maintain hot water in hot water system.

B. Balance flush valves, flow control valves and mixing valves for adequate flow and temperature to plumbing fixtures and equipment.

3.08 DISINFECTION

A. Disinfect water piping in the following manner:
   1. Clean and flush water pipe with water until water at remote tap is clear.
   2. Fill water systems with solution containing 50 ppm of chlorine (minimum concentration). Allow solution to stay in water system for 24 h. Alternately use solution of 200 ppm of chlorine (minimum concentration) for 3 h.
   3. Flush water system of chlorine solution.
   4. Allow clean water to stand in system for 24 h. Take sample from remote tap for bacteriological test.

B. Do not use water system for potable water supply until safe bacteriological test is obtained. Repeat steps 1 through 4 until safe water system is obtained.

3.09 BACTERIOLOGICAL TESTS

A. Take representative water samples and test to ensure bacteriologically safe water supply system. Include HPC (Heterotrophic Plate Count) test and test for presence of Pseudomonas aeruginosa as well as regular coliform bacteria test. HPC test maximum containment level of 500 organisms/ml. Perform bacteriological tests shortly before Owner's acceptance of building. If tests fail, make corrections and retest.

B. When connecting to existing water supply of unknown quality, sample for analysis and comparison with finished water system analysis shall be taken prior to making new connection. This will allow isolating source of contamination from within scope of work or pre-existing water supply. Final conditions shall meet criteria specified above for areas within scope of work.

END OF SECTION

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SECTION 22 1314
SANITARY WASTE AND STORM DRAINAGE SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section includes materials and methods for sanitary waste and vent piping systems within and including piping to 5 ft outside building wall.

1.02 RELATED WORK

A. Section 20 0529 - Piping and Equipment Supporting Devices

B. Section 20 0700 - Mechanical Systems Insulation

C. Section 22 4000 - Plumbing Fixtures

1.03 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.04 QUALITY ASSURANCE

A. Order piping with each length marked with manufacturer's name or trademark and type of pipe; with each shipping unit marked with purchase order number, metal or alloy designation, temper, size, and supplier's name.

B. Installed material not meeting specification requirements must be replaced with material that meets these specifications without additional cost to Owner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure material is undamaged and complies with Specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends from damage. End caps shall remain in place. Protect fittings by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve Contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.06 SUBMITTALS

A. Manufacturer's technical data for the following:
   1. Pipe and fittings
   2. Joints
   3. Cleanouts
   4. Air gap fittings
   5. Traps

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials herein specified shall be new, unless otherwise noted.

2.02 PIPE, FITTINGS, AND JOINTS

A. Interior Underground 15” and Smaller:
   1. Cast Iron:
      a. Pipe: Hub and spigot pipe, service weight, ASTM A74, NSF certified with material test reports marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer
      b. Fittings: Hub and spigot fittings, service weight, ASTM A74, NSF certified with material test reports marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer

c. Joints: Neoprene rubber compression gaskets, ASTM C564

2. Polyvinyl Chloride (PVC):
   a. Pipe:
      1). Schedule 40, Class 12454 (PVC 1120), ASTM D1785
   b. Fittings: Socket fitting, DWV patterns, ASTM D3311. Fabricated fittings 10” and larger shall be per ASTM F1866.
   c. Joints: Primer, low VOC, ASTM F656; solvent cement, low VOC, ASTM D2564

B. Interior Above Ground:
1. Cast Iron:
   a. Pipe: Hubless cast iron pipe, ASTM A-888, CISPI 301, NSF certified with material test reports marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer
   b. Fittings: Hubless cast iron fittings, ASTM A-888, CISPI 301, NSF certified with material test reports marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer
   c. Joints: Heavyweight no-hub couplings with stainless steel clamps, FM 1680 Class 1, ASTM C-1540, Mission Heavyweight, Husky Series 4000, Ideal Tridon “HD”, or Clamp-All Hi-Torq 125
2. Cast Iron
   a. Pipe: Hub and spigot pipe, service weight, ASTM A74, NSF certified with material test reports marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer
   b. Fittings: Hub and spigot fittings, service weight, ASTM A74, NSF certified with material test reports marked with collective trademark of Cast Iron Soil Pipe Institute or receive prior approval by Engineer
   c. Joints: Neoprene rubber compression gaskets, ASTM C564
3. Polyvinyl Chloride (PVC):
   a. Pipe: Schedule 40, Class 12454 (PVC 1120), ASTM D1785
   b. Fittings: Drain, waste, and vent (DWV) pattern fittings, ASTM D2665; socket fitting patterns, ASTM D3311. Fabricated fittings 10” and larger shall be per ASTM F1866.
   c. Joints: Primer, low VOC, ASTM F656; solvent cement, low VOC, ASTM D2564

C. Adapter Couplings for Joining Dissimilar Pipe Materials:
1. Acceptable Manufacturers: Fernco, Mission
2. 1” through 6” diameter: Fernco Proflex 3000 Series shielded coupling with neoprene gasket, stainless steel shield, and stainless steel clamping bands. Adapter couplings shall be specifically designed for pipe materials being joined.

2.03 CLEANOUTS

A. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to number listed in Drains and Cleanout Schedule.

B. Provide recessed, solid brass, cleanout plugs where fittings are used as cleanouts. Provide taper-thread plug with Teflon tape thread wrap.

C. Floor Cleanouts: Cleanout with cast iron ferrule, adjustable top, nickel-bronze scoriated cover and frame, bronze taper-thread plug, equal to J.R. Smith 4033L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4033L-F-C.

D. Floor Cleanouts, Carpeted Areas: Cleanout with cast iron ferrule, adjustable round top, nickel-bronze scoriated cover and frame, bronze taper-thread plug, and small stainless steel carpet marker, equal to J.R. Smith 4033L-Y. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4033L-F-C-Y.

E. Floor Cleanouts, Tiled Areas: Cleanout with cast iron ferrule, adjustable square tile top, nickel-bronze scoriated cover and frame, and bronze taper-thread plug, equal to J.R. Smith 4053L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4053L-F-C.

F. Floor Cleanouts, Unfinished Floors and Areas Outside Building: Cleanout with cast iron ferrule, adjustable round top, scoriated cast iron tractor cover, and bronze taper-thread plug, equal to J.R. Smith 4239L. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4239L-F-C.

G. Floor Cleanouts, Areas with Heavy Traffic: Cleanout with cast iron ferrule, adjustable housing, heavy-duty ductile iron scoriated top, and brass taper-thread plug, equal to J.R. Smith 4233L-M. Provide flashing flange and clamp where cleanout is installed in elevated slabs, equal to J.R. Smith 4233L-M-F-C

H. Wall Cleanouts: Cleanout with cast iron counter sunk ferrule, bronze or brass taper-thread plug, secured stainless steel access cover, equal to J.R. Smith 4472T.

2.04 AIR GAP FITTINGS

A. Air gap fittings constructed of cast iron with integral air gap having free area of at least twice the inlet area. Josam, Mifab, Smith, Wade, Watts or Zurn, equal to J.R. Smith 3950 or 3951.

2.05 TRAPS

A. Same material as pipe or fittings unless specified with fixtures. Refer to Section 22 4000 - Plumbing Fixtures. Provide 17 ga. brass, chrome plated traps for exposed traps.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturer's recommendations, and recognized industry practices.

B. Connect piping to fixtures, each piece of equipment, and drains. Install required piping as shown on drawings.

C. Grade horizontal lines with minimum of 1/8” per ft, except piping 2” diameter or smaller which shall be run at 1/4” per ft slope.

D. Grade horizontal lines with minimum of 1/4” per ft, except piping 4” diameter or larger which may be run at 1/8” per ft slope with approval of local authority.

E. Install piping parallel with building lines and at heights, which do not obstruct any portion of window, doorway, stairway, or passageway, except, as may be shown on plans. Install overhead piping as high as possible.

F. Grade vent pipe for complete drainage by gravity to soil or waste pipes. Vent terminations shall be set true and level. Locate vent piping at least 10 ft away from window, door, or intake openings. Coordinate closely with roofing contractor to prevent damage to roofing membrane. Flashing shall be in accordance with requirements of roofing manufacturer.

G. Where interferences develop, offset, or reroute piping as required to clear interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit, and equipment of other trades to allow sufficient clearances. Consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

H. Provide protective sleeve covering of elastomeric pipe insulation, where piping and/or fittings are embedded in masonry or concrete.

I. Maintain piping in clean condition internally during construction.

J. Mitered ells, notched tees, and orange peel reducers are not allowed. Bushings are not allowed on threaded piping.

K. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including required service space for this equipment, unless piping is serving this equipment.

L. Set cleanouts true and level and protect properly throughout construction.

M. Trap each fixture and piece of equipment requiring sanitary drainage connections. Trap seals shall be standard depth, except when deep seals are required by code. Traps shall be set true and level and located within limits of code requirements. Traps shall not be used as separator, interceptor, or other type of device to retain solids. Traps shall be provided with thread type approved cleanout plugs when specified. Protect traps during construction and seal off to prevent stones, debris, and other foreign matter from entering before use. Locate running traps for full accessibility with double cleanout.

N. Provide plugs or caps for pipe openings during construction to prevent debris from entering pipe. Temporary plug shall be plastic cap or equivalent.

3.02 UNDERGROUND WARNING TAPE

A. Provide warning tape for exterior buried sewers per Section 20 0553.

3.03 POLYVINYL CHLORIDE (PVC) PIPE

A. Pipe Joints :

1. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints with PVC pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if fitted with wheels designed for use with PVC pipe that do not leave raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Check dry fit of pipe and fittings. Reject materials, which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.
2. Maintain pipe, fittings, primer, and cement between 40°F and 100°F during application and curing. Apply primer and solvent using separate daubers (3” and smaller piping only) or clean natural bristle brushes about 1/2 size of pipe diameter. Apply primer to fitting socket and pipe surface with scrubbing motion. Check for penetration and reapply as needed to dissolve surface to depth of 4-5 thousandths. Apply solvent cement to fitting socket and pipe in amount greater than needed to fill gap. While both surfaces are wet, insert pipe into socket fitting with quarter turn to bottom of socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4” and larger. Hold joint for 30 seconds or until set, whichever is longer. Reference manufacturer's recommendations for initial set time before handling and for full curing time before pressure testing.

B. Install plastic pipe and fittings as recommended by manufacturer. Include adequate offsets or expansion joints to allow for pipe expansion.

C. Do not install plastic pipe in plenum space.

3.04 CAST IRON PIPE

A. No-hub Piping: Place gasket on end of one pipe of fitting and clamp assembly on end of other pipe or fitting. Firmly seat pipe or fittings ends against integrally molded shoulder inside neoprene gasket. Slide clamp assembly into position over gasket. Tighten fasteners to manufacturer's recommended torque.

B. Hub and Spigot Piping: Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Insure pipe is supported off ground so lubricant does not pick up dirt. Push spigot end into end of gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

C. Install cast iron pipe and fittings as recommended by CISPI in their publication "Installation of Cast Iron Soil Pipe and Fittings".

D. Support piping at every coupling. Locate hanger within 18” of coupling.

E. Installations with multiple joints within a 4 ft developed length shall be supported at every second joint.

F. Secure base of risers with thrust restraints to prevent joint separation. Restraint shall be in accordance with CISPI recommendations.

G. Brace horizontal piping 5” and larger to prevent horizontal movement. Install bracing at every branch connection and every change of direction in accordance with CISPI recommendations.

3.05 TESTING

A. Refer to Testing paragraph of Section 20 0000 - General Mechanical Requirements.

B. Gravity Systems:
1. Water test may be applied to system either in its entirety or in sections. Piping shall be tightly plugged and submitted to 10 ft head of water located at highest point. Provide separate standpipe above highest point being tested or extend system to obtain required 10 ft head of water. Head shall be maintained for at least 30 minutes before inspection starts.

C. Pressurized Systems:
1. Water test system may be applied to system in its entirety or in sections. Test piping with water to pressure of 50 psi for 2 h. No decrease in pressure allowed. Provide pressure gauge with shutoff and bleeder valve at highest point of system tested. Inspect joints in system under test.

D. Defective work or material shall be replaced or repaired as necessary and inspection and test repeated. Repairs shall be made with new materials. No caulking of threaded joints or holes will be allowed.

E. Do not backfill pipe until successfully tested.

F. Testing with air will not be allowed.

END OF SECTION

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SECTION 22 4000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section lists plumbing fixtures and accessories including method of installation.

1.02 RELATED WORK

A. Section 22 1118 - Water Distribution System

B. Section 22 1314 - Sanitary Waste and Storm Drainage Systems

1.03 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.04 SUBMITTALS

A. One package of manufacturer's technical data for all items. Submittal shall be assembled brochure, showing cuts and full detailed descriptions for each item.

B. Shop drawings on items specified herein.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials as specified shall be new unless otherwise noted.

B. Insulation for traps and supplies shall be molded closed cell vinyl insulation and shall meet ASTM E84 for flame and smoke spread. Insulation shall be vandal resistant and be color as listed.

2.02 MANUFACTURERS

A. Plumbing fixtures shall be provided from list of approved manufacturers. Home Market, Generic Broker, or Wholesaler’s house brands are not acceptable.

B. Manual Faucets: Chicago Faucet, T and S Brass, or Zurn equal to number listed

C. Manual Faucets: Chicago Faucet, Delta HDF, Kohler or Moen Commercial, equal to number listed

D. Fixture Traps: Engineered Brass Company, Kohler, McGuire, or Zurn equal to number listed

E. Insulated Traps and Supplies: McGuire or True-Bro equal to model listed

F. Supplies and Stops: Chicago Faucet, Kohler, McGuire or Zurn equal to number listed

G. Supplies and Stops: Brasscraft, Engineered Brass Company, Kohler, LSP Aqua-Flo or McGuire equal to number listed

2.03 TRAPS

H. Sinks: P-traps shall be chrome plated brass body with cleanout plug, 17 ga. seamless tubular wall bend, cast brass slip nuts and wall escutcheon. Trap size to match fixture connections.

2.04 STOPS AND SUPPLIES

I. Sinks: Angle pattern, lock shield cap, loose key handle, copper alloy control valve body, stem, and gland nut, 1/2” NPT inlet x 1/2” compression outlet, McGuire LF2167LK

2.05 PROTECTIVE PIPE INSULATION COVERS

A. Manufactured plastic wraps for covering plumbing fixture hot and cold water supplies, trap and tailpieces shall comply with Americans with Disabilities Act (ADA) requirements.

B. Lavatories: Offset strainer, p-trap and angle stop and supply insulation cover, white, True-Bro Lav Guard 2

2.06 PLUMBING FIXTURES

A. Refer to schedule on drawings for detailed fixture selection criteria not contained herein.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing fixtures as recommended by manufacturer. Caulk around fixtures mounted on irregular surfaces such as tile or stone with silicone sealant, same color as fixture.

B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.

C. Install barrier free fixtures in compliance with local code and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27” above finished floor to avoid contact by wheelchair users.

D. Return fixture waste and supply piping into wall as high as practical under fixture. Provide accessible shutoff in fixture supply. Protect "barrier free" supply and drain piping with white colored wrap neatly trimmed to prevent contact with hot or sharp surfaces by user.

E. Provide individual supplies to fixtures and rough-in fixture piping with adequate support to prevent movement fore, aft, and laterally. Provide additional blocking as required.

3.02 PROTECTION

A. Protect finished surfaces of fixtures from accidental damage or discoloration by use of protective covering.

3.03 CLEANING

A. Prior to Owner acceptance, clean fixtures with compounds recommended by manufacturer and remove stains and marks from surrounding walls and countertops.

END OF SECTION

SECTION 22 6114
LABORATORY COMPRESSED AIR SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section covers piping and equipment required to provide laboratory grade compressed air as shown on plans and details.

1.02 RELATED WORK

A. Section 20 0529 - Piping and Equipment Supporting Devices

1.03 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

B. Items listed as “Cleaned for Oxygen Service” shall comply with requirements of CGA Standard G-4.1, Cleaning Equipment for Oxygen Service.

1.04 SUBMITTALS

A. Shop drawings on items specified herein.

1.05 PRODUCT DELIVERY

A. Deliver pipe and equipment properly packaged to protect against shipping and handling damage.

B. Installed pipe shall be sealed during construction to prevent construction debris from entering piping system.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials herein specified shall be new unless otherwise noted.

2.02 PIPE AND FITTINGS

A. Above Ground
   1. Copper
      a. Pipe:
         1) Copper tube, Type L hard temper, cleaned and capped, ASTM B280, marked "ACR" or similar in accordance with ASTM
         2) Copper tube, Type L hard temper, cleaned and capped, ASTM B819, marked "MED" or similar in accordance with ASTM
      b. Fittings: Wrought copper, solder joint, pressure rated, cleaned, and bagged, ANSI B16.22
      c. Joints: Brazed, silver solder, BCu-3 or BCuP-5 type, AWS A5.8, 1250ºF melting point minimum.

2.03 UNIONS

B. Copper 3” and smaller:
   1. Wrought copper union, Nibco 633-W

2.04 VALVES

A. Ball Valves:
   1. Acceptable manufacturers: Apollo, Nibco, Watts
   2. 3” and Smaller:
      a. Full port, 3-piece, bronze body, stainless steel ball, PTFE seats, stainless steel trim, blow-out proof stem, 6” tube extension, oxygen cleaned and bagged, quarter turn handle, 600 psi CWP; Apollo 82 240 Special Female through 2”

2.05 PRESSURE REGULATORS

A. Manufacturers: Cashco, Fisher, Jordan or approved equal

B. Bronze body and spring case, direct acting valve, manual adjustment screw with top nut, stainless steel trim, resilient valve seat, cleaned for oxygen service. Refer to schedule on drawings for performance criteria.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install compressed air piping as shown on drawings and details.

B. Provide low point drain valve at bottom of risers. Pipe mains shall not be trapped between connection at riser and last branch take-off. Branch take-offs to rooms or individual spaces shall be from top of main.

C. Cut copper tube square and ream before assembly. Keep piping capped during construction to prevent intrusion of construction debris.

D. Support piping drops through finished ceiling from structure above to prevent any lateral or up/down movement. Other outlet drops shall be supported from walls, columns, or workbenches using appropriate hangers, anchors, or Unistrut.

E. Install temporary plugs and caps on openings during construction phase.

3.02 COPPER TUBING

A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.

B. Brazed Copper Joints:

1. Brazed joints shall be ASTM Grade 4 or 5 and have melting point at approximately 1250ºF. Solder impurities shall not exceed 0.15%.
2. Tubing shall be delivered to site with original mill caps in place.
3. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
4. Joints shall be cleaned and polished before brazing.
5. Flux of any type shall not be used.
6. Apply heat carefully to prevent damage to pipe, fittings, and valves. Disassemble valves where possible to prevent damage to seats during brazing.
7. Purge tube with nitrogen during brazing procedure. Provide manual shut-off valve and check valve as required for purge gas.

3.03 TESTING

A. Refer to testing paragraph of Section 20 0000 - General Mechanical Requirements.

B. Air piping shall be tested at 150 psig for 2 h prior to connection of laboratory fixtures. Soap test each joint to detect leaks during test period. No loss of pressure allowed during test period. Defective joints shall be cut out and replaced. Air piping shall be re-tested at 100 psig for 8 h after final connection of laboratory fixtures.

C. Air compressor equipment shall be delivered pre-assembled and tested by equipment manufacturer.

D. Verify proper signal transmission for each condition specified to Building Automation Controller.

3.04 CLEANING

A. All pipe, fittings and valves will be cleaned by manufacturer. On- or off-site cleaning of any components by Contractor is not allowed. Any components, which have become contaminated, will not be used on any clean systems. They may be used in laboratory vacuum or any water system using copper pipe or fittings.

B. Before system is placed into use, flush piping with product air to remove foreign particles.

3.05 WARRANTY

A. Manufacturer shall warrant air compressor package and components complete, for period of 2 yrs. from date of start-up.

END OF SECTION

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SECTION 22 6214
LABORATORY VACUUM PIPING SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section covers piping and equipment required to provide laboratory vacuum to outlets.

1.02 RELATED WORK

A. Section 20 0529 - Piping and Equipment Supporting Devices

B. Section 22 2114 - Plumbing Specialties

1.03 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.04 SUBMITTALS

A. Shop Drawings on items specified herein

1.05 PRODUCT DELIVERY

A. Deliver pipe and equipment properly packaged to protect against shipping and handling damage.

B. Installed pipe shall be sealed during construction to prevent construction debris from entering piping system.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials as specified shall be new unless otherwise noted.

2.02 PIPE AND FITTINGS

A. Above Ground
   1. Copper
      a. Pipe: Copper tube, Type L, hard temper, ASTM Specification B88
      b. Fittings:
         1) Cast copper alloy, solder joint, pressure rated, ANSI B16.18
         2) Wrought copper or bronze, solder joint, pressure rated, ANSI B16.22
      c. Joints: Lead free (<0.2%) solder, Bridgit or Silvabrite, ASTM B32; flux, ASTM B813

2.03 FLANGES

A. Copper:
   1. Cast red brass, Alloy 844, ASTM B584, Class 150 (150 psig), Standard bolt pattern, ANSI Standard B16.24 with neoprene gasket

2.04 VALVES

A. Copper Piping Systems:
   1. Manufacturers: The following list of valve manufacturers is acceptable unless otherwise noted subject to providing valves equal to items specified: Nibco, Apollo and Watts
   2. Size 4” and Smaller:
      a. Ball Valves: Full port, 3-piece bronze body, quarter turn, stainless steel ball and stem, Teflon seats, blowout-proof stem, 600 psi CWP rated, screwed, or soldered joint. Apollo 82-140 Series or Apollo 92-240 Series

PART 3 EXECUTION

3.01 INSTALLATION

A. Install vacuum piping as shown on drawings and details.

B. Provide low point drain valve at bottom of risers. Pipe mains shall not be trapped between connection at riser and last branch take-off. Branch take-offs to rooms or individual spaces shall be from top of main.

C. Provide line size cleanout plug at end of corridor distribution mains for flushing out piping.

3.02 PIPING SYSTEMS

A. Piping for Laboratory Vacuum system shall be copper.

3.03 COPPER TUBING

A. Copper tubing shall be installed per Copper Development Association guidelines in addition to methods specified herein.

B. Soldered Copper Joints:

1. Use non-acidic and lead free flux on cleaned pipe and fittings for soldered joints.
2. Cut tube square, remove burrs from exterior of tube and ream interior of tube before assembly.
3. Fill joints with solder by capillary action. Solder shall cover joint periphery. Wipe joint clean.
4. Apply heat carefully to prevent damage to pipe, fittings, and valves.
5. Follow manufacturer's recommendations when heating valves and equipment for soldered connections.

3.04 CLEANING

A. Before system is in use, flush piping with dry compressed air to remove foreign particles.

3.05 TESTING

A. Refer to testing paragraph of Section 20 0000 - General Mechanical Requirements.

B. Vacuum piping shall be tested at 200 psi for 2 h prior to connection of laboratory fixtures. Soap test each joint to detect leaks during test period. No loss of pressure allowed during test period. Vacuum piping shall be re-tested at 100 psi for 8 h after final connection of laboratory fixtures.

C. Test plastic vacuum exhaust piping with air, maintaining pressure of 15 psi for 2 h with no loss in pressure allowed. Inspect all joints in system. Do not conceal any piping until satisfactorily tested. Defective joints shall be repaired and retested. Mercury column gauge shall be used to register air pressure.

END OF SECTION

SECTION 23 0000
GENERAL HVAC REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Specification requirements defined in Division 20 of this Specification apply to and are in addition to the work associated with equipment, systems, materials, and installation requirements specified in Division 23. Contractor shall provide the requirements specified in Division 20 to obtain complete systems, tested, adjusted, and ready for operation.

1.02 RELATED WORK

A. Section 20 0000 - General Mechanical Requirements

B. Section 20 0529 - Piping and Equipment Supporting Devices

C. Section 20 0553 - Mechanical Systems Identification

D. Section 20 0573 - Mechanical Systems Firestopping

E. Section 20 0700 - Mechanical Systems Insulation

PART 2 PRODUCTS

2.01 NOT APPLICABLE TO THIS SECTION.

PART 3 EXECUTION

3.01 NOT APPLICABLE TO THIS SECTION.

END OF SECTION

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SECTION 23 0594
WATER SYSTEMS TEST ADJUST BALANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 DESCRIPTION

A. This Contractor shall be responsible for providing complete testing, adjusting, and balancing (TAB) work of all HVAC hydronic systems including distribution systems and the equipment and apparatus connected.

B. Work required shall consist of setting volume (flow) and speed adjusting facilities provided or specified for systems, recording data, making tests, and preparing reports, as hereinafter specified.

C. TAB work shall be performed by separate, independent contractor who is certified by either National Environmental Balancing Bureau (NEBB), Associated Air Balance Council (AABC) or Testing, Adjusting and Balancing Bureau (TABB).

D. TAB work may be performed by Mechanical Contractor with prior written approval by Architect/Engineer.

E. Upon direction of Architect/Engineer or TAB Contractor, Mechanical Contractor shall provide at no additional cost to Owner, any additional work and/or devices necessary to properly balance system, including calibrated balancing valves, gauge tapings, flow sensors, and thermometer wells. Mechanical Contractor shall also be responsible for trimming and balancing pump impellers as necessary to obtain design pump flow rates, or maximum pump efficiency.

1.03 PROCEDURES

A. Unless otherwise specified, test, adjust and balance water systems including all equipment, apparatus, and distribution systems in accordance with the latest edition of NEBB, AABC or TABB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.

1.04 INSTRUMENTS

A. Instruments used for measurements shall be accurate, and calibration histories for each instrument shall be available for examination. Calibration and maintenance of instruments shall be in accordance with requirements of NEBB, AABC or TABB.

B. Application of instruments and accuracy of measurements shall be in accordance with NEBB, AABC, or TABB Standards.

1.05 REPORTS

A. Submit 5 certified copies of Final Reports on applicable NEBB, AABC or TABB Reporting Forms for approval. Provide sortable electronic version as well as hard copy.

B. Each individual Final Report Form submitted, shall bear name of person who recorded data and seal of supervisor of TAB Contractor.

C. Include identification of all types of instruments used and their latest dates of calibration with Final Reports.

D. Note any and all discrepancies in design flows on report forms.

E. Incomplete report forms will not be approved.

1.06 GUARANTEE

A. Guarantee that test, adjust and balance work be performed in accordance with standards and that water systems operate within plus or minus 10% of design flow rates as shown on plans and/or as scheduled.

PART 2 PRODUCTS

2.01 (NOT APPLICABLE TO THIS SECTION)

PART 3 EXECUTION

3.01 GENERAL

A. Test, adjust and balance water systems and associated components in accordance with procedures outlined in Standards.

B. Upon completion of TAB work, mark equipment settings, including valve indicators, and similar devices to indicate final settings in approved manner.

END OF SECTION

SECTION 23 0595
AIR SYSTEMS TEST ADJUST BALANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 DESCRIPTION

A. This Contractor shall be responsible for providing complete testing, adjusting, and balancing (TAB) work of all air systems including distribution systems and the equipment and apparatus connected.

B. Work required shall consist of setting volume (flow) and speed adjusting facilities provided or specified for the systems, recording data, making tests, and preparing reports, all as hereinafter specified.

C. TAB work shall be performed by separate, Independent Contractor who is certified by either National Environmental Balancing Bureau (NEBB), Associated Air Balance Council (AABC) or Testing, Adjusting and Balancing Bureau (TABB).

D. TAB work may be performed by Mechanical Contractor with prior written approval by Engineer.

E. Upon direction of Architect/Engineer or TAB Contractor, Mechanical Contractor shall provide at no additional cost to Owner, any additional work and/or devices necessary to properly balance system, including fan sheave, motor sheave and/or drive belts.

1.03 PROCEDURES

A. Unless otherwise specified, test, adjust and balance air systems including all equipment, apparatus, and distribution systems in accordance with the latest edition of NEBB, AABC, or TABB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.

1.04 INSTRUMENTS

A. Instruments used for measurements shall be accurate, and calibration histories for each instrument shall be available for examination. Calibration and maintenance of instruments shall be in accordance with requirements of NEBB, AABC, or TABB Standards.

B. Application of instruments and accuracy of measurements shall be in accordance with Standards.

1.05 REPORTS

A. Submit 5 certified copies of the Final Reports on applicable NEBB, AABC, or TABB Reporting Forms for approval. Provide sortable electronic version as well as hard copy.

B. Each individual Final Report Form submitted shall bear name of person who recorded data and seal of supervisor of TAB Contractor.

C. Include identification of all types of instruments used and their last dates of calibration with Final Reports.

D. Note any and all discrepancies in design flows on report forms.

E. Incomplete report forms will not be approved.

1.06 GUARANTEE

A. Guarantee that all test-adjust and balance work, be performed in accordance with NEBB Standards and that all air systems operate within plus or minus 10% of design flow rates as shown on plans and/or as scheduled.

PART 2 PRODUCTS

2.01 (NOT APPLICABLE TO THIS SECTION)

PART 3 EXECUTION

3.01 GENERAL

A. Test, adjust and balance all air systems and the associated components in accordance with procedures outlined in the Standards.

B. Upon completion of TAB work, mark equipment settings, including damper control positions, fan speed control levers, and similar devices to indicate final setting in approved manner.

C. Plug holes in insulation, ductwork, and housings with acceptable test plugs.

END OF SECTION

SECTION 23 2116
PIPE AND PIPE FITTINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 20 0573 – Mechanical Systems Firestopping

B. Section 23 0594 - Water Systems Test Adjust Balance

C. Section 23 2118 - Valves

D. Section 23 2120 - Piping Specialties

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Specification of an item in this or any other sections shall not relieve Contractor from providing all items, articles, materials, operations, methods, labor, equipment, and incidentals necessary for a complete and functional system.

B. Use only new material, free of defects, rust, and scale, and guarantee for services intended.

C. Use material meeting the latest revision of ASTM specifications as listed in this specification.

D. Follow local codes if they require other types of pipe or joints.

E. Use only long radius elbows having centerline radius of 1.5 pipe diameters unless otherwise indicated.

F. Manufacturer, pressure class, size and heat code of each fitting and flange shall be permanently identified on its body in accordance with MSS SP-25.

G. Where size for a pipe segment is not indicated, the pipe segment size shall be equal to the largest pipe segment to which it is connected. Transition to smaller size shall occur on the side of fitting where smaller size is indicated.

H. Unless otherwise indicated, fittings and accessories connected to pipe shall be of the same material as the pipe.

I. Unless otherwise indicated, construct piping for highest pressures and temperatures in respective system in accordance with the latest revision of the applicable Sections of ASME Code for pressure piping, ASME B31 including the following:
   1. B31.9 Building Services Piping

1.04 SUBMITTALS

A. Please embed pdf bookmarks in submittals to enhance navigation and facilitate review process.

B. Shop Drawings for each piping system for all pipe sizes including, but not limited to, the following:
   1. Name of system
   2. Pipe; ASTM number, grade if known, type, wall thickness, material
   3. Fittings; ASME number, grade if known, class, type, wall thickness, material
   4. Joint type
   5. Flanges; ASTM number, grade, class, type, material
   6. Bolts and nuts; material
   7. Thread joint sealants; material
   8. Flange gaskets; material, rating
   9. Unions; ASTM number, type, material, rating
   10. Type of welding

11. Welding Quality Control Program
12. Test pressure and media
13. Pipe flushing/cleaning plan
14. Pipe cleaning method
15. All other appropriate data

C. Submit pipe certification as specified under Pipe Certification in this Section.

D. Provide Flushing and Cleaning Plan:
1. Submit pipe flushing/cleaning plan for water systems for approval. Plan shall detail methods for compliance with requirements of this section, including:
a. Flushing and cleaning procedure narratives.
b. Size, power source, and connection points of contractor provided pumps that will be used for flushing and cleaning.
c. If Contractor proposes to utilize project system pumps, method of protecting pumps from damage and developing required velocity of section of piping to be flushed.
d. Method of sectionalizing piping to obtain required velocity.
e. Minimum velocities at each section of pipe, clearly indicating any sections where 6 fps cannot be achieved.
f. Location and means of temporary bypasses for coils, control valves and other equipment.
g. Flushing schedule and drawings or diagrams that will be used for inspection and sign off prior to and after procedure, at Owner's option.
2. Submit documents showing verification of flushing/cleaning following specified requirements and results.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Furnish pipe with plastic end-caps/plugs on each end of pipe. Maintain end-caps/plugs through shipping, storage, and handling to prevent pipe-end damage and eliminate dirt and construction debris from accumulating inside of pipe.

B. Where possible, store materials inside and protect from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.

C. Before shipping, all carbon steel piping shall be free of rust and scale and furnished with plastic end caps/plugs on each end of pipe.

1.06 FLANGES

A. Use either flat faced or raised-face flanges for mating with flat-faced or raised-face flanges.

B. Welding Neck Flanges:
1. All flanges shall be welding neck type unless otherwise indicated.

C. Bore dimension of flange shall match inside diameter of connecting pipe.

D. Bolts and Nuts:
1. Threads shall be in accordance with ANSI/ASME B1.1, Class 2A tolerance for external threads and Class 2B tolerance for internal threads. Threads shall be coarse-thread series except that alloy steel bolting 1-1/8" and larger in diameter shall be 8 pitch thread series.
2. Threaded rods are not allowed in lieu of bolts.

E. Where allowed under specific piping systems specified in this section, use of low strength (ASTM A307) bolts shall be limited to service temperatures of 400°F and used only with non-metallic flat ring gaskets.

1.07 CATHODIC PROTECTION

A. Cathodic protection shall be designed and provided by system pre-insulated pipe manufacturer for pipe systems as specified in Part 2. Cathodic protection shall conform to recognized practices and shall be designed by qualified personnel.

Measurements of corrosivity of soil environment expressed in terms of soil's electrical resistivity (ohm/cm) shall be taken and checked out by pre-insulated pipe manufacturer. Resistivities shall be given along proposed routing of piping systems. Anodes and test stations shall be provided by this Contractor as recommended by pre-insulated pipe manufacturer.

B. After installation, field survey shall be made by pre-fabricated pipe manufacturer and measurement of current and conduit-to-soil potentials at each test station shall be taken.

PART 2 PRODUCTS

2.01 HEATING HOT WATER (THROUGH 250 PSIG/250°F)

A. 2-1/2" and Smaller:
1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube
2. Fittings: ASME B16.22, wrought copper solder joint
3. Joint: ASTM B32, lead free solder, similar to Bridgit, Silvabrite, Silverflow or Canfield
4. Unions: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper solder joint, Class 125. No unions to be used for line sizes 3/4" and smaller. Unions shall be used for line sizes over1".
5. Flanges: Class 150, ASME B16.24, ASTM B61 or ASTM B62 cast copper alloy
6. Bolts and Nuts
   a. Type 316 stainless steel bolts conforming to ASTM A193 Grade B8M Class 1 or Class 2 with Type 316 stainless steel nuts conforming to ASTM A194 Grade 8M. Use 316 SS washers.
7. Gaskets:
   a. ASME B16.21 and ASTM F104 flat ring type, asbestos-free, compressed inorganic fiber with nitrile binder.
   b. Gasket thickness 1/16”
   c. Maximum Seating Stress (*y*) 3050 psi
   d. Minimum Gasket Factor (*m*) 4.2
8. Use solder joints for valves and piping specialties in copper piping
9. Press Joint Option:
   a. Contractor may use press copper fittings as manufactured by Viega, Other acceptable manufacturers are Nibco and Elkhart. “Push-to-connect” or “push-in” fittings, which are not press-type, will not be accepted.
   b. Fittings: Copper press fittings with EPDM seal, 0 to 250°F, maximum 200 psi.
   c. Joints: Press joints by fitting manufacturer approved tool.

2.02 CHILLED WATER AND CHILLED BEAM CHILLED WATER

A. 2-1/2" and Smaller:
1. Pipe: ASTM B88 seamless, Type L, hard temper copper tube
2. Fittings: ASME B16.22, wrought copper solder joint
3. Joint: ASTM B32, lead free solder, similar to Bridgit, Silvabrite, Silverflow or Canfield
4. Unions: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper solder joint, Class 125. No unions to be used for lines sizes 3/4" and smaller. Unions shall be used for line sizes over 1".
5. Flanges: ASME B16.24, Class 150, ASTM B61 or ASTM B62 cast copper alloy
6. Bolts and Nuts:
   a. Bolts conforming to ASTM A193, Grade B8M Class 1 or Class 2 with nuts conforming to ASTM A194, Grade 8M. Use 316 SS washers.
7. Use solder joints for valves and piping specialties in copper piping.
8. Press Joint Option:
   a. Contractor may use press copper fittings as manufactured by Viega. Other acceptable manufacturers are Nibco and Elkhart.
   b. Fittings: Copper press fittings with EPDM seal, 0 to 250°F, maximum 200 psi.
   c. Joints: Press joints by fitting manufacturer approved tool.

2.03 VENTS AND RELIEF VALVES

A. Unless otherwise indicated, use pipe and pipe fittings as indicated for the system to which relief valve or vent is connected.

2.04 PRESSURE GAUGES AND TAPPINGS

A. Use pipe and pipe fittings as indicated for the system to which pressure gauge or tapping is connected. Use "Threadolets", "Sockolets" or tee fittings for tappings. Refer to Part 3 under General for use of "Threadolets" and "Sockolets".

B. Gauge pipe shall be 1/4" unless otherwise indicated.

2.05 COOLING COIL CONDENSATE DRAIN

A. Piping shall be one of the following, unless otherwise indicated on drawings:
   1. Copper
      a. Pipe: ASTM B88 Type M, hard temper copper tubing
      b. Fittings: ASTM B16.22 wrought copper fittings
      c. Joint: ASTM B32, 95-5 tin-antimony solder, Bridgit or Silvabrite

PART 3 EXECUTION

3.01 GENERAL

A. Remove foreign materials before erection. Ream ends of piping to remove burrs.

B. Install piping parallel to building walls and ceilings and at such heights so as not to obstruct any portion of window, doorway, stairway, or passageway. Install piping to allow adequate service space for equipment. Refer to drawings and/or manufacturer's recommendations. Install vertical piping plumb. Where interferences develop in field, offset, or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings or other architectural details before installing piping.

C. Provide anchors, expansion joints, swing joints and expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

D. Mitered elbows, welded branch connections, notched tees and "orange peel" reducers are not allowed. Unless specifically indicated, reducing flanges, and reducing bushings are not allowed. Reducing bushings may be used for air vents and instrumentation connections.

E. Unless otherwise indicated, use fittings as specified in Part 2 of this Section for elbows, tees, reducers, etc.

F. "Weldolets" with outlet size 2-1/2” and larger and "Threadolets" or "Sockolets" with outlet size 2" and smaller may be used for branch connections up to one pipe size smaller than main. Use "Threadolets" where threaded fittings are specified and use "Sockolets" where socket weld fittings are specified. Install in accordance with PFI (Pipe Fabrication Institute) Standard ES49.

G. Install drains throughout systems to permit complete drainage of entire system.

H. Do not install piping over electrical panelboards, switchgear, switchboards, or motor control centers.

I. Install valves, control valves and piping specialties, including items furnished by others, as specified and/or detailed.

J. Make connections to equipment installed by others where that equipment requires piping services indicated in this Section.

K. For piping within the scope of ASME B31.1 Power Piping, transfer piping material specification and "Heat Number" to each segment of pipe prior to cutting.

3.02 THREADED PIPE JOINTS

A. Threads of pipe and fittings shall conform to ASME B1.20.1.

B. Ream pipe ends after cutting and clean before erection. Apply thread sealants to cleaned male threads. Assemble joint to appropriate depth and remove any excess pipe joint compound from tightened joint.

3.03 FLANGED JOINTS

A. Clean flange surfaces and align them parallel. Bolt holes of gaskets shall be cut slightly larger than bolt diameter. Gasket ID shall be slightly larger than flange ID.

B. Position gasket concentrically so compression is equally distributed over entire gasket surface.

C. Lubricate bolts and run nuts down by hand.

D. By using torque wrench, tighten nuts in the proper sequence so gasket is compressed evenly, and to the appropriate torque specified by bolt manufacturer.

3.04 COPPER PIPE JOINTS

A. Cutting of tubing shall not make tubing out of round. Ream cut tube ends to full inside diameter.

B. Remove slivers and burrs remaining from tube cut by reaming and filing both pipe surfaces. Clean fitting and tube with emery or sand cloth. Remove residue from cleaning operation, apply flux and assemble joint. Use solder or brazing to secure joint as specified for specific piping service.

C. Press Joint Option:
1. Cut pipe square and ream before assembly
2. Insert pipe fully into fitting and mark on pipe at shoulder of fitting
3. Check fitting alignment against mark on pipe to ensure pipe is fully engaged
4. Press joint with press tool approved by fitting manufacturer

3.05 WATER SYSTEMS

A. Unless otherwise indicated, install horizontal piping level. Install manual air vents at all high points where air may collect. If vent is not in accessible location, extend air vent piping to nearest code acceptable drain location with vent valve located at nearest accessible location to pipe.

B. Main branches and runouts to terminal equipment may be made at top, top 45°, side or bottom 45° of main provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.

C. Unless otherwise indicated, use top or top 45° connection to main for upfeed risers, and use side or bottom 45° connection to main for downfeed risers. Bottom connection is not allowed.

D. Use minimum of 3 elbows in each pipeline to terminal equipment to provide flexibility for expansion and contraction of piping systems. Offset pipe connections at equipment to allow for service, such as removal of terminal device.

E. Unless otherwise indicated, use concentric fittings for changes in pipe sizes and for valves smaller than pipe sizes.

F. Notch and dimple branch tubes. Braze joints. Apply heat properly so that pipe and tee do not distort. Remove distorted connections.

3.06 COOLING COIL CONDENSATE DRAIN

A. Trap each cooling coil drain pan connection with trap seal of sufficient depth to prevent conditioned air from moving through piping. Extend drain piping to nearest code approved drain location. Construct trap with plugged tee for cleanout purposes.

B. Pitch pipe down at not less than 1/8" per foot for proper drainage.

C. Where copper piping is allowed, joints and fittings may be secured with 95-5 tin-antimony solder or brazing alloys.

3.07 UNIONS AND FLANGES

A. Install union or flange at each automatic control valve and at each piping specialty or piece of equipment that requires tube pull or removal for maintenance, repair, or replacement. If required, provide additional unions or flanges in order to facilitate removal of piping sections that interfere with tube pulls or equipment removal. Where valve is located at piece of equipment, provide flange or union connection on equipment side of valve.

B. Concealed unions or flanges are not allowed.

3.08 PIPING SYSTEM PRESSURE TESTS

A. Owner and/or Owner's representative may elect to witness pressure test. Notify Owner and/or Owner's representative at least 3 days in advance.

B. Conduct pressure test prior to flushing and cleaning of piping systems.

C. Conduct hydrostatic (HYDRO) test in accordance with ASME B31.1 137.4. Test pressure shall be in accordance with ASME B31.1 but shall not be lower than the minimum test pressure listed below.

D. If leaks are found, repair with new materials and repeat test until leaks are eliminated. Caulking will not be acceptable.

E. Pressure tests may be made of isolated portions of piping systems to facilitate general progress of installation. Any revisions made in piping systems require retesting of affected portions of piping systems.

F. No systems shall be insulated until it has been successfully tested. If required for additional pressure load under test, provide temporary restraints at expansion joints or isolate them during test. Unless otherwise noted, minimum test time shall be 4 h plus such additional time as may be necessary to conduct examination for leakage.

G. No pressure drop shall occur during test period. Any pressure drop during test period indicates leakage.

H. Provide pumps, gauges, instruments, test equipment, temporary piping and personnel required for tests and provide removal of test equipment and draining of pipes after tests have been made.

I. For hydrostatic tests, remove air from piping being tested by means of air vents. Measure and record test pressure at high point in system. Where test pressure at high point in system causes excessive pressure at low point in system due to static head, portions of piping system may be isolated and tested separately to avoid undue pressure. However, every portion of piping system must be tested at the specified minimum test pressure.

J. Conduct pressure tests with parameters indicated below:

System	Minimum Test Pressure	Remarks
Heating hot water	100 psig	HYDRO
Chilled Beam Chilled water	100 psig	HYDRO

3.09 FLUSHING AND CLEANING PIPING SYSTEMS

A. Notify Owner and/or Owner’s representative at least 7 days in advance.

B. Flush new water systems thoroughly for 15 minutes or longer, as required to ensure removal of dirt and foreign matter from piping system. Bypass pumps and equipment and remove strainers from strainer bodies. Provide circulation by Contractor-supplied portable pumping apparatus.

C. Provide temporary piping or hose to bypass coils, control valves, heat exchangers, other factory-cleaned equipment, and any component that may be damaged.

D. Sectionalize system to obtain minimum velocity of 6 fps. Provide temporary piping to connect dead-end supply and return headers as necessary. Flush bottoms of risers.

E. After initial flushing of system, use portable pumping apparatus to circulate cold water detergent for water systems.

F. After initial flushing of system, use portable pumping apparatus for continuous 24 h minimum circulation of cold water detergent similar to Nalco 2567 cleaner. Flush detergent clear with continuous draining and raw water fill for additional 12 h or until all cleaner is removed from system. Dispose of all cleaning and rinse water per local jurisdiction requirements and Facility Owner's requirements. Replace strainers and reconnect permanent pumping apparatus and all apparatus bypassed.

3.10 INITIAL SYSTEM FILL AND VENT

A. Fill and vent systems with proper working fluids.

END OF SECTION

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SECTION 23 2118
VALVES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 20 0700 - Mechanical Systems Insulation

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 SUBMITTALS

A. Shop Drawings for each system for all sizes including, but not limited to, the following:
   1. Name of system
   2. Manufacturer's name
   3. Type
   4. Model number
   5. Materials of construction
   6. Temperature/pressure ratings
   7. Manufacturer's data sheets clearly cross-referenced
   8. All other appropriate data

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers and Figure Number listed under each item.

B. Butterfly valves and check valves manufactured by grooved coupling manufacturer will be acceptable where grooved pipe connection system is allowed, provided valves meet requirements specified in this section.

2.02 WATER SYSTEM VALVES

A. General:
   1. Valves 2" and smaller in copper piping shall have solder ends.
   2. Press Ends:
      a. Valves with press ends will be acceptable where press joints are allowed, provided valves meet requirements specified in this section. Temperature and pressure ratings shall be equal to or exceed ratings of press fittings used.
   3. Provide valve stem extensions with sufficient length to allow for insulation where insulation is specified.

B. Ball Valves:
   1. 2" and Smaller: ASTM B584 bronze body, chrome plated brass/bronze or stainless steel ball, full port for 3/4" and smaller and conventional port for 1” and larger, Teflon seat rings, blowout-proof stem, 2-piece construction, 600 psi WOG, 150 psi SWP, Nibco Fig. T(S)-580-70, Apollo No. 70, Watts, Milwaukee BA-150, Hammond, FNW or Anvil
   2. 2" and Smaller: ASTM B584 bronze body, threaded, stainless steel ball and stem, full port, Teflon seat rings, blowout-proof stem, 3-piece construction, 600 psi WOG, 150 psi SWP, Nibco Figure T(S)-595, Apollo, Watts, Hammond, Grinnell, Kitz or Milwaukee

C. Shut-Off Valves:
   1. 2" and Smaller: ball valves as specified in this Section

D. Balancing Valves (Multi-Turn Type):
   1. 2" and Smaller:
      a. Variable orifice with multiple turn valve type as manufactured by Armstrong Series CBV or ABV, Tour & Andersson (Victaulic) Series 786 or 787, NIBCO 1709 or 1710.

Maximum Allowable Working Pressure, 250°F Maximum Allowable Operating Temperature. Furnish valve with adjustable memory stop and quick disconnect taps with built-in check valve for pressure differential measurement, integral valve setting index and memory locking device.

b. Valves shall measure down to 0.3 gpm with accuracy of ±5%.
c. Valves shall be leak-tight at full rated working pressure.
d. Unless otherwise indicated, size balancing valves so that at design flow rate, pressure drop across balancing valve with valve approximately 50% open will be at minimum 25% of reading range of meter used for balancing.

E. Terminal Unit Valve Assembly
1. Terminal unit valve assembly may be used instead of individual valve and other components, provided each valve and component meets specified requirements.
2. Victaulic, Nexus, Griswold, HCi, IMI Flow Design or Hays are acceptable.
3. Inlet Assembly: combination of isolation ball valve, y-strainer with 20 mesh SS screen and blowdown valve, union, and PT test port.
4. Outlet Assembly: Union assembly consisting of union, manual air vent and PT test port at coil outlet (control valve inlet) and ball valve, union, PT test ports and balancing valve at control valve outlet. Balancing valves shall be as specified under Balancing Valves in this Section.
5. Components: Assembly shall have minimum pressure/temperature ratings to 400 psi/ 230°F.
6. Flexible Hose:
a. Flexible hoses up to 18” in length may be used in inlet and outlet assemblies for 1” and smaller.
1) EPDM Core:
a). Flexible hose shall be constructed of EPDM core, stainless steel braided cover, stainless steel ferrules, and brass end connections. Maximum Allowable Operating Pressure (MAOP) shall be not less than 300 psi at 230°F.
2) Stainless Steel (Corrugated) Core:
a). Flexible hose shall be constructed of corrugated 300 series stainless steel core, 300 series stainless steel braided cover, stainless steel ferrules, and 304 stainless steel end connections. Maximum Allowable Operating Pressure (MAOP) shall be not less than 400 psi) at 600°F.

F. Drain Valves:
1. Ball valve as specified above with threaded hose adapter and cap. If 3-piece ball valves are specified, use 2-piece ball valves with same construction.

2.03 GAUGE VALVES

A. Gauge valve size shall match pressure gauge connection size as specified in Section 23 2120 – Piping Specialties.

B. Ball valves meeting valve specification for applicable piping system may be used.

PART 3 EXECUTION

3.01 GENERAL

A. Install valves as shown on plans, details and according to manufacturer's installation recommendations.

B. After piping systems have been pressure tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust, replace packing, or replace valves to stop leaks.

C. Install control valves furnished under Control Systems. Provide reducing fittings as required.

D. Refer to Section 23 2116, Part 3 for reducing fittings requirement for valves smaller than pipe size.

3.02 SHUT-OFF VALVES

A. Provide shut-off valves at all equipment and at each automatic valve for servicing.

3.03 BALANCING VALVES

A. Provide balancing valves where indicated on drawings and as required for complete balancing of water systems.

B. Provide straight inlet and outlet pipe length in accordance with manufacturer's recommendation.

3.04 GAUGE VALVES

A. Provide gauge valves at each pressure gauge as shown and at each pressure tapping where pressure sensing tubing is connected.

3.05 TERMINAL UNIT VAVLE ASSEMBLY

A. Flexible hoses used in terminal unit valve assemblies shall be installed with lateral offset not to exceed 4" from centerline of pipe.

END OF SECTION

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SECTION 23 2120
PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 23 0594 - Water Systems Test Adjust Balance

B. Section 23 2118 - Valves

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 REFERENCE STANDARDS

A. Metal bellows expansion joints shall be constructed and applied in accordance with "Standards of the Expansion Joint Manufacturer's Association", 10th Edition.

1.04 SUBMITTALS

A. Shop Drawings for all items in this Section including, but not limited to, the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the Documents
   3. Materials of construction
   4. Dimensional data
   5. Capacities/ranges
   6. Temperature/pressure ratings
   7. Pressure drop

PART 2 PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified, select devices for highest pressures and temperatures existing in respective systems in accordance with ANSI Specifications.

B. Piping specialties in copper piping shall have bronze or brass body with solder ends.

2.02 THERMOMETERS

A. Manufacturers: Taylor, Trerice, Weksler, Miljoco, Winters, or Weiss

B. Pipeline mounted thermometers: 9" scale cast aluminum case and frame, clear acrylic plastic window front, permanently stabilized glass tube with mercury free indicating fluid, adjustable angle stem, extended neck suitable for insulated piping as required, and compatible with sockets as specified herein.

C. Panel or remote mounted thermometers: vapor actuated dial type with remote bulb, 4-1/2" minimum diameter cast metal casing with double front. Sensing bulbs shall be of length to suit pipe diameter with extended necks as required for insulated piping, suitable for insertion in separable brass sockets as specified herein.

D. Duct type thermometers: dial type with minimum dial size of 4-1/2" and maximum graduations of 2°F, complete with swivel mounting arrangement to permit up to 45° rotation for easy reading.

E. Range of thermometer for particular installation shall extend from point at least 40°F below lowest point of equipment's or system's operating range to point at least 40°F above highest point of that range.

F. Thermometers by temperature control manufacturer meeting above Specification will be acceptable.

2.03 PRESSURE GAUGES

A. Manufacturers: Ashcroft, U.S. Gauge, Marsh, Trerice, Miljoco, Marshalltown, Weksler, Winters or Weiss equal to Trerice 600 Series

B. Minimum 4-1/2" diameter die cast aluminum case, glass or acrylic plastic window, phosphor bronze bourdon tube with bronze bushed movement, recalibration from front of gauge dial and 1/4" NPT forged brass socket.

C. Select gauge range so that normal operating pressure is at midpoint of gauge.

D. Pressure Snubbers:
   1. 1/4" or 1/2" size, matching gauge pipe size as specified in Section 23 2116 - Pipe and Pipe Fittings, 1000 psig WP. Brass for carbon steel pipe or copper pipe. Stainless steel for stainless steel pipe.

2.04 PRESSURE/TEMPERATURE TEST STATIONS

A. Pete's plugs made by Peterson Equipment Company, Sisco, Super Seal by Flow Design Inc. (FDI), or approved equal.

B. Test plugs shall be 1/4" or 1/2" NPT, brass body and cap, 1-1/2" length for non-insulated pipe and 3" length for insulated pipe, with Nordel self-closing valve cores, rated at 500 psig at 275°F, and shall receive either temperature or pressure probe with 1/8" OD.

C. Furnish portable test kit within durable case containing the following:
   1. A compound pressure gauge,3-1/2" dial, 30" Hg – 100 psi, field calibration screw, surge protector and stainless steel gauge adapter with 1/8" diameter probe (2% accuracy of mid-range).
   2. Two pocket testing thermometers, 1-3/4" dial, 5" long stainless steel stem, 0 - 220°F and 25 - 125°F ranges with external calibration (1% accuracy of entire scale).

2.05 PIPELINE STRAINERS

A. Manufacturers: Metraflex, Mueller Steam Specialty, Nibco, Hoffman, Eaton (formally Hayward), Sarco, Keckley, Armstrong, Wheatley, Conbraco, Titan, or Streamflo

B. Liquid System:
   1. 2" and Smaller: full pipeline size, Y-type, with removable screen caps, cast iron, Class 250 (400 psi/150°F WOG), threaded ends for carbon steel piping and cast bronze, Class 125 (200 psi/150°F WOG), solder ends for copper piping. Screen caps shall have threaded blowdown connection.
   2. Liquid Service Screens: stainless steel with screen perforation as indicated below. For strainers serving equipment where manufacturer requires specific screen perforation, provide per manufacturer requirements. Maximum pressure drop shall be 4 ft WG through clean strainer.

Pipe Size	Closed System	Open System
2" and smaller	1/32" (20 mesh)	1/8"
2-1/2" to 4”	1/16”	1/8"
5" and over	1/8"	1/8"

2.06 AIR VENTS

A. Manual Air Vents:
   1. Manufacturers: Bell & Gossett Model 4V, 125 psig at 210°F or approved equal. Use 1/2” ball valve for main pipes.

B. Automatic Air Vents:
   1. Manufacturers: Amtrol, Watson McDaniel, B&G, or Hoffman
   2. Metal construction, non-corrosive working parts, 150 psig WP at 240°F
   3. Normal capacity vent shall be similar to B&G Model 87
   4. High capacity vent shall be float actuated and shall have minimum air elimination rate of 10 cfm at 100 psig, similar to B&G Model 107A.

C. Thermostatic Air Vents:
   1. Balanced pressure type, cast bronze body, bronze bellows caged in stainless steel, stainless steel valve and seat, 1/2” threaded connection, 125 psig WSP, equal to Armstrong Model TV-2.

PART 3 EXECUTION

3.01 GENERAL

A. Install piping specialties as indicated on plans, details and according to manufacturer's recommendations.

3.02 THERMOMETERS

A. Install thermometers in thermowells in locations indicated.

3.03 PRESSURE GAUGES

A. Install gauges for with pressure snubbers and gauge valves.

3.04 PRESSURE GAUGE TAPPING

A. Install tappings with gauge valves at each point where sensing device is required under Control Systems and at gauge locations as shown.

B. Use threadolets or tee fittings to mount gauge tappings or test stations. Install fittings for side mounting to avoid collection of air or dirt.

3.05 PRESSURE/TEMPERATURE TEST STATIONS

A. Pete's plug may be used in lieu of thermometer test well and pressure gauge tappings.

B. Use threadolets or tee fittings to mount gauge tappings or test stations. Install fittings for side mounting to avoid collection of air or dirt.

3.06 PIPELINE STRAINERS

A. Provide drain valve at each strainer blowdown connection with hose threaded adapter and cap. Valve size shall be same as blowdown connection size.

3.07 AIR VENTS

A. Install manual air vents at all high points in water systems where air may collect and where shown on drawings.

B. Install automatic air vent at top of air separator and where shown on drawings. Provide shut-off valve to isolate air vent from system. Pipe automatic air vent to the nearest floor drain.

C. Install high capacity automatic air vent at air separator.

END OF SECTION

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SECTION 23 3114
DUCTWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 20 0529 - Piping and Equipment Supporting Devices

B. Section 20 0700 - Mechanical Systems Insulation

C. Section 23 0595 - Air Systems Test Adjust Balance

D. Section 23 3314 - Ductwork Specialties

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 SUBMITTALS

A. For each duct system, submit schedule utilizing reinforcement tables from SMACNA HVAC Duct Construction Standards Metal and Flexible where applicable. Each duct system schedule shall include, but not be limited to, the following:
   1. Name of Contractor/manufacturer fabricating each duct system
   2. Material and gauge
   3. Pressure class
   4. Transverse joint type and length and reinforcement rigidity class with designated joint T number or proprietary duct connection if utilized for each system
   5. Certified test results of proprietary joint products, if used, tested in accordance with SMACNA procedures
   6. Intermediate reinforcement spacing and rigidity class with metal angle dimensions and gauge
   7. Type of longitudinal seam
   8. Fitting construction details
   9. Support methods including spacing, upper attachments, and lower attachments
   10. Sealant and gasket
   11. Sealing class

B. Duct leakage testing methods, apparatus and apparatus certification signifying meter is in conformance with ASME Requirements for testing meters.

C. Duct liner including data on thermal conductivity, air friction correction factor, and temperature and velocity limitation.

D. Submit shop drawings for manufactured duct system products

1.04 DELIVERY, STORAGE AND HANDLING

A. Protect duct and fittings from damage due to normal handling during shipment and storage. Protection shall be applied to ends of duct to prevent dirt and moisture from entering ducts and fittings.

1.05 DESCRIPTION

A. Furnish and erect ductwork free of objectionable vibration, chatter, and pulsations. Verify dimensions at site, making field measurements and drawings necessary for fabrication and erection.

B. Duct sizes indicated are net inside dimensions.

C. Where size for a duct segment is not indicated, the duct segment size shall be equal to the largest duct segment to which it is connected. Transition to smaller size shall occur on side of fitting where smaller size is indicated.

1.06 DESIGN CRITERIA

A. All products shall conform to NFPA 90A, and shall possess flame spread rating of not over 25 and smoke developed rating no higher than 50.

B. Unless otherwise indicated, construct all ductwork of galvanized sheet metal for pressure class not less than 2” WG for positive pressure ductwork and not greater than -2” WG for negative pressure ductwork.

C. Ductwork shall comply with Local, State and Federal requirements.

D. Unless otherwise indicated, pressure class for VAV system supply ductwork between supply fan discharge and air terminal device inlet shall be equal to static pressure at fan discharge but not less than 4” WG; pressure class for ductwork on suction side of air handling unit and suction side of return fan shall be equal to static pressure at inlet of return fan but not less than -2” WG.

E. Unless otherwise indicated, pressure class for constant air volume system ductwork shall be equal to external static pressure (fan entrance or discharge pressure minus associated unit internal component pressure drop), but not less than ± 2” WG.

F. Duct transverse joints and reinforcement material, including angle ring flanges and stiffeners, shall be of same material as duct.

G. Except as modified in this Section of specifications or on drawings, use material, weight, thickness, gauge, construction, and installation methods as outlined in the following SMACNA publications:

1. HVAC Duct Construction Standards Metal and Flexible, 3rd Edition, 2005, for rectangular and round ductwork up to positive 10” WG and negative 10” WG and flat oval ductwork up to positive 10” WG.
   a. Tie rods shall be 1/2” or 3/4”, galvanized steel EMT/conduits with bolt assembly consisting of rubber washer and friction anchored threaded insert similar to Ductmate Easyrod or PPI Condu-Lock.
   b. Internal tie rods or bracing are not allowed for ductwork 36” and smaller.
   c. Midpanel tie rods are not allowed.
2. Round Industrial Duct Construction Standards, 2nd Printing 1999
3. Round Industrial Duct Construction Standards, 2nd Edition, September 1999
4. Rectangular Industrial Duct Construction Standards, 2nd Edition, 2004
5. Accepted Industry Practice for Industrial Duct Construction, 2nd Edition, 2008, for round ductwork -4” to 20” WG (Table 1-A) and for rectangular ductwork -4” to 20” WG (Table 2-A).

Adhesives and sealants used on installation of ducts shall comply with South Coast Air Quality Management District (SCAQMD) Rule #1168; Indoor Environmental Quality Section, Credit EQ-4.

PART 2 PRODUCTS

2.01 GALVANIZED STEEL SHEET

A. Lock Former Quality (LFQ), cold rolled, open hearth soft steel sheet capable of double seaming without fracture, ASTM A924/A924M or ASTM A653/A653M. Galvanized coating shall be G90.

B. Use G90 Galvaneal or Zinc grip where painting is specified.

2.02 FLEXIBLE DUCT

A. Manufacturers: Thermaflex, or Flexmaster

B. Factory fabricated, UL listed under UL-181 as Class 1 duct, meeting requirements of NFPA 90A with flame spread of 25 or less and smoke developed rating of 50 or under.

C. Flexible duct shall have minimum ratings as follows:

1. Operating Temperature: -20ºF to 250ºF

2. Internal Working Pressure: Positive: 6” WG
   Negative: 1” WG
3. Burst Pressure: 2-1/2 times working pressure
4. Velocity: 5000 fpm

D. Unless otherwise indicated, duct shall be nonmetallic insulated type composed of polyester film, polyethylene film, nylon film, CPE film, or coated woven fiberglass liner bonded permanently to corrosion resistant coated steel wire helix without adhesive.

E. Insulation shall be flexible fiberglass insulation with minimum R-value of 6 at mean temperature of 75ºF. Vapor barrier jacket shall be aluminum foil reinforced, polyethylene, or metalized polyester film with maximum perm rating of 0.05 permper ASTM.

F. Insulation material shall not be exposed to air stream.

G. Lined flexible duct shall have the following minimum acoustical performance in accordance with ARI Standard 885. Dynamic Insertion Loss in each octave band of 5 ft or 10 ft straight duct shall not be less than the following:

Dynamic Insertion Loss (dB)
Octave Band Center Frequency (Hz)
(Based on 5 ft length)

Duct Diameter (in)	125	250	500	1000	2000	4000
6”	6	9	18	22	24	15
8”	6	10	18	20	21	12
10”	5	11	18	18	18	9

(Based on 10 ft length)

Duct Diameter (in)	125	250	500	1000	2000	4000
6”	10	15	28	33	35	22
8”	10	18	29	32	32	20
10”	9	19	28	31	29	18

2.03 GLASS FIBER DUCT LINING

A. Manufacturers: Manville, Owens-Corning, Knauf or CertainTeed

B. Lining shall be made of long textile-type glass fibers, 1” thick with 3.0 pcf density.

C. Lining shall meet the following:
1. Acoustical performance per ASTM C1071
2. Erosion test per UL 181
3. Fungi and bacteria resistance per ASTM C1338
4. Water vapor absorption per ASTM C1104
5. Corrosion resistance per ASTM C665
6. Thermal Conductivity of not more than 0.24 (Btu·in/(h·ft^{2}·°F)) at 75°F mean temperature per ASTM C518
7. Air friction correction factor not exceed 1.15 at 2000 fpm
8. Suitable for air velocities to 5000 fpm per ASTM C1071 and temperatures to 250ºF per ASTM C411
9. Adhesives to comply with ASTM C916, Foster 85-60, Childers CP-127, Miracle-Kingco PF-101 or PF-102.

2.04 MANUFACTURED ROUND DUCTWORK (POSITIVE PRESSURE)

A. Single Wall:

1. Manufacturers: Lindab, Semco or McGill AirFlow, equal to McGill AirFlow Uni-Seal duct and fittings suitable to positive 10” WG.
2. Ducts shall be machine formed round and/or flat oval as shown on drawings, constructed of G90 galvanized steel. Use spiral lockseam construction. Longitudinal seam construction may be used for ductwork over 80” diameter with minimum 16 ga. Use fittings as indicated on drawings, as specified, and as required in accordance with manufacturer's published data.
3. Unless otherwise indicated, connection shall be slip type with minimum 2” insertion length or flanged joint in accordance with manufacturer's recommendations. When flange joints are required, use Van Stone angle rings welded to duct.
4. Internal bracing is not allowed.
5. Pre-sealed snaplock pipe system “Greenseam +” as manufactured by Ductmate Industries may be used for low pressure supply air duct.

2.05 MANUFACTURED SELF-SEALING ROUND DUCTWORK SYSTEM

A. Single-wall:
1. Manufacturers: Lindab Spirosafe, Eastern Sheet Metal (ESM) Eastern Tight, or Tambe Metal Products Zip Seal
2. Ductwork system shall consist of fittings with factory-fitted sealing gasket and spiral duct which will seal duct joints without use of duct sealer.
3. Ducts shall be machine formed round as shown on drawings, constructed of G90 galvanized steel. Use spiral lockseam construction. Use fittings as indicated on drawings, as specified, and as required in accordance with manufacturer's published data.
4. Unless otherwise noted, duct and fittings shall be constructed per SMACNA’s Duct Construction Standards (+10” WG) shown in the following table:

Diameter (”)	Galvanized Spiral Duct	Galvanized Fittings
3 - 14	26 ga.	24 ga.
16 - 26	24 ga.	22 ga.
28 - 36	22 ga.	20 ga.
38 - 50	20 ga.	20 ga.

5. All fitting ends shall have factory equipped with double-lipped, U-profile or tubular EPDM rubber gasket. Gasket shall be classified by Internationally Recognized Laboratory Authority to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
6. Ductwork system performance shall meet SMACNA’s Leakage Class 3 Requirements from -20” WG to +12” WG.

2.06 DUCT SEALANTS AND GASKETS

A. Sealant:
1. Flexible, water based, adhesive sealant compounded specifically for sealing joints and seams in ductwork. Hardcast, McGill AirSeal, Ductmate PROseal, Mon-Eco Industries, Childers, DP1010 or H.B. Fuller/Foster.
2. Sealants shall be UL 723 (ASTM E84) classified, and meet NFPA 90A and 90B.
3. Sealants shall comply with requirements for LEED EQ 4.
4. Select sealants as recommended by manufacturer for specific application.
5. Submit sealant manufacturer's data sheets including performance data, pressure ratings, surface burning characteristics data, VOC compliance with LEED EQ 4, detailed installation instructions.
    a. Sealants for exterior ductwork shall include explicit statement by manufacturer indicating suitability for application.

b. Sealants for exposed (uninsulated) exterior ductwork shall be UV resistant and include explicit statement by manufacturer indicating suitability for exposed exterior application.

6. Duct tapes are not allowed.

B. Gaskets:

1. Butyl, copolymer or neoprene based tape similar to Ductmate 440 Gasket Tape or Neoprene Gasket Tape for flanged joints.

2.07 CABLE SUSPENSION SYSTEM

A. Suspension system shall be similar to Gripple Hang-Fast as manufactured and supplied by Gripple Incorporated or Ductmate Industries “Clutcher” cable hanging system.

B. Suspension system shall be load rated and verified by SMACNA Testing and Research Institute to be in compliance with SMACNA HVAC Duct Construction Standards, 2005, Chapter 5.

PART 3 EXECUTION

3.01 GENERAL

A. Unless otherwise indicated, install ductwork level, parallel , and/or perpendicular to building structure, walls, and ceilings and at such heights not to obstruct any portion of ceiling, window, doorway, stairway, or passageway. Install ductwork to allow adequate access and service space for equipment. Refer to drawings and/or manufacturer's recommendations. Install vertical ductwork plumb. Where interferences develop in field, offset, or reroute ductwork as required to clear such interferences. In all cases, consult drawings for exact location of duct spaces, ceiling heights, door and window openings or other architectural details before installing ductwork.

B. Make allowances for beams, pipes, or other obstructions in building construction and for work of other contractors. Check plans showing work of other trades and consult with Engineer in event of interference. Transform, divide, or offset ducts as required, in such a manner as to maintain same cross sectional area of duct as indicated on drawings. Where it is necessary to install pipes or similar obstructions through ducts, consult with Engineer and obtain written approval from Engineer and Owner. If approved, provide streamlined encasement or collar designed in accordance with SMACNA Standards and seal to prevent air leakage.

C. Ductwork shall be free of kinks and dents.

D. Fabricate and install duct, fittings, joints, seams, reinforcement, supports, sealing, liner, etc., in sizes indicated on drawings and in accordance with manufacturer's published data and SMACNA Standards except as modified in this section of specifications or on drawings.

E. Provide transitions where different size or different shape ductwork segments are connected. Use concentric transitions unless otherwise shown. Unless otherwise indicated, make diverging transitions with maximum angle of 15° per side (30° total diverging) and converging transitions with maximum angle of 25° per side (50° total converging).

F. Provide transitions at ductwork system components and connections to equipment. Refer to Specification Section 23 3713 – Diffusers, Registers, and Grilles, for additional information regarding diffuser/register/grille connections.

G. Refer to ductwork symbols list on drawings for additional and dimensional requirements for fittings.

H. Seal duct seams and joints to meet SMACNA Class A as minimum for all ductwork including low-pressure ductwork.

I. Construct ductwork so that interior surfaces are smooth. Internal duct hangers and internal bracing are not allowed. Refer to Part 1, Design Criteria for internal tie rods.

J. Support coils, filters, air terminals, dampers, sound attenuator devices or other devices installed in duct systems with angles or channels and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets, nuts, bolts and washers.

K. Air terminal devices may be supported by strap hangers if air terminal manufacturer approves. Strap hangers are not allowed for fan powered devices, double wall type and Titus Steri-Loc type devices.

L. Install outside air intake duct to pitch down at minimum 1” per 20 ft toward intake louver or

M. Where 2 different metal ducts meet, install joint in such a manner that metal ducts do not contact each other by using proper gasket seal or compound.

N. Install motor operated dampers and connect to or install equipment furnished by others. Provide necessary blank-off plates or transitions to mount control dampers as specified in Section 23 0901 - Control Systems Integration.

O. Do not install ductwork over electrical panelboards, switchgear, switchboards or motor control centers.

P. When original galvanized finish is altered or damaged, apply field galvanizing paint as follows:
1. Prepare surface with use of power sanders or wire brushes to remove rust, paint, etc.
2. Apply cold galvanizing material equal to ZRC Products, Inc.

3.02 ELBOWS

A. Rectangular Duct (SA/RA/EA):
1. Use radius elbows with centerline radius to width ratio of 1.5 (SMACNA Type RE 1).
2. Where 1.5 centerline radius elbows do not fit, use radius elbows with centerline radius to width ratio of 1.0 (SMACNA Type RE 3).
3. Where 1.0 centerline radius elbows do not fit, use radius elbows with centerline radius to width ratio of 0.75 (SMACNA Type RE 3) or 45° throat with radius heel elbows (SMACNA Type RE 8).
4. Use splitter vanes for 1.0 radius elbows, 0.75 radius elbows and 45° throat with radius heel elbows as follows;
   a. No vanes for duct with width less than 24”
   b. Single vane for duct with width 24” to 36”
   c. Two vanes for duct with width over 36”
5. Fabricate splitter vanes in accordance with SMACNA HVAC Duct Construction Standards, Chart 4-1, (p. 4.11) and Figure 4-9 (p. 4.13).
6. Square throat elbows with or without turning vanes are not allowed unless specifically indicated. Square throat elbows without turning vanes may be used for transfer air ducts.

B. Round and Oval Duct:
1. Unless specific type is indicated, use radius elbows with centerline radius to diameter ratio of 1.5 regardless of duct velocity. Where 1.5 radius elbows do not fit, use 1.0 radius elbows.

3.03 LONGITUDINAL SEAM

A. Rectangular Duct:
1. Unless otherwise indicated, use Pittsburgh lock seam.
2. Seal longitudinal seams with approved sealant or pre-sealed with encapsulated mastic.
3. Button punch snap lock construction (SMACNA L-2) may be used for ductwork that is both 2” WG (+ or -) and lower, and 36” and smaller in width or height. For ductwork over 24” in width or height, add screw 4” from each end.
4. Button punch snap lock construction is not allowed for ductwork in chases and areas above inaccessible ceiling.
5. Button punch snap lock construction is not allowed on aluminum ductwork.

B. Round and Oval Duct:

1. Unless otherwise indicated, longitudinal seams shall be in accordance with SMACNA HVAC Duct Construction Standards with the following exceptions.
   a. SMACNA seam types RL-3, 6A, 6B, 7 and 8 shown in Figure 3-2 are not allowed.

3.04 TRANSVERSE JOINT

A. Rectangular Duct:
   1. Transverse joints shall be in accordance with SMACNA HVAC Duct Construction Standards.
   2. Ductmate 25/35/45 connection systems with corner clips or optional nuts and bolts may be used. Incorporate use of all Ductmate accessories to ensure integrity of transverse connection. Install joints in strict accordance with the latest edition of Ductmate 25/35/45 Assembly and Installation Instruction Manual and Duct Construction Standards. Nexus or WDCI will be acceptable.
   3. Lockformers TDC or Engles TDF may be used in accordance with T-25 flanges of SMACNA HVAC Duct Construction Standards Metal and Flexible, 2005, provided that corner pieces with bolts are used. If TDF/TDC flanges are damaged, replace the damaged joint(s) by straightening and reinforcing with minimum 1-1/2” x 1-1/2” x 1/4" angle at each side of transverse joint.
   4. Where any type of flanged transverse joint is used for exterior uninsulated ductwork, top flange shall have continuous sheetmetal cap or continuous cleat to protect joint.

B. Round Duct:
   1. Unless otherwise indicated, use beaded sleeve joints (SMACNA RT-1) with minimum 2” insertion length or flange joints (SMACNA RT-2 or RT-2A).
   2. Connection systems manufactured by Ductmate Industries (Spiralmate and Ovalmate) or McGill AirFlow (Uni-flange) may be used for supply air ductwork.
   3. AccuFlange connected systems may be used with gaskets specified in Part 2 of this Section.

3.05 DUCT SUPPORTS

A. Unless otherwise indicated, use straps or Z bar hangers with 3/8” rods to support rectangular ducts 60” wide and smaller and trapeze hangers with rods or angles to support rectangular ducts over 60” wide.
   1. Use trapeze hangers to support externally insulated ductwork with weight bearing inserts. Refer to Section 20 0700 – Mechanical Systems Insulation and details.

B. For round ducts 24” diameter or smaller, use single hanger.
   1. Cable Suspension System may be used up to 24” diameter at spaces higher than 8 ft above floor or platform.
   2. Round Duct Strap Bracket by Ductmate Industries may be used up to 24” diameter.

C. For round ducts 25” diameter or larger, use 2 minimum 3/8” rods, with trapeze in accordance with the following schedule:

Duct Size	Trapeze (Half Round)
25” to 36”	1-1/2” x 1-1/2” x 1/8"
37” to 48”	1-1/2” x 1-1/2” x 1/4" or 2” x 2” x 1/8"
49” to 60”	2” x 2” x 1/4"
61” to 84”	2-1/2” x 2-1/2” x 1/4"

D. Refer to Section 20 0700 - Mechanical Systems Insulation for ductwork insulation, weight bearing inserts and insulation protection shield requirements.

E. Support ducts located on roof as detailed.

F. Support vertical ducts at every floor, but not exceeding 12 ft.

G. The following upper attachments, upper attachment devices, lower hanger attachments, hanger devices, and/or hanger attachments are not allowed except where specifically indicated:

1. Hook or loop
2. Nailed pin fasteners
3. Expansion nails without washers
4. Powder actuated fasteners (forced entry anchors). Forced entry anchors may be used for upper attachments of flexible ductwork supports.
5. Beam or "C" clamps without retaining clips or friction clamps (provide retaining clips for "C" clamps)
6. Non-factory manufactured upper attachments for metal pan deck including wire coil and double circle (Items 16 and 17 of Fig 5-4 of SMACNA HVAC Duct Construction Standards 2005)
7. Wire hanger
8. Trapeze hangers supported by wires or straps
9. Rods, straps or welded studs directly attached to metal deck
10. Drilled hole with attachment to structural steel
11. Lag screw expansion anchor
12. Rivets
13. Non-metallic hangers or straps

H. Supporting devices shall be standard products of manufacturers having published load ratings.

I. Refer to Section 20 0529 - Piping and Equipment Supporting Devices for additional support requirements including attachments to structures.

J. For welded ducts, soldered ducts or ducts with water tight joints, do not use supports utilizing screws or other penetrations into ductwork.

K. Unless Architectural Documents indicate the required framing, provide angle iron framing around roof opening where duct penetrates through roof decking, to maintain roof decking structural integrity in accordance with roof decking manufacturer's recommendations. This is not required for concrete decking. For concrete decking, consult with the project structural engineer for location and size of opening prior to execution of Work.

3.06 PROTECTION OF DUCTWORK

A. Protect ductwork during construction against entry of foreign matter and construction dirt.

B. Keep ductwork capped when work is complete for the day or when duct is not being worked on or added to. Use of polyvinyl (VISQUEEN) with duct tape wrap is an adequate measure as long as it is secure with no openings or tears in product.

C. If ductwork is not protected, remove dirt and foreign matter from the duct system and obtain inspection and approval from Engineer upon completion of cleaning before operating fans.

D. Return fans are not allowed to operate during construction to avoid intake of construction dirt/dust into return air ductwork.

3.07 DUCT LEAKAGE TEST

A. Refer to Test and Balancing portion of Section 20 0000 - General Mechanical Requirements.

B. Owner and/or Owner's representative may elect to witness leakage tests. Notify Owner and/or Owner's representative at least 3 days in advance.

C. Test each supply, return, and exhaust ductwork as follows, unless otherwise indicated in this section or in schedules.
1. Test **25**% of total installed duct area for duct pressure positive or negative Class 3” wg and higher.
2. Test **10**% of total installed duct area for duct pressure positive or negative Class 2” wg.
3. Test 100% of total installed duct area for ductwork located in inaccessible spaces including shafts.
4. Engineer will select sections of ductwork to be tested.

5. If test results are acceptable to Engineer, remainder of ductwork is permitted to proceed without further testing. If ductwork fails test, repair all ductwork including ductwork not tested. Then repeat leakage tests for new sections of ductwork as described above.

D. Leakage test procedures shall be in accordance with test method described in Section 3 of SMACNA HVAC Air Duct Leakage Test Manual, except as modified in this Section. Test apparatus shall be in accordance with Section 5 of SMACNA HVAC Air Duct Leakage Test Manual.

E. Test pressure shall be equal to duct pressure class. Negative pressure ductwork shall be tested with negative test pressure.

F. Air leakage shall not exceed limits specified or scheduled. If leakage exceeds allowable limits, identify leaked areas, repair, seal and retest.

G. Provide filter system on duct inlet to test blower. Filter system shall be equal to final filtering efficiency of AHU supply air duct system. Filters are not required for negative pressure testing.

H. Do not insulate ductwork until it has been successfully tested.

I. Maximum permitted leakage (L) in cfm/100 sf duct surface area of each ductwork shall be calculated by:

$L = C_L \times P^{0.65}$

1. P = test pressure (duct pressure class).
2. C_L = duct leakage class, 2 for round/oval ducts and 4 for rectangular ducts and flexible ducts.
3. Total allowable leakage in a duct section:
   = L x (total duct surface area of the section)

3.08 LOW PRESSURE DUCT CONSTRUCTION (PRESSURE CLASS 2” WG AND UNDER)

A. Use welds, rivets or nuts, and bolts for fabricating ductwork. Fully threaded sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if screw does not extend more than 1/2” into duct. Sheet metal "TEK" screws 3/4” in length may be used as fasteners in conjunction with factory made transverse joints.

B. Unless otherwise indicated, construct branch take-off fittings as follows:
1. For branch take-offs including branch ducts serving more than one diffuser or grille, use 45° entry fittings. For supply air ducts, conical taps may be used.
2. For take-offs serving single diffuser, register or grille, use straight spin-in collars with manual balancing dampers.

C. Splitter dampers and/or extractors are not allowed.

3.09 LOW PRESSURE DUCT LININGS

A. All portions of duct designated to receive duct liner shall be completely covered with duct liner. Transverse joints to be neatly butted and there shall be no interruptions or gaps.

B. Duct liner shall be adhered to sheet metal with 90% coverage of adhesive, and all exposed leading edges and all transverse joints shall be coated with adhesive. Adhesives shall meet ASTM C916 Type II. Foster 85-60/85-00, Childers CP-127, Miracle-Kingco PF-101/PF-102.

C. Duct liner shall be additionally secured with mechanical fasteners, which shall compress duct liner sufficiently to hold it firmly in place. Use weld pins only. Adhesive bonded pins or impact pins are not allowed. Spacing of mechanical fasteners with respect to duct liner interior width shall be in accordance with SMACNA Standard, "HVAC Duct Construction Standards, Metal and Flexible."

D. Apply lining to the following ductwork:
1. Air transfer ducts

3.10 FLEXIBLE DUCT

A. Install flexible ducts in accordance with manufacturer's installation instructions and SMACNA Standards, except as modified in this Section of Specifications.

B. In supply air systems with air terminal devices, flexible ducts shall be used for duct connections to diffusers, grilles, and registers for sound attenuation purposes, except above non-accessible ceilings. Flexible ducts shall be 6 ft long.

C. Centerline radius of bends shall not be less than one duct diameters. FlexFlow Elbow supports by Thermaflex or similar products shall be used at diffuser/grille connection to assure full radius elbow.

D. Support flexible ductwork as recommended by manufacturer and with minimum 0.5” wide saddles with maximum sag of 0.5” per ft between supports. Spacing of supports shall beat a maximum of 5 ft on center , with no portion lying on ceiling supporting system.

E. Individual sections of flexible ductwork shall be of one-piece construction. Splicing of short sections is not allowed.

F. Connect flexible duct liner to collars and rigid duct in accordance with manufacturer’s installation instructions. If manufacturer’s installation instructions do not include stainless steel draw-bands, provide stainless steel draw-bands in addition to manufacturer’s installation instructions. One draw-band shall secure flexible duct to rigid duct and another shall secure flexible duct outer jacket to rigid duct. If collars have beads, position draw bands behind beads.

G. Pull insulation and vapor barrier jacket over liner connection and secure with draw band. For terminations at externally insulated ductwork, fittings, grilles, diffusers, etc., secure flexible duct jacket to ductwork insulation jacket with compatible vapor barrier tape.

H. Flexible ducts are not allowed above non-accessible ceilings.

END OF SECTION

SECTION 23 3314
DUCTWORK SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 23 0595 - Air Systems Test Adjust Balance

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 SUBMITTALS

A. Shop Drawings including, but not limited to, the following:
   1. Manufacturer's name and model number
   2. Capacities
   3. Temperature/pressure ratings
   4. Materials of construction
   5. Dimensions
   6. Manufacturer's installation instructions and/or detailed drawings
   7. All other appropriate data

1.04 DESIGN CRITERIA

A. Products and materials shall conform to NFPA Section 90A, possessing flame spread rating of not over 25 and smoke developed rating no higher than 50.

B. Ductwork specialties exposed to air stream, such as dampers, turning vanes and access doors, shall be of same material as duct or unit at where the specialties are mounted, unless otherwise noted.

C. Unless otherwise noted, ductwork specialties shall be designed and constructed for pressure class of ductwork in which they are installed.

PART 2 PRODUCTS

2.01 MANUAL BALANCING DAMPERS

A. Manufacturers: Ruskin, Greenheck, Vent Products, Pottorff or Air Balance, constructed in accordance with SMACNA HVAC Duct Construction Standards, except as modified below.

B. Rectangular Dampers:
   1. For low pressure ductwork, for damper blade height up to 12”, use single blade type with minimum 22 ga. galvanized steel blade with minimum 3/8” rod for blade width up to 18”, and with minimum 18 ga. galvanized steel blade with minimum 1/2” continuous rod for blade width from 19” to 48”. For damper blade height more than 12”, use multiple blade type with minimum 16 ga. galvanized steel channel frames, opposed blade linkage operation, with blades minimum 16 ga. and 6” to 8” maximum blade width, minimum 1/2” continuous rod and 1/2” x 1/2" galvanized steel angle blade stops. Bearings shall be nylon or molded synthetic. Construct dampers over 48” in width or height in multiple sections with mullions.

C. Single Blade Round Dampers:
   1. For low pressure ductwork, damper shall have blade 24 ga., but no less than two gauges more than duct gauge. Rod shall be minimum 3/8” diameter or square continuous. Bearings shall be nylon or molded synthetic.
   2. For high pressure ductwork, damper blade shall be minimum 16 ga. Rod shall be minimum 1/2” square continuous and tack welded to blade. Provide sealed end bearing similar to Ventlok #609 and acorn nut type dial regulator similar to Ventlok #635 or 641.

D. Provide damper operators with locking devices and damper position indicators. Sheet metal screws are not allowed in construction or installation of dampers. Use rivets or tack welds.

E. Dampers shall be properly stiffened and fabricated to prevent vibration, flutter, or other noise.

F. Extend damper shafts through duct insulation or use elevated regulators for externally insulated ducts to accommodate specified insulation thickness.

2.02 FIRE DAMPERS

A. Manufacturers: Air Balance, NCA, Greenheck, Nailor, Cesco, Pottorff Louvers and Dampers, or Ruskin

B. Fire damper assemblies shall be listed by UL 555 with 165°F fusible link and shall meet construction standards as set forth in NFPA 90A.

C. Fire resistance rating of fire dampers shall be as shown on drawings.

D. Dampers shall be dynamic type dampers suitable for maximum air velocity and pressure to which they are subjected, but not less than 2000 fpm and 4" WG.

E. Dampers shall be curtain type with blades out of air stream when in open position. Where curtain type dampers are not available because of size, use multiple blade type dampers.

F. For round ducts, dampers similar to Ruskin Model FDR25 may be used where products are suitable for duct size, velocity, and static pressure.

G. Damper fire rating shall be compatible with rating of building surface in which damper is used.

H. Submit UL installation details showing mounting method and duct connection method.

I. Where ceiling fire dampers are used, they shall be similar to Ruskin CFD(R) 2 or 3, UL Classified for installation in fire rated floor or roof/ceiling assemblies.

2.03 ACCESS DOORS

A. Access doors shall be rectangular, minimum 22 ga. frame and minimum 24 ga. door, fit airtight with neoprene gasket and shall be suitable for duct pressure class. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners are not acceptable.

B. Low Pressure Ducts (Pressure Class 2" and Under):
   1. Doors shall be hinged type with sash lock for exposed application and non-hinged type with cam latches for concealed application.
   2. Access doors constructed in accordance with SMACNA HVAC Duct Construction Standard (Figure 7-2) or similar to Ruskin Model ADC or ADH will be acceptable.
   3. Sandwich style access doors made by Ductmate, Ward Industries, Greenheck, or Flexmaster are acceptable, provided that they meet insulation requirements.

C. High Pressure Ducts (Pressure Class 3" and Over):
   1. Use access doors factory fabricated and rated by manufacturer's published literature for installation in systems with pressures to positive or negative 10" WG.
   2. Sandwich access doors made by Ductmate, Ward Industries, Pottorf, Greenheck, or Flexmaster are acceptable, provided that they meet insulation requirements.

2.04 DUCT FLEXIBLE CONNECTIONS

A. Manufacturers: Unless specifically indicated, Ventfabrics, Inc., Ductmate or Duro Dyne. Material shall be glass fabric, fire retardant, waterproof, air tight and comply with NFPA 90A and 701 (formally UL 214).

B. General Supply, Return and Exhaust Ductwork:
   1. Material for indoor use to be 30 oz per square yard, double coated with neoprene, tensile strength (warp/fill) of 475 lbs / 375 lbs, tear strength of 13 lbs x 13 lbs, suitable for -40°F to 200°F continuous operation.
   2. Material for outdoor use shall be combination of inner layer of Duro Dyne Neoprene or similar and outer layer of 24 oz per square yard, coated with Hypalon, UV resistant, suitable for -40°F to 250°F, similar to Duro Dyne Durolon.

2.05 INSTRUMENT TEST HOLES

A. Manufacturers: Ventlok 699 (up to 1” insulation thickness) or Ventlok 699-2 (over 1” insulation thickness).

B. Use concave gaskets for round ductwork.

PART 3 EXECUTION

3.01 MANUAL BALANCING DAMPERS

A. Install manual balancing dampers in supply, return and exhaust branch ducts, as shown on drawings and as required to regulate airflow to meet air balance requirements.

B. Install manual balancing damper in branch duct to each diffuser and grille. Install dampers as close as possible to take-offs.

C. Install balancing dampers so as not to flutter or vibrate and as far as possible upstream from the air outlet.

D. Do not install balancing dampers in supply ductwork upstream of air terminal devices.

E. Balancing damper is not required where terminal air device serves a single diffuser or grille.

3.02 FIRE DAMPERS

A. Install dampers where shown on drawings in accordance with manufacturer's installation instructions and requirements of NFPA 90A. Install dampers complete with mounting collars, retaining angles, connections to adjoining ductwork and duct access doors. Install duct access door at each damper with door size large enough to permit replacement of fusible links and resetting of dampers.

B. Test and demonstrate proper operation of each damper after system is installed and ready for operation.

1. Manually test each damper for proper operation by removing fusible link or actuating EFL or PFL. Repair or replace any damper that does not close completely. Replace fusible link and certify in writing that each damper was installed according to manufacturer's installation instructions and that each damper can be expected to close completely when fusible link melts.
2. Notify Owner and/or Owner’s representative at least 48 h prior to testing to allow for witnessing.

C. Contractor shall provide letter from manufacturer's representative indicating that dampers are installed per manufacturer's installation instructions.

3.03 ACCESS DOORS

A. Install access doors where specified, indicated on drawings, and in locations where maintenance, service, cleaning or inspection is required, including automatic dampers, fire dampers, reheat coils, valves and control devices within duct or casing, at outside air intake duct and at inlet side of turning vanes in return ductwork.

B. Locate access doors for greatest ease of access.

C. Size and quantity of duct access doors shall be sufficient to perform intended service, but not less than the following:

Rectangular Duct Size	Minimum Access Door Quantity and Size
10”and smaller	(1) 8” x 8”
12” to 15” and smaller	(1) 10” x 10”
16” to 21”	(1) 14” x 14”
22” to 27”	(1) 18” x 18”
28” to 51”	(1) 24” x 24”
52” to 96”	(2) 24” x 24”

Round Duct Size	Minimum Access Door Size
10” and smaller	8” x 4”
15” and smaller	12” x 8”
29” and smaller	16” x 12”
30” and over	24” x 18”

D. Increase duct size to accommodate access door size indicated above where required.

E. Access doors for life safety dampers shall be adequate size for inspection and maintenance, but not less than 12” x 12”If adjacent duct or damper is smaller than 12” x 12”, provide larger size duct or damper to accommodate minimum access door size without transition.

3.04 DUCT FLEXIBLE CONNECTIONS

A. Connect ductwork to fans or casings containing rotating equipment or mounted on vibration isolators with duct flexible connections. Installed width shall be suitable for specific application but shall not be less than 4”. Install flexible connections in accordance with SMACNA Standards with double lock or "Grip Loc" connection.

B. Duct flexible connections are not allowed for fan connection serving kitchen hood, or perchloric acid hood.

3.05 INSTRUMENT TEST HOLES

A. Provide instrument test holes at air entering and air leaving side of all internal air handling system components for static pressure differential (Delta P) or temperature differential (Delta T) measurements.

B. Provide ductwork instrument test holes as shown on drawings, or as directed by TAB personnel, or Engineer.

END OF SECTION

SECTION 23 3600
AIR TERMINAL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 23 3114 - Ductwork (Support)

B. Section 23 3314 - Ductwork Specialties (Access Doors)

C. Section 23 8214 - Heating and Cooling Terminal Devices

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 SUBMITTALS

A. Shop Drawings including, but not limited to, the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the documents
   3. Capacities/ratings
   4. Materials of construction
   5. Sound rating data
   6. Dimensions
   7. All other appropriate data

1.04 QUALITY ASSURANCE

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

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1 – 2010, Section 5 – “Systems and Equipment” and Section 7 – “Construction and System Start-Up.”

1.05 DESIGN CRITERIA

A. Where any of air terminal devices are indicated on drawings to control space conditions in conjunction with reheat coil, that reheat coil may be furnished as integral part of or standard accessory to devices specified below. See related work above.

B. When air terminal devices are furnished with reheat coils, either integrally or remotely mounted, control panels of terminal devices shall be mounted on the same side of air terminal device as reheat coil piping connection.

C. Unless otherwise stated, units shall be system pressure independent and maintain air volume within ± 5% of required airflow regardless of system air pressure. Inlet velocity pressure sensor shall be multi-point center averaging type and be capable of amplifying pressure signals.

D. Unless otherwise stated, unit casings shall be constructed of galvanized steel or aluminum meeting SMACNA or ASHRAE Standards, but not lighter than 22 ga.

E. Joints and seams of air terminal devices shall be sealed with appropriate sealant to minimize casing air leakage.

F. Unit leakage test shall comply with ASHRAE Standard 130 – Laboratory Methods of Testing Air Terminal Units.

G. Unit performance shall be certified in accordance with AHRI Standard 880 including sound rating data certified for both casing discharge and radiated sound levels from 125 through 4000 Hz.

H. Supply air units shall be capable of operating from minimum inlet static pressure scheduled to 3” WG.

I. Provide supply air units with internal thermal insulation faced with minimum 0.001" thick aluminum foil. Insulation shall be compressed glass fiber with minimum 3/4" thick, 4 lb/ft^3 density with R-value of 3.5[(h·ft^2·°F)/Btu]. Insulation and facing shall meet requirements of UL 181 (Air Erosion, Mold growth and Humidity), and NFPA 90A (Flame 25/Smoke 50) and ASTM C665 (Fungi Resistance). Secure liner with full-seam-length, galvanized steel angles or Z-strips, which enclose and seal all edges. Tape or adhesive will not be acceptable. Liner assembly shall be similar to Titus Steri-Loc.

J. Unit manufacturer or manufacturer's designated representative will be required to verify air terminal device performance and adjust or replace device within warranty period when it is determined that problem exists in area served by device.

K. Room sound levels due to discharge and/or casing radiation from units when operating from minimum pressure scheduled to 2" WG inlet static pressure shall not exceed noise criteria (NC) values in any spaces as indicated below. If units exceed sound level specified, provide terminal sound attenuators to comply with the noise criteria stated below. Refer to Section 23 3314 - Ductwork Specialties for sound attenuating devices.

Type of Room	Noise Criteria (NC)
All spaces unless otherwise indicated	35
Computer Rooms	40
Laboratories and Support Spaces	50
Conference Rooms	30

1.06 CONTROLS COORDINATION

A. Unit manufacturer shall provide unit inlet flow sensor, pneumatic tubing, and control enclosure for Control Contractor's use.

B. Control Contractor shall furnish all actuators, linkages if required, differential pressure transmitters, controllers and any other devices required for unit control that are not provided by unit manufacturer for unit manufacturer's factory mounting. Unit manufacturer and Control Contractor shall coordinate for proper factory installation.

C. Unit manufacturer shall factory install devices furnished by Control Contractor to result in complete functioning unit. Unit manufacturer shall be responsible for reviewing compatibility of devices furnished by Control Contractor with units being provided.

D. Unit manufacturer shall perform preliminary calibration based on scheduled airflow rates.

E. Control Contractor shall be responsible for calibrating actuators and controllers through TAB work for scheduled airflow rates.

F. Control Contractor's field mounting will be acceptable, provided Control Contractor coordinates proper installation with unit manufacturer. Control Contractor shall be responsible for complete functioning unit.

PART 2 PRODUCTS

2.01 VARIABLE VOLUME AIR TERMINAL DEVICES

A. Manufacturers: Titus, Price or Nailor

B. Units shall be suitable for 24 V electric control system. Control Contractor shall be responsible for wiring from control panels to each terminal unit.

C. Furnish units with reheat coils having capacities as indicated in schedules.

D. Casing leakage rates shall not exceed the following maximum values:

Unit Size	Max. Casing Leakage (cfm)	
	0.5” WG	1.0” WG
4, 5, 6	2	3
7, 8	4	5
9, 10	4	6
12	5	7
14	6	9
16	7	10

E. Provide access doors for all air terminal devices with reheat coils at inlet side of coils. Refer to Section 23 3314 - Ductwork Specialties for access doors. Unit manufacturer's standard access doors are acceptable, provided that access doors are appropriately sized and internally lined with same materials as unit casing. If access doors are provided in separate sections as extension of units, these sections shall be internally lined in same manner as units.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install units as shown on drawings and according to manufacturer's installation instructions.

B. Install units with sufficient service space to unit control, actuators, and access panels.

C. Provide minimum length of 3 times box inlet diameter of straight rigid duct at box inlet.

D. Provide access doors for terminal devices with reheat coils at inlet side of coils.

E. Provide access panels compatible with ceiling for all units located above non-accessible ceilings.

END OF SECTION

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SECTION 23 3713
DIFFUSERS, REGISTERS AND GRILLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 SUBMITTALS

A. Shop Drawings including, but not limited to, the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the Documents
   3. Capacities/ratings
   4. Materials of construction
   5. Sound ratings
   6. Dimensions
   7. Finish
   8. Color selection charts where applicable
   9. Manufacturer's installation instructions
   10. All other appropriate data

1.03 DESIGN CRITERIA

A. Performance data shall be based on tests conducted in accordance with ASHRAE Standard 70-2006.

B. Screw holes on surface shall be counter sunk to accept recessed type screws.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Titus, Price or Nailor

B. Acceptable manufacturers for specialty products are listed under each item.

2.02 CEILING DIFFUSERS

A. Diffusers shall be aluminum or steel as scheduled, unless otherwise indicated, and furnished with frame type appropriate to installation. Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 times duct diameter straight duct into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into diffuser neck and providing directional control of airflow.

B. Diffuser models, sizes and finishes shall be as shown on drawings and/or as scheduled. Unless noted otherwise, diffusers shall have baked enamel or powder coat finish with white color.

2.03 ARCHITECTURAL SQUARE PANEL CEILING DIFFUSERS

A. Architectural square panel ceiling diffusers shall be similar to Titus Model OMNI diffuser.

B. Diffusers shall have one piece 18 ga. face panels. Face panel shall be removable by means of four positive locking posts. Exposed surface of face panel shall be smooth, flat, and free of visible fasteners and have rounded off corners. Face panel shall project no more than 3/8” below outside border of diffuser back pan. Back of face panel shall have an aerodynamically shaped, roller edge to ensure tight horizontal discharge pattern.

C. Ceiling diffusers with 24” x 24” full face shall have no less than 18” x 18” face panel size.

D. Back pan shall be one piece die-stamped and shall include integrally drawn round inlet. Diffuser back pan shall be constructed of 22 ga. steel. Diffuser neck shall have minimum of 1-1/4” depth available of duct connection. Back pan shape with face panel shall deliver 360° radial horizontal air pattern.

E. Unless otherwise indicated, diffusers shall have baked enamel or powder coat finish with white color.

2.04 REGISTERS AND GRILLES

A. Registers and grilles shall be aluminum or steel as scheduled unless otherwise indicated, and furnished with frame type appropriate to installation.

B. Supply registers and grilles shall be double deflection type blades to provide for air deflection adjustment in all directions.

C. Return and exhaust registers and grilles shall have fixed blade core.

D. Registers shall be furnished complete with opposed blade volume control dampers, operable from face.

E. Register and grille models, sizes and finishes shall be as shown on drawings and/or as scheduled. Unless noted otherwise, registers and grilles shall have baked enamel finish with color selected by Architect.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.

B. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar sizes.

C. Seal connections between ductwork drops and diffusers/registers/grilles air tight.

D. Support independently diffusers and grilles designed for T-bar mounting that exceed weight limit of ceiling suspension system in which they are to be installed.

E. Unless otherwise shown, provide wire mesh screen at end of each open ended duct (OED) that is exposed in occupied spaces.

F. Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

G. Protect diffusers, registers and grilles from construction dirt. Clean or replace those soiled or stained prior to turnover to Client.

END OF SECTION

SECTION 23 8214
HEATING AND COOLING TERMINAL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 20 0513 - Motors

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 SUBMITTALS

A. Shop Drawings for all items in this Section including, but not limited to, the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the documents
   3. Capacities/ratings
   4. Materials of construction
   5. Dimensions and weights
   6. Color selection chart where applicable
   7. Wiring diagrams
   8. For chilled beams, submit performance data from independent testing agency. Performance data to include cooling capacity at supply water temperatures scheduled, air pressure drop, sound data, and water pressure drop for each beam length.
   9. All other appropriate data

1.04 REFERENCE STANDARDS AND DESIGN CRITERIA

A. Finned-Tube Radiation: Ratings shall be IBR Certified.

PART 2 PRODUCTS

2.01 FIN TUBE RADIATION

A. Manufacturers: Slant/Fin, Sterling, Mesteck, Vulcan or Rittling

B. Heating elements shall be constructed of aluminum fin on copper tube or steel fin on steel tube as scheduled, supported on wall mounting brackets with slide cradles 3 ft on center for free expansion without noise.

C. Enclosures and grilles will be provided by General Contractor.

D. Provide all necessary accessories such as inside corner, outside corners, enclosure extensions and end caps as required for complete installation as indicated on drawings and/or schedules.

E. Furnish complete with access doors at all valves.

2.02 ACTIVE CHILLED BEAMS

A. Manufacturers: Dadanco, Semco, Price, or approved equal.

B. Units shall be induction type with primary air connection(s), induction nozzles, chilled water coil(s), heating hot water coil(s) (where scheduled), integral air diffuser(s) and removable induction inlet grille for access to coil face(s). Units shall be designed for **2-pipe, cooling only duty**.

C. All components of chilled beam shall meet NFPA 90A requirements for flame spread and smoke developed.

D. Housing shall be formed/stamped aluminum or galvanized steel.

E. Units shall be complete with flush mounted, removable induction grille for access to coil(s), supply air plenum with inlet duct collars, induction nozzles, and slotted supply diffusers in 1-way or 2-way throw configuration as scheduled.

F. Induction inlet grille shall be removable for coil access. Grilles shall have safety cables or chains to support grille core during coil access or grilles shall be hinged along one side, allowing grille core to swing down 90 degrees minimum for coil access.

G. Provide minimum of 4 adjustable support tabs/brackets per unit, for hanger support from building structure Each beam shall be individually supported to building structure as recommended by manufacturer. Installation hardware shall be in accordance with manufacturer's recommendations and any local codes that dictate hanging requirements.

H. Diffuser and induction grille face shall be constructed of aluminum or pressed steel components. Induction grille shall be perforated steel or aluminum, of sufficient gauge to avoid sagging. Air plenum shall be constructed of minimum 22 ga. galvanized steel. Interior of plenum shall be painted black if visible from room side.

I. Diffuser and induction grille face shall be powder coat or baked enamel finish of manufacturer's standard white color.

J. Units shall be designed with standard US (IP) dimensions and NPT pipe connections.

K. Units shall be of nominal length and width scheduled and shall be compatible with ceiling type scheduled or specified by Architect.

L. Water coils shall be constructed of 1/2" or 5/8" OD seamless copper tubes with minimum wall thickness of 0.016" with aluminum fins suitable for minimum working pressure to 300 psig at 75ºF temperature. Coil connections shall be NPT threaded.

M. Coils shall be rated according to AHRI Standard 410. Coils shall be delivered factory clean, flushed, and capped. Water pipes shall be factory fitted with one vent and one drain valve.

N. Coil shall be factory painted flat black.

O. Where dual coils are used to meet scheduled capacity, provide dual coils with factory pre-piped single point supply, and return connections.

P. Provide flexible metal hose assemblies for cooling water connections for each chilled beam. Minimum length of metal hose assembly shall be 18" and maximum length shall be 24".
   1. Flexible Hose:
      a. Stainless Steel (Corrugated) Core:
         1). Flexible hose shall be constructed of corrugated 300 series stainless steel core, 300 series stainless steel braided cover, stainless steel ferrules, and 304 stainless steel end connections. Maximum Allowable Operating Pressure (MAOP) shall be not less than 400 psi at 600°F.
      b. EPDM Core:
         1). Flexible hose shall be constructed of EPDM core, stainless steel braided cover, stainless steel ferrules, and brass end connections. Maximum Allowable Operating Pressure (MAOP) shall be not less than 300 psi at 230°F.

Q. Submittals shall include performance data from independent testing agency. Performance data to include cooling/heating capacity at supply water temperatures scheduled, air pressure drop, supply air throw performance, sound data and water pressure drop for each chilled beam length and throw configuration.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install units as indicated on drawings, and according to manufacturer's installation instructions.

B. Install branch piping to each unit with minimum of 3 elbows to allow for expansion and contraction.

C. Protect units during construction against entry of foreign matter and construction dirt.

D. Unless otherwise shown on drawings, mount vertical type wall mounted heating units 12" above finished floor.

3.02 FIN TUBE RADIATION

A. Install dirt guard gasket to mounting strip or caulk along top of mounting strip.

B. Install enclosure brackets at not more than 4 ft intervals.

C. Unless otherwise shown on drawings, mount units with manufacturer's recommended minimum height above finished floor to provide capacities scheduled.

3.03 ACTIVE CHILLED BEAMS

A. Mount units in ceilings as shown on drawings and on reflected ceiling plans.

B. Support units independently of ceiling grid and directly from building structure, with minimum of 4 supports per chilled beam, using threaded rod or approved cable supported system. Wire supports are not allowed.

C. Where necessary, provide strut supports spanning under wide obstructions (ducts) to allow for proper alignment of chilled beam to ceiling grid.

D. Support units in accordance with applicable seismic restraint requirements.

E. Install manual air vents for complete venting of air from system. Provide drain valves at low points of main or branch main piping.

F. Multiple chilled beams may be zoned to match associated supply air terminals and controlled through single control valve. Refer to chilled beam schedule and/or drawings for chilled beams served by common control valve.

END OF SECTION

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SECTION 23 8314
RADIANT CEILING PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 20 0700 - Mechanical Systems Insulation

B. Section 23 0594 - Water Systems Test Adjust Balance

C. Section 23 2116 - Pipe and Pipe Fittings

D. Section 23 2118 - Valves

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 SUBMITTALS

A. Shop Drawings including, but not limited to, the following:
   1. Manufacturer's name and model number
   2. Identification as referenced in the documents
   3. Capacities/ratings
   4. Materials of construction
   5. Dimensions
   6. Manufacturer's installation instructions
   7. All other appropriate data

B. Submit color samples of panels.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original protective packaging. Store materials in area protected from weather, moisture, dirt, or dust. Handle material to prevent damage, paint chipping or deformation.

1.05 SYSTEM DESCRIPTION

A. Provide complete radiant panel ceiling system where shown on drawings, as scheduled, and as herein specified.

B. Supervise installation of all equipment in ceiling panels. Provide special protection in areas where work must occur after ceiling panel installation, to avoid damage or soiling of ceiling panels.

C. Restore to original condition or replace materials damaged, or with surface defects.

1.06 RADIANT CEILING PANEL PERFORMANCE REQUIREMENTS

A. Radiant ceiling panels shall be heating only.

1.07 TESTING AND FILLING

A. Test each radiant panel zone including all interconnecting piping between supply and return points at 100 psig for minimum one hour before corrections are made to water circulating system. No loss of pressure shall occur during test.

B. All system piping shall be thoroughly cleaned, flushed, drained, and refilled as specified in Section 23 2116 - Pipe and Pipe Fittings before radiant panels are connected into system.

C. Notify Architect and/or Engineer in writing at least 3 days before starting final testing and filling process.

D. Upon completion of testing, submit test data to Architect and/or Engineer.

1.08 QUALIFICATION AND GUARANTEE

A. Contractor shall install system in accordance with manufacturer's recommendation, complete, and to the satisfaction of Architect and/or Engineer.

B. Guarantee radiant ceiling panel system to perform as specified and to function without objectionable noise generated from thermal expansion/contraction or hydronic resonance to Architect's and/or Engineer's satisfaction and acceptance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Air-Tite, Airtex, Rittling, Sterling, Aerotech, or Shelly

2.02 METAL CEILING PANELS

A. Extruded Aluminum Linear Panels:
   1. System shall be equal to Air-Tite Model AR-X.
   2. Construct panels of extruded aluminum having thickness of not less than 0.06”. 1/2" ID copper tubing shall be mechanically attached to aluminum faceplate. Copper tubing shall be formed into oval shape and heat conductive paste, of non-hardening kind, shall be placed between copper tubing and aluminum faceplate. Oval tube shall be held in place by aluminum saddle, which extends more than halfway around diameter of tube. Use of adhesive and/or clips to attach copper tube to extrusion will not be acceptable.

B. Panel Surface Finish:
   1. Panel surface finish shall be 2 coats of white baked enamel.

2.03 INSULATION

A. 1" thick glass fiber insulation blanket equal to Johns Manville "R" Series Microlite.

2.04 PIPING

A. Interconnecting piping between radiant panels shall be 1/2" OD type L soft drawn seamless copper tubing with wrought copper or bronze fittings. Use lead free solder equal to Bridgit or Silvabrite.

B. Tubing shall be sufficient length to allow for expansion and contraction and tubing for panels requiring access above ceiling shall be at least 6 ft in length so as to allow lowering of panel. Final 3 ft of supply and return piping connection to panels shall be made with type L soft drawn seamless copper tubing and direct connection without fitting.

PART 3 EXECUTION

3.01 DIMENSION VERIFICATION

A. Verify all field conditions and dimensions before commencing installation.

3.02 VALVES, DRAINS, AIR VENTS, ETC.

A. For branch pipe feeding radiant panels, use top take-off for branch pipe connection to main with manual air vents.

B. Install valves, drains, air vents, etc. as shown on drawings. Install air vent at end of each radiant panel circuit.

3.03 INSULATION

A. Install insulation above radiant panels.

B. Install edges of insulation tightly butted.

C. Locate vapor barrier foil jacket top side of insulation. Jacket shall cover insulation completely so that no fiberglass insulation is exposed to ceiling plenum space.

END OF SECTION

SECTION 26 0000
GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 DESCRIPTION

A. Intent of drawings and Specifications is to obtain complete systems tested, adjusted, and ready for operation.

B. Except as otherwise defined in greater detail, the terms "provide", "furnish" and "install" as used in Division 26 Contract Documents shall have the following meanings:
   1. "Provide" or "provided" shall mean "furnish and install".
   2. "Furnish" or "furnished" does not include installation.
   3. "Install" or "installed" does not include furnishing.

C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.

E. Included in this Contract are electrical connections to equipment provided by others. Refer to Architectural, Mechanical, Plumbing, and final shop drawings for equipment being furnished under other sections for exact locations of electrical outlets and various connections required.

F. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for dimensions.

G. Where architectural features govern location of work, refer to Architectural Drawings.

H. Perform work in "neat and workmanlike" manner as defined in ANSI/NECA 1, Standard Practices for Good Workmanship in Electrical Contracting.

1.03 RELATED WORK

A. Temporary Services:
   1. Division 01 - Temporary Facilities and Controls.

B. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before work is started.
   2. When interruption of services is required, Architect, Owner and other concerned parties shall be notified and shall determine a time.

C. Demolition:
   1. Division 02 - Selective Demolition
   2. Division 02 - Building Demolition
   3. Perform required demolition to accomplish new work.
      a. Remove abandoned wiring to source of supply. Wiring and conduit shall be extended where necessary to maintain circuit continuity to areas beyond the demolition scope area.
      b. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
      c. Disconnect abandoned outlets and remove devices.
      d. Remove abandoned outlets if conduit servicing them is abandoned and removed.
      e. Provide blank cover for abandoned outlets that are not removed.

f. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
g. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.
h. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

4. Accomplish work in neat workmanlike manner to minimize interference; annoyance or inconvenience such work might impose on Owner or other Contractors.
5. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
6. Equipment noted to be removed and turned over to Owner, shall be delivered to Owner at place and time Owner designates.
7. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
8. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner and with other Contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such work.

D. Cleaning and Repair
1. Clean and repair all materials and equipment that remain or are to be reused.
2. Panelboards.
a. Clean exposed surfaces and check tightness of electrical connections.
b. Replace damaged circuit breakers and provide closure plates for vacant positions.
c. Provide typed circuit directory showing revised circuiting arrangement.
3. Luminaires:
a. Remove existing luminaries for cleaning.
b. Use mild detergent to clean exterior and interior surfaces; rinse with clean water and wipe dry.
c. Replace lamps and broken electrical parts.

E. Concrete Work:
1. Provide cast-in-place concrete as required by Contract Documents unless otherwise noted.
2. Concrete shall comply with Division 03 - Concrete.
3. Provide anchor bolts, metal shapes and templates to be cast in concrete or used to form concrete as required for anchoring and supporting electrical equipment.

F. Painting:
1. Furnish equipment with factory applied prime finish unless otherwise specified.
2. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Owner.
3. Furnish one can of touch up paint for each final factory-applied finish coat of product.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State, and local authorities and utility companies, in force at time of execution of Contract shall become part of this specification.

1.05 REFERENCE STANDARDS

A. Agencies or publications referenced herein refer to the following:
1. AEIC Association of Edison Illuminating Companies
2. ANSI American National Standards Institute
3. ASME American Society of Mechanical Engineers
4. ASTM American Society for Testing and Materials
5. BICSI Building Industry Consulting Services International
6. EIA Electronic Industries Association
7. FIPS Federal Information Processing Standards

8. FCC Federal Communications Commission
9. ICEA Insulated Cable Engineers Association
10. IEEE Institute of Electrical & Electronics Engineers
11. IESNA Illuminating Engineering Society of North America
12. NEC National Electrical Code
13. NECA National Electrical Contractors Association
14. NEMA National Electrical Manufacturers Association
15. NESC National Electrical Safety Code
16. NETA National Electrical Testing Association
17. NFPA National Fire Protection Association
18. NIST National Institute of Standards & Technology
19. OSHA Occupational Safety and Health Administration
20. TIA Telecommunications Industries Association
21. UL Underwriters Laboratories, Inc.

B. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

1.06 LISTING

A. Install materials bearing UL label or UL listing, unless UL label or listing is not available for that type of material.

B. Other nationally recognized testing agencies, acceptable to AHJ, are approved.

1.07 ENCLOSURES

A. Typical NEMA Enclosures and Usage
1. NEMA 1 - Indoors. Falling dirt.
2. NEMA 3R - Outdoors. Rain, snow, sleet.
3. NEMA 4X - Outdoors. Rain, sleet, snow, windblown dust. Hose down plus corrosion resistant.
4. NEMA 7 - Indoors. Class I, Division 1 or 2, Groups A, B, C or D. (Flammable gas).
5. NEMA 9 - Indoors. Class II, Division 1 or 2. Groups E, R, or G. (Combustible dust).
6. NEMA 12 - Indoors. Falling Dirt. Falling liquids. Flying dust, lint, and fibers. Oil or coolant seepage.

1.08 SUBMITTALS

A. Shop Drawings (Product Data):
1. Refer to Division 01 - Submittal Procedures.
2. Note that for satisfying submittal requirements for Division 26, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, the expression "Shop Drawings" is generally used throughout Specification.
3. Submit shop drawings for equipment and systems as requested in respective specification sections. Submittals which are not requested may not be reviewed.
4. Submittal tracking number is to include the respective specification number.
5. Specifically mark general catalog sheets and drawings to indicate specific items submitted and its correlation to specific designation for product in drawings.
6. Specifically indicate proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
7. When manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. Clearly mark and note submittal accordingly.
8. Submit complete record of required components when luminaires, equipment and items specified include accessories, parts, and additional items under one designation.
9. Include wiring diagrams for electrically powered or controlled equipment.
10. Submit electrical equipment room layouts drawn to scale, including equipment, raceways, accessories and required working clearances. Submit electrical equipment room layouts concurrently with electrical distribution equipment submittals.

11. Where submittals cover products containing non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
12. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.
13. Submittals that are not complete, not permanent, or not properly checked by Contractor, will be returned without review.
14. "Coordination Drawings", which are normally prepared by Contractor to coordinate work among various trades and to facilitate installation, shall not be submitted for Division 26 work unless specifically requested in technical sections. These types of drawings typically include dimensioned piping, ductwork, or electrical raceway layouts.
15. Unless specifically requested in Division 26 technical sections, submittals of coordination drawings will be returned without review.

B. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

C. Operation and Maintenance Manuals:
1. Refer to Division 01 - Operation and Maintenance Data.
2. Upon completion of work but before final acceptance of system, submit to Architect for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2” thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.
3. Organize manuals by specification section number and furnish table of contents and tabs for each piece of equipment or system.
4. Manuals shall include the following:
   a. Copies of shop drawings
   b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment, with component exploded views and part numbers. Where manufacturer's data includes several types or models, designate applicable type or model.
   c. CD ROM's of O&M data with exploded parts lists where available
   d. Phone numbers and addresses of local parts suppliers and service companies
   e. Internet/WEB page addresses where applicable
   f. Wiring diagrams
   g. Start up and shut down procedure
   h. Factory and field test records
   i. Additional information, diagrams or explanations as designated under respective equipment or systems specification section
5. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
6. Furnish O&M manuals and instructions to Owner prior to request for final payment.

D. Record Documents:
1. Refer to General Conditions of Contract and Division 01 - Project Record Documents. Prepare complete set of record drawings in accordance with Division 01.
2. Use designated set of prints of Contract Documents as prepared by Architect to mark-up for record drawing purposes.

1.09 JOB CONDITIONS

A. Building Access:
1. Arrange for necessary openings in building to allow for admittance of all apparatus.

B. Coordination:
1. Equipment provided under other Divisions of these specifications.
   a. Motors

b. Electrically powered equipment
c. Electrically controlled equipment
d. Starters, where specified
e. Variable frequency drives, where specified
f. Control devices, where specified
g. Temperature Control wiring

2. Provide the following devices required for control of motors or electrical equipment, unless noted otherwise:
   a. Starters
   b. Disconnect devices
   c. Control devices:
      1). Pushbuttons
      2). Pilot lights
      3). Contacts
   d. Conduit, boxes and wiring for Power wiring
   e. Conduit, boxes and wiring for Control wiring, except temperature control wiring
3. Connect and wire equipment complete and ready to operate according to wiring diagrams furnished by various trades.
4. Wire starters or other similar control devices furnished by others.
5. This contractor's drawings and/or specifications show number and hp rating of motors furnished by others, together with their actuating devices. Should any change in size, hp rating, voltage, or means of control be made to any motor or other electrical equipment after Contracts are awarded, Contractor responsible for change shall immediately notify this Contractor. Additional costs due to these changes shall be responsibility of Contractor initiating change.
6. Equipment and wiring shall be selected and installed for conditions in which it will be required to perform. (i.e., general purpose, weatherproof, rain tight, explosion proof, dust tight, or any other special type as required.)
7. Comply with local utility motor starting requirements and provide starters for motors furnished by others as specified herein or under various trade sections of those specifications.

C. Cutting and Patching:
1. Refer to General Conditions of the Contract and Division 01 - Cutting and Patching.
2. Perform cutting and patching required for complete installation of systems, unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
3. Provide materials required for patching unless otherwise noted.
4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.
5. Where alterations disturb lawns, paving, walks, etc., replace, repair, or refinish surfaces to condition existing prior to commencement of work. This may include areas beyond construction limits.

D. Housekeeping and Cleanup:
1. Refer to Division 01 - Closeout Procedures.
2. As work progresses or as directed by General Contractor, periodically remove waste materials from building and leave area of work broom clean. Upon completion of work, remove tools, scaffolding, broken and waste materials, etc. from site.

1.10 WARRANTY

A. Refer to Division 01 for general warranty requirements.

B. Refer to technical sections for warranty requirement for each system.

1. Where no warranty requirements are called out, warrant for 1 year after acceptance by Owner equipment, materials, and workmanship to be free from defect.

C. Repair, replace, or alter systems or parts of systems found defective at no extra cost to Owner.

D. In any case, wherein fulfilling requirements of any guarantee, if this contractor disturbs any work guaranteed under another contract, this contractor shall restore such disturbed work to condition satisfactory to Owner and guarantee such restored work to same extent as it was guaranteed under such other contract.

E. Warranty shall include labor, material, and travel time.

PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. Refer to Division 01 - Product Requirements.

B. Produce substitutions are to be approved prior to submitting bids.

C. Refer to individual specification sections for specific substitution requirements related to that section.

D. The Engineer reserves the right to refuse product substitutions after the electrical subcontract has been awarded.

PART 3 EXECUTION

3.01 GENERAL

A. Verify elevations and dimensions prior to installation of materials.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 01.

B. Store and protect products under provisions of Division 01

C. Store in clean, dry space.

D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer’s written instructions.

F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

G. Provide supplemental heat if required to prevent moisture contamination.

3.03 FLOOR, WALL, ROOF AND CEILING OPENINGS

A. Coordinate location of openings, chases, furred spaces, etc. with appropriate Contractors. Provide sleeves and inserts that are to be built into structure during progress of construction.

B. Remove temporary sleeves, if used to form openings, prior to installation of permanent materials. Utilize minimum 24 ga. galvanized sheet metal for permanent sleeves above grade, interior locations unless otherwise noted.

C. Provide Schedule 40 carbon steel pipe with integral water stop for steel sleeves required below grade or to exterior.

D. Submit to Structural Engineer for review and approval size and location of core-drilled holes prior to execution.

E. Submit product data and installation details for penetrations of building structure. Include schedule indicating penetrating materials, (steel conduit, PVC conduit, cables, cable tray, etc.), sizes of each, opening sizes and sealant products intended for use.

F. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Section 26 0593 - Electrical Systems Firestopping.

G. Submit complete penetration layout drawings showing openings in building structural members including floor slabs, bearing walls, shear walls, etc. Indicate and locate, by dimension, required openings including those sleeved, formed or core drilled. Submit drawings for approval prior to preparing openings in structural member.

H. Provide 2” clearance around penetration openings intended for raceways and cables. Where fire resistant penetrations are required, size openings in accordance with written recommendations of firestopping systems manufacturer.

I. Seal non fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.

J. Seal non-rated wall openings with urethane caulk.

K. Where penetrations occur through exterior walls into building spaces, use steel sleeves with integral water stop, similar to type "CS" for poured wall openings or “modular” for cored and precast wall sleeves by Thunderline Corporation. Seal annular space between sleeves and pipe with "Link-Seal" modular wall and casing seals by Thunderline Corporation or sealing system by another manufacturer approved as equal by Engineer. Sealing system shall utilize Type 316 stainless steel bolts, washers, and nuts.

L. Finish and trim penetrations as shown on details and as specified.

M. Provide chrome or nickel plated escutcheons where raceways pass through walls, floors or ceilings and are exposed in finished areas. Size escutcheons to fit raceways for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitor’s closets, storage rooms, etc., unless suspended ceilings are specified.

3.04 EQUIPMENT ACCESS

A. Install raceways, junction and pull boxes, and accessories to permit access to equipment for maintenance. Relocate raceways or accessories to provide maintenance access at no additional cost to Owner.

B. Install equipment with sufficient maintenance space for removal, repair, or changes to equipment. Provide ready accessibility to equipment and wiring without moving other future or installed equipment.

C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors for equipment shall provide access for servicing, repairs and/or maintenance.

D. Provide necessary coordination and information to the Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes, and rough-in dimensions.

E. Locate electrical outlets and equipment to fit details, panels, decorating or finish at space. Architect reserves right to make minor position changes of outlet locations before work has been installed.

F. Verify door swings before installing room light switch boxes. Install boxes on latch side of door unless otherwise noted

3.05 EQUIPMENT SUPPORTS

A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers, etc.

B. Provide steel shell with plug type concrete anchors for attaching equipment to concrete. Plastic, rawhide, or anchors using lead are not allowed.

C. Do not support equipment or luminaires from metal roof decking.

3.06 SUPPORT PROTECTION

A. In occupied areas, mechanical and electrical rooms and areas requiring normal maintenance access, guard certain equipment to protect personnel from injury.

B. Provide minimum 1/2” thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment, including bus duct, cable tray, pull boxes and electrical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

C. Protect threaded rods or bolts at supporting elements as described above. Trim threaded rods or bolts such that they do not extend beyond supporting element.

3.07 ELECTRICAL SYSTEMS IDENTIFICATION

A. Refer to Section 26 0553 – Electrical Systems Identification.

3.08 ACCEPTANCE TESTING

A. Contractor shall perform acceptance testing. Contractor to subcontract testing to qualified testing agency if they cannot meet the requirements of Section 26 0813. Equipment to be tested is noted as "Testing by Electrical Contractor" in technical specification sections. Perform in accordance with Section 26 0812 – Power Distribution Acceptance Tests and Section 26 0813 – Power Distribution Acceptance Test Tables or as outlined in technical specification sections.

B. When testing is to be witnessed by Architect/Engineer or Inspector, notify them at least 10 days prior to testing date.

C. When equipment or systems fail to meet minimum test requirements, replace, or repair defective work or materials as necessary and repeat inspection and test until equipment or systems meet test requirements. Make repairs with new materials.

D. Contractor is responsible for certifying in writing equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria and name and title of person signing test certification documents.

E. Maintain copies of certified test results, including those for any failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

3.09 START-UP

A. Systems and equipment shall be started, tested, adjusted, and turned over to Owner ready for operation. This includes "Owner-Furnished, Contractor-Installed" (OFCI) and "Contractor-Furnished, Contractor-Installed" (CFCI) systems and equipment.

B. Follow manufacturer's pre-start-up checkout, start-up, trouble shooting and adjustment procedures.

C. Contractor shall provide services of technician/mechanic knowledgeable in start-up and checkout of types of systems and equipment on project.

D. Provide start-up services by manufacturer's representative where specified or where Contractor does not have qualified personnel.

E. Coordinate start-up with all trades.

3.10 CLEANING

A. Clean systems after installation is complete.

B. Vacuum debris from panelboards, switchboards, motor starter and disconnect switch enclosures, junction boxes and pull boxes two weeks before energization and again prior to completion.

C. Where louvers are provided in switchgear or transformer enclosures, vacuum louvers free of dust and dirt.

D. Clean luminaire lenses and lamps at time of installation and clean lens exteriors just prior to final inspection.

E. Thoroughly clean equipment of stains, paint spots, dirt, and dust. Remove temporary labels not used for instruction or operation.

END OF SECTION

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0529 - Hangers and Supports for Electrical Systems

B. Section 26 0553 - Electrical Systems Identification

C. Section 26 0593 - Electrical Systems Firestopping

D. Section 26 0812 - Power Distribution Acceptance Tests

E. Section 26 0813 - Power Distribution Acceptance Test Tables

1.02 REFERENCE

A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Section includes conductors and cables rated 600 V and less, connectors, splices, and terminations rated 600 V and less, sleeves and sleeve seals for cables.

B. Conductor and conduit sizes in these contract documents are based on copper wire, and only copper wire shall be used.

1.04 REFERENCE STANDARDS

A. ASTM A 53/A 53M – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

B. ASTM B 1 – Standard Specification for Hand-Drawn Copper Wire.

C. ASTM B 8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

D. NEMA WC 3 – Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-19-81).

E. NEMA WC 5 – Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (ICEA S-61-402).

F. NEMA WC 70 – Non-Shielded Power Cable 2000 V or less for the Distribution of Electrical Energy (ICEA S-95-668).

G. NFPA 70 – National Electrical Code.

H. UL 44 – Thermoset-Insulated Wires and Cables.

I. UL 83 – Thermoplastic-Insulated Wires and Cables.

J. UL 486A-486B – Wire Connectors.

K. UL 486C – Splicing Wire Connectors.

L. UL 486D – Standard for Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations.

M. UL 486E – Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors.

1.05 SUBMITTALS

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

B. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation.

C. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.

D. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations of components and circuits.
   2. Operation and Maintenance Data:
      a. Include manufacturer's recommended operating instructions, maintenance procedures and intervals, and preventive maintenance instructions.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with NFPA 70 for components and installation.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

B. Wire and cable boxes and reels shall bear the date of manufacture.
   1. Date of manufacture shall not precede contract date by more than one year.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Protect from dirt, fumes, water, corrosive substances, and construction debris.

1.08 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

B. Manufacturer shall provide standard 1 yr warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cerrowire

B. General Cable Corporation

C. Senator Wire & Cable Company

D. Southwire Company

E. Approved equal

2.02 DESCRIPTION

A. NEMA WC 70; single copper conductor insulated wire; 600V rated insulation; 90°C maximum operating temperature for dry and wet or damp locations.
   1. Thermoplastic-insulated wires and cables: NEMA WC 5, UL 83; Type THHN, THWN, THHW.
   2. Thermoset-insulated wires and cables: NEMA WC 3, UL 44; Type XHHW-2.

2.03 REMOTE CONTROL AND SIGNAL CIRCUITS

A. Class 1
   1. Copper conductor, single insulated wire.
   2. Insulation type THHN, THHW rated 90°C, 600 V insulation class.
   3. Type XHHW-2 for ambient temperature less than 32°F.
   4. UL 83 listed, ASTM B 1 for solid conductors; ASTM B 8 for stranded conductors.

B. Classes 2 and 3
   1. Copper conductor, multiple twisted conductors covered with an overall non-metallic jacket unless otherwise noted.
   2. Insulation type XLE, rated 105°C, 300 V insulation class.
   3. UL listed for use in space in which circuits will be installed.

2.04 CONNECTORS, SPLICES, AND TERMINALS

A. Manufacturers:
   1. AFC Cable Systems, Inc.
   2. Burndy Division of Hubbell Incorporated
   3. Hubbell Power Systems, Inc.
   4. Ideal Industries, Inc.
   5. O-Z/Gedney; EGS Electrical Group LLC.
   6. 3M; Electrical Products Division
   7. Thomas and Betts Division of ABB
   8. Tyco Electronics Corp.
   9. Approved equal

B. Description: UL 486A-486B, UL 486C, UL 486D, UL 486E; factory-fabricated connectors, splices, and terminals of size, ampacity rating, material, type, and class for application and service indicated.

2.05 TERMINATIONS

A. Compression set, bolted or screw type lug, or direct to bolted or screw type terminal.

2.06 PLASTIC CABLE TIES

A. Nylon or approved; locking type; metallic ties not permitted.

PART 3 EXECUTION

3.01 INSTALLATION OF CONDUCTORS AND CABLES

A. Install conductors in a raceway system, unless otherwise specified or indicated.

B. Install conductors only after:
   1. Building interior is enclosed and weather tight
   2. Mechanical work likely to damage conductors has been completed
   3. Raceway installation is complete and supported

C. Pull conductors into raceway at same time.

D. Neatly train and lace conductors inside boxes, equipment, and panelboards.

E. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

F. 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.

G. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

H. Provide adequate support for conductors not in raceway. Do not support conductors from ceiling grid or from accessible ceiling support systems.

I. Support cables and conductors in vertical raceways per requirements in Section 26 0529 - Hangers and Supports for Electrical Systems.

J. Identify and color-code conductors and cables according to Section 26 0553 - Electrical Systems Identification.

K. Wiring at Outlets: Install conductor at each outlet, with minimum 12" of slack.

L. Limit conduit fill to a maximum of 9 current-carrying conductors.

M. Install stranded conductors where conductors terminate in crimp type lugs. Do not place bare stranded conductors directly under terminal screws.

3.02 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders and Branch Circuits: Solid or stranded #10 AWG and smaller; stranded for #8 AWG and larger.

B. Minimum conductor sizes shall be as follows:
   1. #12 AWG – Branch circuits of any kind.
   2. #14 AWG – Remote control and signal systems, fire alarm system.

C. Branch wiring length limitations:
   1. 208Y/120 V circuits over 100' in length: Increase wire size one size for each 100' of length. Increase conduit size as required.
   2. 480Y/277 V circuits over 150' in length: Increase wire size one size for each 150' of length. Increase conduit size as required.

3.03 CONDUCTOR INSULATIONS AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Feeders: Type THHW, THWN, XHHW-2, rated 75°C for wet locations, single conductors in raceway.

B. Branch Circuits: Type THHN, XHHW-2, rated 90°C for dry and wet or damp locations, single conductors in raceway.

C. Wiring in Fluorescent Fixture Channels: Type THHN, rated 90°C for dry and damp locations, single conductors.

D. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh strain relief device at terminations to suit application.

3.04 REMOTE CONTROL AND SIGNAL CIRCUITS

A. Sizing – #14 AWG minimum.

B. Installation:
   1. Install cables in cable tray and cable rings.
   2. Provide protection for exposed cables where subject to damage.
   3. Support cables above accessible ceilings; do not rest on ceiling tiles.
   4. Use suitable cable fittings and connectors.

3.05 CONNECTORS, SPLICES AND TERMINALS

A. Connectors:
   1. Except where equipment is furnished with bolted or screw type lug, use compression set pressure connectors with insulating covers. Use compression tools and die compatible with connectors being installed.
   2. Use compression-set type with application of insulating tape, pre-stretched or heat-shrinkable insulating tubing for splices and taps of #8 AWG conductors and larger. Install with hydraulic compression tool.
   3. Use pre-insulated "twist-on" connectors with integral spring for splices and taps of #10 AWG normal power conductors and smaller.
   4. Use compression-set, insulated type for splices of #10 AWG and smaller conductors serving life safety loads. "Twist-on" connectors are not allowed in life safety circuits.
   5. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Splices:
   1. Splice wires and cable only in accessible locations such as within junction boxes.
   2. Make splices to carry full capacity of conductors with no perceptible temperature rise.
   3. Splices are to be made with compression barrel connector where no taps exist or allowance for future taps is being made.
   4. Where the splice includes provisions for taps, use Burndy insulated Unitap. Locate in pull or junction box sized for all conductors to be spliced and tapped.

5. Make below-grade splices in manholes and handholes watertight with pre-stretched or heat-shrinkable insulating tubing, or resin-filled insulator.
6. Use electrical tape to build up insulation level equivalent to cable insulation and cover with not less than two half-lapped layers of plastic electrical tape, for joints, taps, and splices of #1 AWG conductors and larger.
7. Plastic snap-on or piercing type mechanical splice insulators are not allowed.
8. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Terminals:
1. All terminals are to be compression type.
2. Train wires to eliminate fanning of stands, crimp with proper tool and die.
3. Insulate ends of spare conductors with electrical tape and identify spare circuit number where appropriate.
4. Eye type crimped terminal for removable screw type terminal. Forked torque terminal when screw terminal cannot be removed.
5. Torque screw termination per manufacturer's recommended values.
6. Terminate motors connections using the following methods:
   a. 300V and below: Use compression-set, insulted eye terminal for screw lug connections or barrel type cable to cable connections.
   b. Above 300V: Use 3M 5300 series insulated motor lead splicing kit.

3.06 CABLE TIES

A. Neatly bundle conductors and cables together for support. Size cable ties sufficiently to accommodate the multiple cables being supported.

3.07 FIELD QUALITY CONTROL

A. Test 600 volt conductors and cables per requirements in Sections 26 0812 – Power Distribution Acceptance Tests and 26 0813 – Power Distribution Acceptance Test Tables.

B. Interpret test results in writing and submit to Engineer.

C. Replace conductors and cables that are found defective, at no expense to Owner.

END OF SECTION

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SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 DESCRIPTION

A. Section includes methods and materials for grounding systems and equipment, as required by State Codes, NFPA 70, applicable portions of other NFPA codes, as indicated herein.

1.03 REFERENCE STANDARDS

A. TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

B. ASTM B 3 – Specification for Soft or Annealed Copper Wire

C. ASTM B 8 – Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft

D. ASTM B 33 – Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes

E. IEEE C2 – National Electrical Safety Code (ANSI)

F. NETA MTS – Maintenance Testing Specifications

G. NFPA 70 – National Electrical Code

H. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance

I. [NFPA 780 – Lightning Protection Systems

J. UL 96 – Lightning Protection Components]

K. UL 467 – Grounding and Bonding Equipment

1.04 SUBMITTALS

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

B. Field Quality-Control Test Reports:
   1. Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.
   2. Test reports of resistance to earth. Each test report shall include:
      a. Date of test, soil moisture content, and soil temperature
      b. Test operator
      c. Instrument or other test equipment used
      d. Electrode designation or location
      e. Ground impedance in ohms
      f. Assumptions made - if required

C. Closeout Submittals:
   1. Operation and Maintenance Manuals: Include the following:
      a. Instructions for periodic testing and inspection of grounding system.
         1) Instructions to perform tests to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
         2) Include recommended testing intervals.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.

2. Comply with UL 467 for grounding and bonding materials and equipment.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in clean, dry space. Protect from dirt, fumes, water, corrosive substances, and construction debris.

1.07 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

B. Manufacturer shall provide standard 1 yr written warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 PRODUCTS

2.01 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction, insulation color: green.

2.02 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. Compression Connectors: Irreversible type.

PART 3 EXECUTION

3.01 APPLICATIONS

A. Equipment Grounding Conductors: Install solid conductor for #12 AWG and smaller and stranded conductors for #10 AWG and larger. Conductors are to have green insulation for #10 AWG and smaller and identified with green tape at terminations, boxes, and splices for sizes #8 AWG and larger.

B. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors

3.02 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with feeders and branch circuits. Install for each branch circuit neutral originating from panelboards, including lighting circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits
   2. Lighting circuits
   3. Receptacle circuits
   4. Single-phase motor and appliance branch circuits
   5. Three-phase motor and appliance branch circuits
   6. Flexible raceway runs
   7. Armored and metal-clad cable runs

C. Duplex receptacles of any amperage: Install separate jumper between grounding terminal on device and metallic box.

D. Size of equipment grounding conductors for branch circuits: As indicated in NFPA-70, except minimum size shall be #12 AWG.

E. Size of branch panel feeder originating at switchboards/switchgear: As indicated in NFPA-70, except in no instance smaller than #8 AWG.

F. Install equipment grounding conductor from secondary side of each transformer to grounding electrode system as required for separately derived system.

G. Install grounding conductor to luminaires hanging form conduit swivel hangers.

3.03 SEQUENCING, SCHEDULING

A. Permanently attach service grounds before permanent building service is energized.

B. Permanently attach equipment grounds prior to energizing equipment.

3.04 INSTALLATION

A. Connections: Exposed and visible for inspection at all times. Do not install insulation over ground connections.

B. Identify all grounding conductors by system and room number of termination at building grounding electrode point.

C. 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.

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. Make grounding connections on surface that has been cleaned of paint, dirt, oil, etc., so that connections are bare metal to bare metal contact.

F. Make grounding connections tight with UL listed grounding devices, fittings, bushings, etc.

G. Equipment Grounding Conductor: Terminate in panelboard at green wire ground bus.

H. Multiple Conductors on Single Lug: Not permitted. Terminate each grounding conductor on its own terminal lug.

I. Flexible Metallic Conduit, Non-Metallic Rigid Conduit, or Liquid Tight Flexible Conduit: Install green wire grounding conductor with phase conductors in conduit.

END OF SECTION

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SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0533 – Raceway and Boxes for Electrical Systems

B. Section 26 2416.13 – Lighting and Appliance Panelboards

C. Section 26 2816 – Enclosed Switches and Circuit Breakers

D. Section 26 2913 – Enclosed Controllers

E. Section 26 5000 – Lighting

1.02 REFERENCE

A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Section includes the following:
   1. Manufactured hangers and supports for individual raceways and cables, slotted channel and angle systems for multiple conduit runs, and most electrical equipment that is not floor mounted.
   2. Construction requirements for concrete housekeeping pads for floor-mounted electrical equipment.

1.04 REFERENCE STANDARDS

A. AWS D1.1/D1.1M – Structural Welding Code-Steel.

B. ASTM A 36/A 36M – Carbon Structural Steel.

C. ASTM A 325 – Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. ASTM A 780 – Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

E. MSS SP-58 – Pipe Hangers and Supports - Materials, Design and Manufacture.

F. MSS SP-69 – Pipe Hangers and Supports - Selection and Application.

G. MFMA-4 – Metal Framing Standards Publication.

H. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction.

I. NECA 101 – Standard for Installing Steel Conduits (Rigid, IMC, EMT).

J. NFPA 70 – National Electrical Code.

K. SSPC-PA 1 – Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel.

1.05 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Raceway and cable supports.
   3. Support for conductors in vertical raceway.
   4. Structural steel for fabricated supports and restraints.
   5. Mounting, anchoring, and attachment components:
      a. Powder-actuated fasteners.
      b. Mechanical-expansion anchors.
      c. Concrete inserts.
      d. Clamps for attachment to structural steel.
      e. Through bolts.

f. Toggle bolts.
g. Hanger rods.

B. Shop Drawings: Include concrete anchors application, size, and placement. Include concrete inserts application, size, loading, and placement. Show fabrications and installation details and include calculations for the following:
1. Trapeze hangers. Include product data for components.
2. Steel slotted channel systems. Include product data for components.
3. Fabricated metal equipment support assemblies.

C. Welding certificates.

D. Schedule of hangers and support devices with support spacing.

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel.”

B. Comply with NFPA 70.

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of 5 times the applied force.

B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Finishes
a. Metallic Coatings:
1) Factory standard primed, galvanized of electroplated finish and applied according to MFMA-4, for indoor applications.
2) Hot-dip galvanized after fabrication and applied according to MFMA-4, for outdoor applications.
b. Painted Coatings: Manufacturer’s standard painted coating applied according to MFMA-4.
2. Channel Dimensions: Selected for applicable load criteria.
3. Manufacturers:
a. Allied Support Systems; Power-Strut Unit.
b. Cooper B-Line, Inc.; A division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corporation.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.
h. National Pipe Hanger Corporation.
i. Michigan Hanger Co., Inc.; O-Strut Division.
j. Approved equal.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Raceway 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 Raceway: 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 suite 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. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; A division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit
         5) Approved equal
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Manufacturers:
         1) Cooper B-Line, Inc.; A division of Cooper Industries
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) ITW Ramset/Red Head; A division of Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
         6) Approved equal
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Toggle Bolts: All-steel springhead type.
   7. Hanger Rods:
      a. MSS SP-58; threaded steel, with adjusting and lock nuts; electroplated zinc finish.
      b. MSS SP-58; nonmetallic, with adjusting and lock nuts.

2.02 FABRICATED METAL FRAMING EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section “Metal Fabrications” for steel shapes and plates; not be lighter than 12 gauge.

C. Finish: Electro-galvanized.

D. Manufacturers: Same as in paragraph 2.1.B.3 above.

2.03 CONTINUOUS INSERT CHANNELS

A. Length and support capabilities to be suitable for application.

B. Brackets, inserts and accessories suitable for channel insert selected.

C. Manufacturers:
   1. Unistrut; Tyco International, Ltd.
   2. Cooper B-Line, Inc.; A division of Cooper Industries
   3. Michigan Hanger Co., O-Strut Division
   4. Anvil International, Inc.
   5. Approved equal

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70.
   1. Size steel hanger rods for individual hangers and trapeze supports as indicated in the following schedule. Total weight of equipment shall not exceed limits indicated.

Maximum Loads (lbs)	Rod Diameter (”)	Maximum Pipe Size With Single Rod
730	3/8	2”
1130	1/2	3”
1818	5/8	5”

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25% in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2” and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements, except as specified in paragraphs below.

B. Raceway Support Methods: In addition to methods described in NECA 1, raceways 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.

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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4” thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4” thick.
   6. To Steel: Spring-tension clamps or beam clamps.
   7. To Light Steel: Sheet metal screws.
   8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

F. Do not support raceway by other raceway.

G. Do not support equipment or raceway from metal roof decking or floor decking.

H. Do not impose weight of electrical equipment, raceways, or lighting fixtures on support provided for other trades or systems.

I. Do not support loads from bottom chord member of trusses or open web chord.

J. Suspend hangers by means of hanger rods. Perforated band iron and flat wire (strap iron) are not allowed.

K. Use conduit-mounting pedestals for piping on roof. Install bottom of pedestal flat on roof deck and insulate exterior of pedestal, flush and counter flush. Coordinate roof mounting methods with roof system installer to maintain roof warranty provided by roof system installer.

L. Minimize use of concrete anchors and inserts after concrete pour.

M. Punching, drilling, welding of building structural steel or welding attachment to building structural steel is not allowed, unless approved by structural engineer.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section “Metal Fabrications” for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

END OF SECTION

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SECTION 26 0533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables
B. Section 26 0526 – Grounding and Bonding for Electrical Systems
C. Section 26 0529 – Hangers and Supports for Electrical Systems
D. Section 26 0553 – Electrical Systems Identification
E. Section 26 0593 – Electrical Systems Firestopping
F. Section 26 2726 – Wiring Devices

1.02 REFERENCE

A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Section includes raceways, fittings, wireways, wall ducts, indoor service poles, outlet boxes, pull and junction boxes, floor boxes, tap boxes and raceway seals.

1.04 REFERENCE STANDARDS

A. ANSI/NECA 1 – Standard Practices for Good Workmanship in Electrical Contracting
B. ANSI C80-1 – Rigid Steel Conduit-Zinc Coated (GRS)
C. ANSI C80-3 – Electrical Metallic Tubing-Zinc Coated (EMT)
D. ANSI C80-6 – Intermediate Metal Conduit-Zinc Coated (IMC)
E. ASTM A 53/A 53M – Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
F. ETL PVC-001 – Intertek ETL SEMKO High Temperature H^2O PVC Coating Adhesion Test Procedure for 200hrs.
G. NEMA 250 – Enclosures for Electrical Equipment (1000 V Maximum)
H. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
I. NEMA OS 1 – Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
J. [NEMA RN 1 – Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit]
K. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit
L. NEMA TC 3 – PVC Fittings for Use with Rigid PVC Conduit and Tubing
M. NFPA 70 – National Electrical Code
N. UL 1 – Flexible Metal Conduit
O. UL 6 – Electrical Rigid Metallic Conduit-Steel
P. UL 360 – Liquid-Tight Flexible Steel Conduit
Q. UL 514A – Metallic Outlet Boxes
R. UL 514B – Conduit, Tubing, and Cable Fittings
S. UL 651 – Schedule 40 and 80 Rigid PVC Conduit and Fittings
T. UL 797 – Electrical Metallic Tubing-Steel
U. UL 870 – Wireways, Auxiliary Gutters, and Associated Fittings
V. UL 1242 – Electrical Intermediate Metal Conduit-Steel

W. UL 1660 – Liquid-Tight Flexible Nonmetallic Conduit

1.05 SUBMITTALS

A. Product Data:
   1. Raceways
   2. Fittings
   3. Wireways
   4. Outlet boxes
   5. Pull and junction boxes
   6. [Floor boxes]
   7. Raceway seals

B. Manufacturer's Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual routing of raceways 2" and larger.
      b. Record actual location and mounting heights of wireways, indoor service poles, floor boxes, tap boxes, outlet, pull and junction boxes.

1.06 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with NFPA 70.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect from dirt, water, construction debris, and traffic.

B. Protect PVC conduit from sunlight.

C. Comply with manufacturer's written instructions.

1.08 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

A. Rigid Steel Conduit (RSC): ANSI C80.1, UL 6; heavy wall galvanized steel.

B. Intermediate Metal Conduit (IMC): ANSI C80.6, UL 1242; thinner wall, galvanized steel.

C. Fittings (couplings, conduit bodies, connectors and bushings): NEMA FB 1, UL 514B; aluminum alloy; threaded; connectors with double locknuts and steel insulating bushings, thermoplastic insulating bushings; conduit bodies cover: stamped steel, with stainless steel screws and neoprene gaskets.

D. Fittings Manufacturers: Cooper Crouse-Hinds; Carlon Electric Products; O-Z/Gedney; Appleton; Hubbell; Robroy Industries – Perma-Cote.

2.02 ELECTRICAL METALLIC TUBING (EMT)

A. ANSI C80.3, UL 797; galvanized steel tubing

B. Fittings (couplings, conduit bodies, and connectors): NEMA FB I, UL 514B; steel, watertight gland compression type or set screw connectors with double locknuts and insulated throat; conduit bodies cover: stamped steel, with stainless steel screws and neoprene gaskets. Indentor, drive-on, die-cast or pressure cast fittings not permitted.

C. Fittings Manufacturers: Same as manufacturers listed in 2.1.D.

2.03 FLEXIBLE METAL CONDUIT (FMC)

A. UL 1; interlocked steel

B. Fittings: NEMA FB I, UL 514B; ¾" – 2" trade size: Die-Cast Zinc; Above 2" trade size: Zinc-Plated Malleable Iron

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. UL 360; interlocked steel, with PVC jacket

B. Fittings: NEMA FB 1, UL 514B; steel

2.05 RIGID NONMETALLIC CONDUIT (RNC)

A. NEMA TC 2, UL 651; Schedule **[40]** PVC

B. Fittings: NEMA TC 3, UL 651

C. NEMA TC 2, UL 651; Schedule 40 and 80 PVC

D. Fittings: NEMA TC 3, UL 651

2.06 METAL WIREWAYS

A. NEMA 250, UL 870; galvanized sheet metal troughs with hinged or removable cover, Type 1 for indoor and 3R for outdoor, unless otherwise indicated.

B. Size: cross section and length as indicated on drawings.

C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mated with wireways as required for complete system.

D. Wireways Covers: Screw-cover type for indoor, flanged-and-gasketed type for outdoor.

E. Knockouts: none.

F. Finish: Manufacturer's standard enamel finish

G. Manufacturers: Same as listed in Section 2.9F.

2.07 OUTLET BOXES

A. Sheet Metal Outlet Boxes: NEMA OS 1, UL 514A; galvanized steel with stamped knockouts.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; 1/2" male fixture studs, where required
   2. Concrete Ceiling Boxes: Concrete type

B. Cast-Metal Outlet Boxes: NEMA FB 1, cast aluminum or cast iron (galvanized), Type FD, with gasketed cover and threaded hubs

C. Gangable type boxes are not allowed

D. Manufacturers: O-Z/Gedney; Raco; Cooper Crouse-Hinds; Approved equal

2.08 PULL AND JUNCTION BOXES

A. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1; galvanized steel

B. Cast-Metal, Pull, and Junction Boxes: NEMA FB 1; cast aluminum or galvanized, cast iron with ground flange, gasketed cover and stainless steel cover screws

C. Minimum size: 4” square by 2-1/8” deep for use with 1” conduit and smaller; 4-11/16” square by 2-1/8” for use with 1-1/4” conduit and larger

D. Sheet Metal Boxes Larger Than 12” in any direction: Hinged cover or a chain installed between box and cover

E. Field-fabricated boxes not allowed without prior approval of local authority having jurisdiction.

F. Manufacturers: O-Z/Gedney; Raco; Cooper Crouse-Hinds; Hubbell-Weigmann; Hoffman; J&A Sheet Metal Inc. Austin Electrical Enclosures; Approved equal

2.09 FLOOR BOXES

A. Metal Floor Boxes: NEMA OS1; cast metal; fully-adjustable; Moisture-proof, with forged brass blank cover with each box and close up covers and/or carpet flanges as required for finished floor.

B. Poke-Through Fittings: Assembly comprising service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination.
   1. Fire Rating: Xhr
   2. Service Fitting Type: Flush
   3. Housing: brass flanges, flush with floor
   4. Configuration: as indicated on drawings
   5. Manufacturers: Hubbell; LeGrand]

2.10 EXPANSION FITTINGS

A. Malleable iron, hot dip galvanized allowing 4” allowing 2” raceway movement.

B. Manufacturers: OZ/Gedney AX Series; or equivalent by manufacturer listed in 2.1.D.

2.11 RACEWAY PENETRATION SEALS

A. Thruwall and Floor Seals.

B. Manufacturers: New construction – OZ/Gedney FSK Series; existing construction – OZ/Gedney CSM Series; or equivalent by manufacturer listed in 2.1.D.

2.12 RACEWAY SEALING FITTINGS

A. For one through four conductors: Manufacturers: OZ/Gedney CSB Series; Approved equal

B. For greater than four conductors: Manufacturers: OZ/Gedney EYA Series with sealing compound; Approved equal

C. Low-temperature or hazardous locations: Manufacturers: OZ/Gedney EYA Series with sealing compound; Approved equal

2.13 CABLE SUPPORTS

A. Manufacturers: OZ/Gedney Type S; or equivalent by manufacturer listed in 2.1.D.

2.14 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends, with integral water stop.

B. Integral Water Stop: Manufacturer: Thunderline Corporation; Approved equal
   1. High density polyethylene (HDPE). Type Century-Line engineered sleeve with end caps.
   2. Steel. Type WS engineered sleeve.

2.15 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and 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: Carbon steel. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 EXECUTION

3.01 COORDINATION

A. Coordinate with Architect/Engineer size and location of required built-in openings in building structure, including those sleeved, formed or core drilled.

B. Coordinate with Architect/Engineer cutting, removing, or piercing general or mechanical insulation, fire-rated walls, ceilings, or steelwork.

C. Verify with Architect/Engineer all surface raceway installations except in mechanical, electrical, and communications rooms.

D. Coordinate with Architect/Engineer exact locations of floor boxes, where shown on drawings, prior to rough-in.

E. Coordinate routing of any through-wall or through-roof conduits.

F. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0593 – Electrical Systems Firestopping.

G. Verify that exterior wall or wet location boxes are gasketed type cast boxes with matching cover.

H. Verify with manufacturer that “touch-up” paint kit are available for use.

3.02 EXAMINATION

A. Examine surfaces to receive raceways and boxes for compliance with installation tolerances and other conditions affecting performance of raceway’s installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 INSTALLATION

A. Raceways:

1. Comply with ANSI/NECA 1 and NFPA 70 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this Section are stricter.
2. Arrange raceways to maintain headroom and present neat appearance.
3. Raceway routing is shown in approximate locations, unless dimensioned. Route to complete raceway installation before starting conductor installation.
4. Keep raceways at least 12”away from parallel runs of fuels, steam, hot-water pipes or ductwork. Install horizontal raceway runs above water and steam piping. Install raceways level and square and at proper elevations: 6’-6” minimum headroom, except in exit pathways 7’-0” minimum headroom. Do not block access to junction boxes, mechanical equipment or prevent removal of ceiling panels, etc.
5. Run raceways concealed in construction to avoid adverse conditions such as heat and moisture, to permit drainage, and to avoid materials and equipment of other trades, except where noted otherwise.
6. Avoid exposed raceway runs. Run raceways exposed where impractical or impossible to conceal or where specific approval is obtained. Run exposed raceways grouped and parallel or perpendicular to construction.
   Do not route exposed raceways over boilers or other high-temperature machinery or in contact with such equipment. Offset exposed raceways at boxes.
7. Route raceways installed above accessible ceilings parallel or perpendicular to construction.
8. Do not install raceways in structural or topping floor slabs, except where noted on the plans. Install raceway in structural or topping floor slabs, where noted on plans, as follows:
   a. Center raceways in structural slabs clear of reinforcing steel, except where crossing same, and spaced on centers equal or exceeding 3 times the raceway diameter. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement. Space raceways laterally to prevent voids in concrete.
   b. Outside diameter of raceway shall not exceed 1/3 the structural slab thickness.
   c. Obtain approval from Engineer for each run of raceway 1” or larger.

d. Do not run raceways through cast-in-place support elements without approval from the structural engineer.
e. Do not install raceways in topping slabs of 3” or less.
f. Locate raceways to avoid conflict with equipment, door bucks, partitions and other equipment bolted to floor.
g. Use concrete tight set screw conduit connectors.
h. Arrange stub-ups so curved portions of bends are not visible above finished slab. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; use flexible metal conduit 6” above the floor. Install threaded plugs flush with floor for future equipment connections.
i. Change from nonmetallic raceway to RMC or IMC before rising above floor.]

9. Cut raceways square using saw or pipecutter.
10. Use hydraulic one-shot raceway bender or factory elbows for bends in raceway larger than 1”, unless sweep elbows required. Bend raceways according to manufacturer’s recommendations. Do not use torches or open flame to aid in bend of PVC conduit.
11. Use raceway fittings compatible with raceways and suitable for use and environment.
12. Provide bushings on all raceways.
13. Raceways minimum sizes:
    a. Minimum raceway size 3/4”, except as noted on drawings.
    b. Minimum size for flexible metal conduit is 1/2” except 3/8” for luminaires.
    c. Minimum size for liquidtight flexible metal conduit is 1/2”.
14. Install empty raceways with 200 lb nylon pull cord; leave at least 12” of slack at each end of pull wire. Cap raceways at both ends.
15. Feed devices on same wall vertically from above or junction box in suspended ceiling.
    a. Do not install horizontal bends in conduit around corners.
16. Raceways Supports:
    a. Independently support or attach raceway system to structural parts of construction. Suspended ceiling systems shall not be considered as structural parts of construction for raceway support. Do not attach raceways to piping system.
    b. Raceway supports for horizontal or vertical single runs:
        1) Hot dipped galvanized heavy-duty sheet steel straps, mineralac clamps or steel slotted support channel system with appropriate components.
    c. Raceway supports for horizontal and vertical multiple runs:
        1) Trapeze-type supports fabricated with steel slotted channel systems with appropriate components.
        2) Support horizontal runs with appropriately sized rods.
        3) Anchor vertical runs to structure.
    d. Vertical raceway runs 1-1/4” and larger passing through floors: Support at each floor with pipe riser clamps.
    e. Do not support raceways with wire, perforated pipe straps or plastic tie-wrap. Remove wires used for temporary support.
    f. Secure raceways in metal stud walls to prevent rattling.
    g. Arrange raceway supports to prevent misalignment during wiring installation.
    h. Do not fasten raceways to corrugated metal roof deck.
    i. For fasteners and supports, including steel slotted support systems, support devices, support spacing, support of conductors in vertical raceways, and hanger rod size, refer to Section 26 0529 – Hangers and Supports for Electrical Systems and NFPA 70.
17. Identify raceways per requirements in Section 26 0553 – Electrical Systems Identification.
18. Ground raceways per requirements in Section 26 0526 – Grounding and Bonding for Electrical Systems.

19. Flexible Conduit Connections: Use maximum of 72” of flexible conduit for recessed and semi-recessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
    a. Use LFMC in damp or wet locations subject to severe physical damage.
    b. Do not use LFMC in plenum spaces or within air handling equipment.
    c. Use FMC in dry locations not subject to severe physical damage.
20. Install stainless steel raceway clamps, mounting hardware, supports, hangers, etc., when located in wet areas.
21. Power and Communications Raceways: Minimum 12” separation when run parallel, cross perpendicular.

B. Wireways:
1. Install in accordance with manufacturer’s instructions.
2. Use screws, clips, and straps to fasten raceway channel to surfaces.
3. Mount plumb and level.
4. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
5. Supports: Per manufacturer’s recommendations.
6. Close ends of raceway channel and unused conduit openings.

C. Boxes:
1. Install boxes to accommodate device indicated by symbol, in conformance with code requirements, number and size of conductors and splices and consistent with type of construction.
2. Install the appropriate cover on surface-mounted boxes:
    a. Raised device covers on 4 square and handy boxes.
    b. Device covers that are square drawn or square cut on boxes in block.
    c. Tile covers on boxes in tile.
    d. Round drawn device covers on boxes in lath and plaster walls or dry wall only.
    e. Set front edge of device boxes flush with finished wall surfaces except on walls of non-combustible materials where boxes may have maximum set back of 1/4”. Secure flush-mounted box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
3. Set outlet boxes parallel to construction and independently attached to same.
4. Do not install back-to-back and through-the-wall boxes. Install with minimum 6” horizontal separation between closest edges of the boxes. Install with minimum 24” separation in acoustic-rated walls and fire-rated walls.
5. Install multi-ganged boxes where 2 or more devices are in same location, unless otherwise noted.
6. Box Support:
    a. Mount boxes straight.
    b. Install horizontal bracing at top or bottom of box for 3 or more gang device boxes in stud walls.
    c. Install stud support one side, with short piece of stud, for up to 2 gang device boxes.
    d. Do not support boxes with tie-wire.
    e. For one and two gang box support, manufactured bracket supports shall be accepted alternate.
    f. Support boxes independently of raceways.
    g. Install adjustable steel channel fasteners for hung ceiling outlet box.
    h. Install stamped steel bridges to fasten flush-mounted outlet box between studs.
    i. Do not install boxes to ceiling support wires or piping systems.
7. Install partitions in multi-ganged boxes where different types of devices are installed, or devices installed operate at different voltages.
8. Mount boxes in block walls at block joint nearest to indicated height.

9. 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.
10. When boxes are installed in fire-resistive walls and partitions, limit penetrations to 16 sq in per penetration and not to exceed a total of 100 sq in per 100 sq ft of wall area. Use FireBlok fire suppression gaskets or fire stop putty pads acceptable to the fire marshal.
11. Pull and junction boxes: Install as shown, or as necessary to facilitate pulling of wire and to limit number of bends within code requirements. Install above accessible ceilings and in unfinished areas.
12. Install boxes to be permanently accessible.
13. Do not intermix conductors from more than one system in same junction box or pull box, unless shown or specifically authorized otherwise.
14. Adjust box location up to 10' prior to rough-in to accommodate intended purpose.
15. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726 – Wiring Devices.
16. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6" from ceiling access panel or from removable recessed luminaire.
17. The drawings do not necessarily show every outlet, pull or junction box required. Add all required boxes as necessary.

D. Floor Boxes:
1. Set floor boxes level and flush with finished floor surface.
2. Install floor boxes and fittings to preserve fire-resistant rating of slabs and other elements, using materials and methods specified in Section 26 0593 – Electrical Systems Firestopping.

E. Expansion Fittings:
1. Install raceway expansion and deflection fittings in all raceway runs embedded in or penetrating concrete where movement perpendicular to axis of the raceway may be encountered.
2. Install raceway expansion fittings complete with bonding jumpers in raceway runs that cross expansion joints in structure and raceway runs mechanically attached to 2 separate structures.
3. Install fitting(s) that provide expansion and contraction for at least 0.0004" per ft of length of straight run per °F of temperature change.
4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation.

F. Raceway Penetration Seals:
1. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
2. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.
3. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Section 26 0593 – Electrical Systems Firestopping.
4. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
5. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1" annual clear space between pipe and sleeve for installing mechanical sleeve seals.
6. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1" annual clear space between raceway and sleeve for installing mechanical sleeve seals.
7. Sleeve-Seal Installation: Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve.

Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

8. Provide chrome- or nickel-plated escutcheons where raceways pass through walls, floors or ceilings and are exposed in finished areas. Size escutcheons to fit raceways for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitor's closets, storage rooms, etc., unless suspended ceilings are specified.
9. Remove temporary sleeves, if used for form wall openings, prior to installation of permanent materials.

G. Raceway Sealing Fittings:
1. Install listed watertight seals to prevent the passage of moisture and water vapor through raceway, where raceway passes from interior to exterior of the building, where raceway passes between areas of different temperatures such as into or out of cold rooms, freezers and air handling units, where raceway enters room which at any time is subject to low or high temperatures and where raceway enters a room which at any time is subject to internal air pressures above or below normal.
2. Install watertight seals in interior of all raceways passing through building roof, ground floor slab (when the raceway does not extend beyond building footprint), or through outside walls of building above or below grade. Seal on the end inside building, using raceway sealing fittings manufactured for the purpose. Locate fittings at suitable accessible locations. For concealed raceways install each fitting in flush steel box with blank coverplate to match finish of adjacent plates or surfaces.

H. Sleeve Installation for Electrical Penetrations:
1. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0593 – Electrical Systems Firestopping.
2. 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.
3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
4. 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.
5. Cut sleeves to length for mounting flush with both surfaces of walls.
6. Extend sleeves installed in floors 2" above finished floor level.
7. Size pipe sleeves to provide 1/2" annular clear space between sleeve and raceway, unless sleeve seal is to be installed.

3.04 APPLICATION

A. Raceway uses permitted and not permitted per NFPA 70 requirements and as described below.

B. Rigid Metal Conduit (RMC) permitted to be installed as follows:
1. Installations below grade and in or under concrete slabs
2. All locations except corrosive atmospheres
3. Hazardous locations
4. Locations requiring mechanical protection
5. Stub up through slabs

C. Intermediate Metallic Conduit (IMC) permitted to be installed as follows:
1. Installation below grade and in or under concrete slabs
2. All locations, except corrosive atmospheres
3. Hazardous locations
4. Locations requiring mechanical protection

D. Electrical Metallic Tubing (EMT) permitted to be installed as follows:
1. Interior partitions
2. Above suspended ceilings
3. In concrete slabs

4. 6 ft AFF in exposed areas of mechanical equipment rooms]
5. Exposed in areas not subject to damage
6. Sizes 2” and smaller except as approved

E. Flexible Metal Conduit (FMC) permitted to be installed as follows:
1. Use flexible metal conduit not over 4 ft in length for final connections for:
   a. Vibrating equipment (including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment) in dry locations.
   b. Final connections to recessed luminaires in lengths not to exceed 6 ft.

F. Liquid Tight Flexible Metal Conduit (LFMC) permitted to be installed as follows:
1. Use liquid tight flexible conduit, not over 4 ft in length, for final connections to:
   a. Vibrating equipment (including transformers and hydraulic, pneumatic, electric solenoid, or motor-driven equipment) in wet locations.
   b. Instruments and control devices
   c. PVC coated LFMC is not allowed in environmental air plenum spaces or air handling equipment.

G. Rigid Nonmetallic Conduit (RNC) permitted to be installed as follows:
1. Direct burial, concrete encased
2. Direct burial, in sand fill on bottom and top
3. Use steel elbow in concrete encased runs

H. One-half inch raceway permitted:
1. Between controller and its control or pilot device
2. Between lighting switch and nearest outlet for luminaire
3. Control wiring where mounted on equipment where conduit must follow contour of equipment
4. Protective and signal systems where noted
5. Where shown on plans

3.05 RACEWAY WIRING METHODS

A. Underground: Install galvanized rigid steel conduit or thickwall nonmetallic conduit encased in concrete; threaded conduit fittings for steel; primed and solvent glue fittings for PVC.

B. In Slab: Install electrical metallic tubing; concrete tight set screw conduit fittings; install cast metal boxes.

C. Outdoor Locations, Above Grade: Install galvanized rigid steel conduit or intermediate metal conduit; threaded conduit fittings; install cast metal or nonmetallic outlet boxes with threaded hubs.

D. Wet and Damp Indoor Locations: Install galvanized rigid steel conduit or intermediate metal conduit; threaded conduit fittings; install cast metal or nonmetallic outlet, junction, and pull boxes with threaded hubs. Install flush mounting outlet boxes in finished areas.

E. Concealed and Exposed Dry Locations Not Subject to Damage: Install electrical metallic tubing; install sheet metal boxes; install flush mounting outlet boxes in finished areas.

F. Exposed Subject to Damage: Install galvanized rigid steel conduit or intermediate metal conduit; threaded conduit fittings; install cast metal boxes with threaded hubs. Open public spaces such as parking garages and common areas are considered subject to damage.

G. Hazardous Locations: Install galvanized rigid steel conduit; threaded conduit fittings; install cast metal boxes.

3.06 FIELD QUALITY CONTROL

A. Inspect raceway, boxes, indoor service poles, and wireways for physical damage, proper alignment, supports and seismic restraints, where applicable.

B. Replace any damaged component of the raceway system or install new raceway system.

C. Inspect components, wiring, connections, and grounding.

3.07 REPAINTING

A. Repair damage to galvanized finishes with manufacturer-supplied zinc-rich paint kit. Leave remaining paint with Owner.

B. Repair damage to PVC or paint finishes with manufacturer-supplied touch-up coating. Leave remaining coating with Owner.

3.08 ADJUSTING

A. Adjust flush-mounted boxes pre-pour and after-pour to be flush with finished materials.

B. Install knockout closures in unused openings in boxes.

C. Align adjacent wall-mounted outlet boxes for switches and similar devices.

D. Adjust outlet boxes to allow luminaires to be positioned as indicated on drawings.

3.09 CLEANING

A. Clean interior and exterior of boxes, wireways, and indoor poles to remove dust, debris, and other material.

END OF SECTION

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SECTION 26 0553
ELECTRICAL SYSTEMS IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables

B. Section 26 0533 – Raceways and Boxes for Electrical Systems

C. Section 26 0923 – Lighting Control Devices

D. Section 26 2416.13 – Lighting and Appliance Panelboards

E. Section 26 2726 – Wiring Devices

F. Section 26 2816 – Enclosed Switches and Circuit Breakers

G. Section 26 2913 – Enclosed Controllers

H. Section 28 3113 – Fire Detection and Alarm Systems

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 - General Requirements.

1.03 DESCRIPTION

A. Section includes the following:
   1. Identification for raceways
   2. Identification for conductors and communication and control cable
   3. Underground-line warning tape
   4. Warning labels and signs
   5. Instruction signs and posted drawings
   6. Equipment identification nameplates
   7. Wiring devices identification

B. Refer to the respective Division 26 Sections, and Sections in other Divisions that specify electrical components, for additional electrical identification requirements.

1.04 REFERENCE STANDARDS

A. ANSI A13.1 – Scheme for the Identification of Piping Systems

B. ANSI C2 – National Electrical Safety Code

C. ANSI Z535.4 1998 – National Standards for Product Safety Signs and Labels

D. 29 CFR – Labor, Part 1910 – Occupational Safety and Health Standards, Section 1910.145 – Specifications for Accident Prevention Signs and Tags

E. NFPA 70 – National Electrical Code

F. UL-510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

1.05 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Nameplate Schedule: Prior to making nameplates, submit a complete schedule to Architect for approval indicating nameplate size, lettering size, color, and actual nameplate information.

1.06 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with ANSI Z535.4-1998

C. Comply with NFPA 70.

D. Comply with 29 CFR 1910.145.

1.07 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 RACEWAY IDENTIFICATION

A. Fire Alarm Conduit
   1. Material: Refer to Section 26 0533 – Raceways and Boxes for Electrical Systems and Section 28 3113 – Fire Detection and Alarm Systems
   2. Identification: Raceways are to be factory applied permanent red in color for entire length and circumference.
   3. Junction box covers are to be factory or field applied permanent red paint.

2.02 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend.

B. Lettered ID Marking Tape Manufacturers: Brady USA, Ideal, Marking Services, Inc. (MRI), Seton, or approved equal.

C. Color-Coding Electrical Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1" to 2" wide.
   1. UL-510 listed, self adhesive, vinyl electrical tape

D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 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. Self-Adhesive Arc Flash Warning Labels: Industrial grade, made of durable polyester with over-laminate to withstand harsh environments (UV rays, scratches, and most chemicals).
   1. Manufacturer: Seton or approved equal

D. Baked-Enamel Warning Signs for Interior Use: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. Nominal size, 7" x 10".

E. 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."
   3. Emergency System Warning: "WARNING – EMERGENCY SYSTEM – DO NOT LEAVE SWITCH IN THE "OFF" POSITION."
   4. Automatic Start Warning: "WARNING – EQUIPMENT MAY START AT ANY TIME."
   5. Arc Flash Labels: Per ANSI Z535.4 and NFPA 70 ART 110.16, the signal word WARNING appearing in black letters on an orange background, with second line below (Arc Flash and Shock Hazard) in black letters on white background and third line below (Appropriate PPE Required) in black letters on white background.

Include the following information on the label:

a. Equipment name
b. Available bolted current
c. Flash protection boundary distance
d. Incident energy level at 18” expressed in cal/cm^2
e. Personnel protective equipment (PPE) class
f. Voltage shock hazard
g. Limited shock approach boundary
h. Restricted shock approach boundary
i. Prohibited shock approach boundary

2.04 WIRING DEVICES IDENTIFICATION

A. Refer to Section 26 2726 – Wiring Devices for requirements.

PART 3 EXECUTION

3.01 APPLICATION

A. Power-Circuit Conductor Identification: For conductors #8AWG and larger, use UL-510 vinyl color-coding conductor tape indicating voltage and phase. Smaller conductors are to utilize factory colored insulation only.

B. Branch Circuit Conductors: Identify conductor source and circuit number at load terminations, and junction boxes using cloth tape and permanent ink. Identify circuit number only at source termination using pre-printed wrap-around identification tape.

C. Equipment Grounding and Bonding Conductor Identification: For conductors #1/0 and larger, use green UL-510 vinyl conductor tape. Smaller conductors are to utilize factory colored insulation only.

D. Isolated Ground Conductor: All conductors are to have factory green insulation with yellow stripe. Field applied color coded tape identification is not allowed.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with project drawings, manufacturer’s wiring diagrams, and Operation and Maintenance Manual.

F. 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 to equipment.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
a. Automatic Transfer Switches
b. Double Ended Equipment
c. Generator Distribution Equipment
d. Fire Pump Disconnects
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.
3. Arc Flash Warning Labels: install per NFPA 70E for each switchgear, switchboard, panelboard, motor control center, industrial control panel (every enclosure that may contain energized conductors or components). Locate labels so they are visible to the personnel before examination, adjustment, servicing, or maintenance of the equipment.

4. Available Fault Current Labels: install per NFPA 70 for each piece of service entrance equipment. Locate labels so they are visible to the personnel before examination, adjustment, servicing, or maintenance of the equipment.

G. Equipment Identification Nameplates: On each unit of equipment, install unique designation nameplate that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply nameplates 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. Nameplate Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic self adhesive backed. Unless otherwise indicated, provide a single line of text with 3/8” high letters on 1-1/2” high nameplate; where 2 lines of text are required, use nameplates sized 2” high.
      b. Outdoor Equipment: Engraved, laminated UV resistant acrylic nameplates with 1/2” high letters. Outdoor equipment labels are to be factory applied with non-corrosive mechanical fasteners or other permanent method to maintain compliance with NEMA rating of enclosure.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   2. Install nameplates for equipment including, but not limited to, the following:
      a. Panelboards, electrical cabinets, and enclosures
      b. Access doors and panels for concealed electrical items
      c. Electrical switchgear and switchboards, including each device
      d. Transformers
      e. Electrical substations
      f. Emergency system boxes and enclosures
      g. Motor-control centers, including each device
      h. Disconnect switches
      i. Enclosed circuit breakers
      j. Motor controllers
      k. Pushbutton stations
      l. Automatic Transfer Switches
      m. Contactors
      n. Remote-controlled switches, dimmer modules, and control devices
      o. Battery inverter units
      p. Battery racks
      q. Power-generating units
      r. Voice and data cable terminal equipment
      s. Master clock and program equipment
      t. Intercommunication and call system master and staff stations
      u. Television/audio components, racks, and controls
      v. Fire alarm control panel and annunciators
      w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks
      x. Monitoring and control equipment
      y. Uninterruptible power supply equipment
      z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions
      aa. Non-concealed junction box covers of auxiliary electrical systems

H. Nameplates shall indicate equipment identification and shall be same as indicated on contract documents. Voltages shall be shown on panelboard nameplates.

3.02 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. Install non-adhesive signs and plastic nameplates parallel to equipment lines; attach non-corrosive mechanical fasteners appropriate to the location and substrate. Attach in a method that does not compromise the NEMA rating of enclosure.

F. Warning Signs: Install warning signs where there is hazardous exposure or danger associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with ANSI A13.1 standard color and design.
   1. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical systems, provide tags of plasticized card stock, either preprinted or hand printed to convey the message; example: “DO NOT OPEN THIS SWITCH WHEN BREAKER IS CLOSED.”

G. System Identification Color Banding for Conductors: Each color band shall completely encircle conductor. Locate bands at source and load terminations and at all junction and tap boxes.

H. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded conductors.
   1. Colors for 208/120 V Circuits:
      a. Phase A (left bus in panelboard): Black
      b. Phase B (center bus in panelboard): Red
      c. Phase C (right bus in panelboard): Blue
      d. Neutral: White
      e. Equipment Ground: Green
      f. Isolated Ground: Green with yellow stripe
   2. Colors for 480/277 V Circuits:
      a. Phase A (left bus in panelboard): Brown
      b. Phase B (center bus in panelboard): Orange
      c. Phase C (right bus in panelboard): Yellow
      d. Neutral: Gray
      e. Equipment Ground: Green
      f. Isolated Ground: Green with yellow stripe

   3. Field-applied, Color-Coding Conductor Tape: Apply no more than 2” wide using multiple turns. Apply last two runs of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings where possible.

I. Painted Identification: Prepare surface and apply paint according to paint manufacturer’s instructions. Do not use cleaning solvents that will harm surface to be painted.

END OF SECTION

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SECTION 26 0593
ELECTRICAL SYSTEMS FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0533 – Raceways and Boxes for Electrical Systems

B. See Architectural Specification sections for additional firestopping requirements.

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 - General Requirements.

1.03 DESCRIPTION

A. Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions (walls, partitions, floors, and ceilings) including both empty openings and openings containing electrical penetrating items, including but not limited to raceways, cables, cable trays, busways, and wireways.

1.04 REFERENCE STANDARDS

A. ASTM E-814 – Standard Test Method for Fire Tests of Through-Penetration Firestops

B. UL 1479 - Fire Tests of Through-Penetration Firestops

C. UL 2079 - Tests For Fire Resistance of Building Joint Systems

1.05 PERFORMANCE REQUIREMENTS

A. Provide firestop system to resist spread of fire, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

B. Firestop systems shall be UL Classified for the application and correspond to those indicated by reference to designations listed by UL Fire Resistance Directory.

C. Conform to applicable Code requirements of Authority Having Jurisdiction.

D. 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.

1.06 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency 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 penetration items, including documentation of UL certification for firestop systems.

C. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Material Safety Data Sheets provided with product delivered to job site.

E. Certification of compliance with Building Codes of Project location.

F. Inspection reports

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.

B. Firestopping tests shall be performed by a qualified testing and inspecting agency, or another agency performing testing and follow-up inspection services for firestop systems acceptable to Authorities Having Jurisdiction.

C. Manufacturer's representative shall be on-site during initial installation of firestop systems to train appropriate Contractor personnel in proper selection and installation procedures.

1.08 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, type and manufacturer, and UL Label where applicable.

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.

C. Handle in accordance with recommended procedures, precautions, or remedies described in material safety data sheets as applicable.

1.09 PROJECT CONDITIONS

A. Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop systems' manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturers' written instructions by natural means or, where this is inadequate, forced-air circulation.

1.10 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 7 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 each installation has been examined by building inspector, if required by Authorities Having Jurisdiction.

1.11 SEQUENCING

A. Sequence work to avoid interferences with building finishes and installation of other products.

1.12 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

B. Manufacturer shall provide standard 1 yr warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. 3M (Fire Protection Products Division), Hilti Inc, Tremco (Sealant/Weatherproofing Division), Nelson Firestop Products, Specified Technologies Inc, RectorSeal Corporation, approved equal.

B. Pyrophobic Systems, Ltd - Intumescent Technologies FireBlok fire suppression gasket for use in 4” X 4” X 2-1/8” boxes.

2.02 MATERIALS

A. Firestop Products: UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire-rating involved for each separate instance; materials shall not contain flammable solvents.

B. Firestop Systems: Produced by the same manufacturer.

C. Fire Suppression Gaskets: Single piece gasket for use in 4” X 4” X 2-1/8” or smaller recessed electrical boxes in walls rated up to 2 hr.

D. Accessories: Components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 “Performance Requirements” Article. Accessories include the following items:
   1. Permanent forming/damming/backing materials
   2. Temporary forming materials
   3. Substrate primers
   4. Collars
   5. Steel sleeves

E. Fill Materials: Including the following:
   1. Firestop putty, caulk sealant, intumescent wrap strips, intumescent firestop collars, firestop mortars, pillows/bags, or a combination of these products to provide a UL-listed system for each application required for this Project; mineral wool backing where specified in manufacturer’s application detail.

F. Mixing
   1. 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

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for opening configurations, penetrating items and other conditions affecting performance of firestopping.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean out openings immediately prior to installing through-penetration firestop system to comply with firestop system manufacturer’s written instructions.

B. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

C. Comply with manufacturer’s recommendations for temperature and humidity conditions before, during and after installation of firestopping.

D. Install fire suppression gaskets inside electrical boxes before conductors are pulled. Install per manufacturer’s requirements.

3.03 INSTALLATION

A. Comply with “System Performance Requirements” Article in Part 1 and with firestop system manufacturer’s written installation instructions and drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during application as required. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Avoid multiple penetrations of common fire barrier opening. Seal each penetration in accordance with manufacturer's UL installation details. When multiple penetrations are unavoidable, seal openings with appropriate UL Classified firestopping systems.

D. Adhere fire suppression gaskets to inside, rear of electrical box with attached adhesive strips.

3.04 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

3.05 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.
   1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Provide certification by Installer that all through-penetration firestop systems have been firestopped in accordance with applicable Building Codes of Project location.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

D. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with specifications.

3.06 CLEANING

A. Clean surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

SECTION 26 0812
POWER DISTRIBUTION ACCEPTANCE TESTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0519 – Low-Voltage Electrical Power Conductors and Cables

B. Section 26 0813 – Power Distribution Acceptance Test Tables

C. Section 26 2816 – Enclosed Switches and Circuit Breakers

D. Section 26 2913 – Enclosed Controllers

1.02 REFERENCE

A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Section includes acceptance testing requirements for assessing the suitability for service and reliability of the power distribution system.

B. It is the purpose of this specification to assure all tested electrical equipment, both contractor and Owner supplied, is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

C. Tests and inspections shall be performed after installation.

D. Tests and inspections shall determine suitability for energization.

E. Electrical systems shall pass tests prior to substantial completion or Owner occupancy.

F. All tests tables referenced in this specification provided in Section 26 0813 – Power Distribution Acceptance Test Tables.

G. Items to be tested and inspected as follows:
   1. 600-volt conductors and cables
   2. Low-voltage insulated-case/molded-case circuit breakers
   3. Low-voltage disconnect switches
   4. Thermographic survey

1.04 REFERENCE STANDARDS

A. ANSI/IEEE C2 – National Electrical Safety Code

B. ANSI/IEEE C37 – Guides and Standards for Circuit Breakers, Switchgear, Relays, Substations, and Fuses

C. ANSI/IEEE C57 – Distribution, Power, and Regulating Transformers

D. ANSI/IEEE C62 – Surge Protection

E. ANSI/IEEE Std. 43 – IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery

F. ANSI/IEEE Std. 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

G. ANSI/IEEE Std. 141 – IEEE Recommended Practice for Electrical/Power Distribution for Industrial Plants (IEEE Red Book)

H. ANSI/IEEE Std. 142 – IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)

I. ANSI/IEEE Std. 241 – IEEE Recommended Practice for Electrical Power Systems in Commercial Buildings (IEEE Gray Book)

J. ANSI/IEEE Std. 242 – IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book)

K. ANSI/IEEE Std. 399 – IEEE Recommended Practice for Power Systems Analysis (IEEE Brown Book)

L. ANSI/IEEE Std. 446 – IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications (IEEE Orange Book)

M. ANSI/IEEE Std. 493 – IEEE Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems (IEEE Gold Book)

N. ANSI/IEEE Std. 1100 – IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (IEEE Emerald Book)

O. NETA – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

P. NEMA AB 4 – Guidelines for Inspection and Preventive Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications

Q. NEMA MG1 – Motors and Generators

R. NFPA 70 – National Electrical Code

S. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance

T. NFPA 70E – Electrical Safety Requirements for Employee Workplaces

U. NFPA 101 – Life Safety Code

V. NFPA 110 – Emergency and Standby Power Systems

W. NIST – National Institute of Standards and Technology

X. OSHA – Part 1910 – Subpart S – 1910.308 – Special Systems

1.05 SUBMITTALS

A. Test Reports: Include the following:
1. Summary of project
2. Description of equipment tested
3. Equipment used to conduct the test
4. Description of test
5. Test results, as compared to manufacturers' or industry accepted standards and tolerances
6. Conclusions and recommendations
7. Signature of responsible test organization authority

B. List of equipment used to perform tests. Identify the following:
1. Type
2. Manufacturer
3. Model number
4. Serial number
5. Date of last calibration
6. Documentation of calibration leading to NIST standards

1.06 QUALITY ASSURANCE

A. Qualifications of Testing Agency:
1. Testing firm shall be regularly engaged in testing of electrical equipment, devices, installations, and systems.
2. Testing firm shall meet Federal Occupational Safety and Health Administration (OSHA) requirements for accreditation of independent testing laboratories.
3. On-site technical person shall be currently certified by the InterNational Electrical Testing Association in electrical power distribution system testing.
4. Testing firm shall use technicians who are regularly employed by the firm for testing services.
5. Testing firm shall submit proof of above qualifications with bid documents when requested.

PART 2 PRODUCTS

2.01 NOT APPLICABLE TO THIS SECTION.

PART 3 EXECUTION

3.01 PREPARATION

A. Documentation: Deliver the following to testing firm, minimum two weeks prior to commencement of testing:
   1. Complete set of electrical plans and specifications, with available short circuit indicated on power riser diagrams.
   2. Approved submittals and shop drawings of equipment being tested.
   3. Pertinent change orders.
   4. Evaluation, overcurrent protective device coordination and arc flash studies provided by Engineer.

B. Schedule: Notify Owner and Engineer 10 working days prior to performance of any tests.

C. Coordination: Coordinate with Construction Manager/Owner/Engineer the testing schedule and availability of equipment ready for testing.

D. Test Power: Provide test power (including specialized) for equipment testing before and after service energizing.

3.02 FIELD QUALITY CONTROL

A. Inspection and Test Procedures: Comply with NETA.
   1. 600 V Conductors and Cables:
      a. Visual and Mechanical Inspection:
         1) Compare cable data with drawing and specifications.
         2) Inspect exposed sections of cables for physical damage.
         3) Verify tightness of accessible bolted electrical connections by calibrated torque wrench in accordance with manufacturer's published data or Table 12.
         4) Perform thermographic survey of bolted electrical connections in accordance with paragraph "Thermographic Survey."
         5) Inspect compression-applied connectors for correct cable match and indentation.
         6) Verify visible cable bends meet or exceed ICEA and manufacturer's minimum allowable bending radius.
         7) For cables are terminated through window-type current transformers, provide an inspection to verify neutral and ground conductors are correctly placed for operation of protective devices.
         8) Inspect for correct identification and arrangements.
         9) Inspect jacket and insulation condition.
      b. Electrical Tests:
         1) Perform insulation-resistance test using megohm meter. Applied potential to be 1000 VDC. Individually test each conductor with other conductors grounded. Test duration shall be one minute.
         2) Perform continuity tests to insure correct cable connection.
      c. Test Values:
         1) Insulation-resistance values should not be less than 50 megohms.
   2. Low-Voltage Insulated-Case/Molded-Case Circuit Breakers, 225A and Larger:
      a. Visual and Mechanical Inspection:
         1) Compare nameplate date with drawings and specifications.
         2) Inspect circuit breaker for correct mounting.
         3) Check cell fit, element alignment and racking mechanism for draw-out breakers.
         4) Operate circuit breaker to insure smooth operation.
         5) Inspect case for cracks or other defects.

6) Verify tightness of accessible bolted electrical connections and/or cable connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 12.
7) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests:
1) Perform a contact-resistance test.
2) Perform insulation-resistance test at 1000 VDC from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase. Test duration shall be one minute. Use a minimum test voltage in accordance with Table 1 or manufacturer's published data.
3) Perform insulation-resistance test at 1000 VDC on all control wiring. Test duration shall be one minute. Do not perform the test on wiring connected to solid-state components. Follow manufacturer's recommendation.
4) Perform adjustments for final trip settings in accordance with overcurrent protective device coordination study.
5) Perform long-time delay time-current characteristic tests by passing 300% rated current through each pole separately unless series testing is required to defeat ground fault functions.
6) Determine short-time pickup and delay by primary current injection.
7) Determine ground-fault pickup and time delay by primary current injection.
8) Determine instantaneous pickup current by primary injection using run-up or pulse method.
9) Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.
10) Verify trip unit calibrations by secondary injection.
11) Determine minimum operation voltage on shunt trip and close coils in accordance with Table 20.
12) Check charging mechanism.

c. Test Values:
1) Bolt-torque levels shall be in accordance with Table 12, unless otherwise specified by manufacturer.
2) Compare microhm or millivolt drop values to adjacent poles or similar breakers. Investigate deviations of more than 50% of lowest value. Investigate any value exceeding manufacturer's recommendations.
3) Circuit breaker insulation-resistance shall be in accordance with Table 1.
4) Control wiring insulation-resistance shall comply with manufacturer's published data. In the absence of manufacturer's published data, use Table 1. Values of insulation resistance less than this table or manufacturer's minimum shall be investigated.
5) Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves are not available, trip times shall not exceed the value shown in Table 7. Circuit breakers exceeding specified trip time at 300% of pickup shall be tagged defective.
6) For molded-case circuit breakers, instantaneous pickup values shall be within manufacturer's published data or tolerances shown in Table 8.
7) Minimum operation voltages on shunt trip and close coils shall be in accordance with manufacturer's published data. In the absence of manufacturer's data, refer to Table 20.

3. Low-Voltage Disconnect Switches:
a. Visual and Mechanical Inspection:
1) Compare equipment nameplate data with drawings and specifications.
2) Inspect physical and mechanical condition.

3) Inspect anchorage, alignment, grounding, and required clearances.
4) Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.
5) Verify that fuse sizes and types are in accordance with drawings, short-circuit and overcurrent protective device coordination studies.
6) Verify that each fuse has adequate mechanical support and contact integrity.
7) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or Table 12.
8) Perform thermographic survey of accessible bolted electrical connection in accordance with paragraph "Thermographic Survey."
9) Verify operation and sequencing of interlocking systems.
10) Verify correct phase barrier installation.
11) Verify correct operation of all indicating and control devices.
12) Confirm correct application of manufacturer's recommended lubricants.

b. Electrical Tests:
1) Measure contact resistance across each switchblade and fuseholder.
2) Perform insulation-resistance test at 1000 VDC from pole-to-pole and from each pole-to-ground. Test duration shall be one minute. Use a minimum test voltage in accordance with Table 1 or manufacturer's published data.
3) Measure fuse resistance.
4) Perform ground fault test, if applicable.

c. Test Values:
1) Compare bolted connection resistances to values of similar connections.
2) Bolt-torque levels should be in accordance with Table 12, unless otherwise specified by the manufacturer.
3) Compare microhm or millivolt drop values to adjacent poles or similar switches. Investigate deviations of more than 50% of lowest value. Investigate any value exceeding manufacturer's recommendations.
4) Minimum insulation-resistance shall be in accordance with manufacturer's published data or Table 1.
5) Investigate fuse-resistance values that deviate from each other by more than 15%.

4. Thermographic Survey:
a. Visual and Mechanical Inspection:
1) Inspect physical, electrical, and mechanical conditions.
2) Remove all necessary covers prior to thermographic inspection.
3) Equipment to be inspected shall include all current-carrying devices. Provide report including the following:
a) Discrepancies.
b) Temperature difference between area of concern and reference area.
c) Cause of temperature difference.
d) Areas inspected. Identify inaccessible and unobservable areas and equipment.
e) Identify load conditions at time of inspection.
f) Provide photographs and thermogram of deficient area.

b. Test Parameters:
1) Inspect distribution systems with imaging equipment capable of detecting minimum temperature difference of 1°C at 30°C.
2) Equipment shall detect emitted radiation and convert detected radiation to visual signal.

3) Thermographic surveys should be performed during periods of maximum possible loading but not less than 40% of rated load of the electrical equipment being inspected. Refer to NFPA 70B, Section 20.17 (Infrared Inspection).

c. Test Results:
1) Temperature differences of 1°C to 3°C indicate possible deficiency and warrant investigation.
2) Temperature differences of 4°C to 15°C indicate deficiency; repair as time permits.
3) Temperature differences of 16°C and above indicate major deficiency, repair immediately.
4) Suggested actions based on temperature rise can be found in Table 18.

B. Test Reports:
1. Testing firm shall do the following:
a. Prepare test report, including description of equipment tested, description of test, test results, conclusions and recommendations, retesting results, list of test equipment used and calibration date.
b. Show test results in comparison to industry and manufacturer's values and tolerances.
c. Interpret test results in writing and give recommendations for acceptance or rejection upon consultation with Engineer and prior to energizing equipment.
d. Assure electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with contract documents.
e. Assure suitability of energization.
f. Report to the Owner and Engineer any system, material, or workmanship that is found defective on the basis of acceptance tests.
g. Retest equipment when required.
h. Maintain written record of tests.
i. Utilize safety practices during the tests in accordance with:
1) Acceptable state and local safety operating procedures
2) Owner's safety practices
3) OSHA
4) NFPA 70E
j. Perform tests with apparatus de-energized and grounded, except where otherwise specifically required ungrounded by test procedures.
k. Assemble and certify final test report.
l. Provide 4 copies of complete test report.
m. Attach label to all tested equipment with indication of date tested and testing firm name.
2. Contractor shall do the following:
a. Investigate, replace, or repair any fault in material or in any part of the installation revealed by the tests.
b. Deliver one copy of each test report directly to Engineer within 30 days after completion of testing, unless directed otherwise. Insert a copy of each test report in the equipment operation and maintenance manuals.

C. Test Equipment:
1. Test Instrument Calibration:
a. Testing firm shall have calibration program that assures test instruments are maintained with rated accuracy.
b. Instruments shall be calibrated in accordance with the following frequency schedule:
1) Field instruments: Analog, 6 months maximum; Digital, 12 months maximum
2) Laboratory instruments: 12 months
3) Leased specialty equipment: 12 months where accuracy is guaranteed by lessor

c. Dated calibration labels shall be visible on test equipment.
d. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
e. Up-to-date instrument calibration instructions and procedures shall be maintained for test instrument.
f. Equipment used for field testing shall be more accurate than instrument being tested.
g. Calibrating standard applied to testing equipment shall be of higher accuracy than instrument tested.

END OF SECTION

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SECTION 26 0813
POWER DISTRIBUTION ACCEPTANCE TEST TABLES

TABLE 1
Insulation Resistance Test Values
Electrical Apparatus And Systems

Voltage Rating	Minimum DC Test Voltage	Recommended Minimum Insulation Resistance In Megohms
250	500	25
600	1,000	100
1,000	1,000	100
2,500	1,000	500
5,000	2,500	1,000
8,000	2,500	2,000
15,000	2,500	5,000
25,000	5,000	20,000
34,500 and above	15,000	100,000

See Table 14 for temperature correction factors.

TABLE 2
Switchgear Low-Frequency Withstand Test Voltages

Type of Switchgear	Rated kV	Maximum Test Voltage kV AC	DC
Low-Voltage Power Circuit Breaker Switchgear	.254	1.6	2.3
	.508	1.6	2.3
	.635	1.6	2.3
MC (Metal-Clad Switchgear)	4.76	14.0	20.0
	8.25	27.0	37.0
	15.0	27.0	37.0
	27.0	45.0	+
	38.0	60.0	+
SC (Station-Type Cubicle Switchgear)	15.5	37.0	+
	38.0	60.0	+
	72.5	*120*.0	+
MEI (Metal-Enclosed Interrupter Switchgear)	4.76	14.0	20.0
	8.25	19.0	27.0
	15.0	27.0	37.0
	15.5	37.0	52.0
	25.8	45.0	+
	38.0	60.0	+

Derived from ANSI/IEEE C37.20.2-1993, Paragraph 5.5, *Metal-Clad and Station-Type Cubicle Switchgear* and C37.20.3-1993, Paragraph 5.5, *Metal-Enclosed Interrupter Switchgear*, and includes 0.75 multiplier with fraction rounded down.

The column headed “DC, Maximum Test Voltage kV” is given as a reference only for those using DC tests to verify the integrity of connected cable installations without disconnecting the cables from the switchgear. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for voltage rating of switchgear. The presence of this column in no way implies any requirement for a DC withstand test on AC equipment or that a DC withstand test represents an acceptable alternative to the low-frequency withstand tests specified in this specification, either for design tests, production tests, conformance tests, or field tests. When making DC tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

Because of the variable voltage distribution encountered when making DC withstand tests, the manufacturer should be contacted for recommendations before applying DC withstand tests to the switchgear. Voltage transformers above 34.5kV should be disconnected when testing with DC. Refer to ANSI/IEEE C57-13-1993 (*IEEE Standard Requirements for Instrument Transformers*) paragraph 8.8.2.
+ Consult Manufacturer

TABLE 3
Recommended Dissipation Factor/Power Factor at 20°C
Liquid Filled Transformers, Regulators, and Reactors
Acceptance Test Values

Oil, Silicone, and Less-Flammable Hydrocarbon Maximum Value (Percent)	
New Power Transformers and Reactors	0.5%
New Distribution Transformers and Regulators	1.0%
Remanufactured Power Transformers and Reactors	1.0%
Remanufactured Distribution Transformers and Regulators	1.5%

TABLE 4
Insulating Fluid Limits

Table 4.1 **Test Limits for New Insulating Oil Received in New Equipment**		
Mineral Oil		
Test	**ASTM Method**	**# 69 kV and Below**
Dielectric breakdown, kV minimum	D877	30
Dielectric breakdown, kV minimum @ 1 mm(0.04”) gap	D1816	25
Dielectric breakdown, kV minimum @ 2 mm(0.08”) gap	D1816	45
Interfacial tension mN/m minimum	D971 or D2285	38
Neutralization number, mg KOH/g maximum	D974	0.015
Water content, (ppm) maximum	D1533	20
Power factor at 25°C, %	D924	0.05
Power factor at 100°C, %	D924	0.40
Color	D1500	1.0
Visual condition	D1524	Bright and clear

ANSI/IEEE C57.106-2002, *Guide for Acceptance and Maintenance of Insulating Oil in Equipment,* Tables 1, 2, and 3.

Table 4.2 **Test Limits for Silicone Insulating Liquid in New Transformers**		
Test	**ASTM Method**	**Acceptable Values**
Dielectric breakdown, kV minimum	D877	30
Visual	D2129	clear, free of particles
Water content, (ppm) maximum	D1533	50
Dissipation/power factor, 60 Hz, % max. @ 25°C	D924	0.1
Viscosity, cSt @ 25°C	D445	47.5 – 52.5
Fire point, °C, minimum	D92	340
Neutralization number, mg KOH/g max.	D974	0.01

ANSI/IEEE C57.111-1989 (R1995), *Guide for Acceptance of Silicone Insulating Fluid and Its Maintenance in Transformers,* Table 2.

TABLE 4 (CONT.)
Insulating Fluid Limits

Table 4.3 Typical Values for Less-Flammable Hydrocarbon Insulating Liquid Received in New Equipment				
ASTM Method	**Test**	**Results**		
		Minimum		**Maximum**
D1816	Dielectric breakdown voltage for 2 mm(0.08”) gap, kV	40	34.5 kV class and below	---
		60	Desirable	
D1816	Dielectric breakdown voltage for 1 mm(0.04”) gap, kV	20	34.5 kV class and below	---
		30	Desirable	
D974	Neutralization number, mg KOH/g	----		0.03
D877	Dielectric breakdown voltage kV	30		----
D924	AC loss characteristic (dissipation factor), % 25°C 100°C	 ---- ----		 0.1 1
D1533B	Water content, (ppm)	----		25
D1524	Condition-visual	Clear		
D92	Flash point (°C)	275		----
D92	Fire point (°C)	300[a]		----
D971	Interfacial tension, mN/m, 25°C	38		----
D445	Kinematic viscosity, mm^2/s. (cSt), 40°C	1.0×10^2(100)		1.3×10^2(130)
D1500	Color	----		L2.5

ANSI/IEEE C57.121-1998, *IEEE Guide for Acceptance and Maintenance of Less-Flammable Hydrocarbon Fluid in Transformers,* Table 3.

The test limits shown in this table apply to less-flammable hydrocarbon fluids as a class. Specific typical values for each brand of fluid should be obtained from each fluid manufacturer.

a. If the purpose of the HMWH installation is to comply with the NFPA 70 *National Electrical Code*, this value is the minimum for compliance with NEC Article 450.23.

TABLE 5

Transformer Insulation-Resistance
Acceptance Test Voltage and Minimum Results

Transformer Coil Rating Type in Volts	Minimum DC Test Voltage	Recommended Minimum Insulation Resistance in Megohms	
		Liquid Filled	Dry
0 - 600	1000	100	500
601 - 5000	2500	1000	5000
5001 - 15000	5000	5000	25000

See Table 14 for Temperature Correction Factors.
NOTE: Since insulation resistance depends on insulation rating (kV) and winding capacity (kVA), values obtained should be compared to manufacturer's test data.

TABLE 6
Medium-Voltage Cables
Acceptance Test Values

Table 6.1
DC Test Voltages

Rated Voltage Phase-to-Phase kV	Conductor Sizes AWG or kcmil (mm)	Nominal Insulation Thickness mils (mm)		Maximum DC Field Test Voltages, kV During/After Installation	
		100% Insulation Level	133% Insulation Level	100% Insulation Level	133% Insulation Level
5	8-1000 (8.4-507) Above 1000 (507)	90 (2.29) 140 (3.56)	115 (2.92) 140 (3.56)	28 28	36 36
8	6-1000 (13.3-507) Above 1000 (507)	115 (2.92) 175 (4.45)	140 (3.56) 175 (4.45)	36 36	44 44
15	2-1000 (33.6-507) Above 1000 (507)	175 (4.45) 220 (5.59)	220 (5.59) 220 (5.59)	56 56	64 64
25	1-2000 (42.4-1013)	260 (6.60)	320 (8.13)	80	96
28	1-2000 (42.4-1013)	280 (7.11)	345 (8.76)	84	100
35	1/0-2000 (53.5-1013)	345 (8.76)	420 (10.7)	100	124

Tables derived from ANSI/ICEA S-93-639/NEMA WC 74-2000, *5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy;* ANSI/ICEA S-94-649-2000, *Standard for Concentric Neutral Cables Rated 5,000 – 46,000 Volts*; ANSI/ICEA S-97-682-2000, *Standard for Utility Shielded Power Cables Rated 5,000 – 46,000 Volts*; and The Okonite Company, *High-Voltage Proof Testing.*

The DC field test voltages listed above are intended for cable designed in accordance with ICEA specifications. When older cables or other types/classes of cables or accessories are connected to the system, voltages lower than those shown may be necessary. Consult the manufacturers of the cables and/or accessories before applying the test voltage.

TABLE 6 (CONT.)
Medium-Voltage Cables
Acceptance Test Values

Table 6.2 AC Test Voltages					
		Nominal Insulation Thickness mils (mm)		AC Test Voltage, kV	
Rated Voltage Phase-to-Phase kV	Conductor Sizes AWG or kcmil (mm)	100% Insulation Level	133% Insulation Level	100% Insulation Level	133% Insulation Level
5 KV	8-1000 1001-3000	90 (2.29) 140 (3.56)	115 (2.92) 140 (3.56)	18 28	23 28
8 kV	6-1000 1001-3000	115 (2.92) 175 (4.45)	140 (3.56) 175 (4.45)	23 35	28 35
15 kV	2-1000 1001-3000	175 (4.45) 220 (5.59)	220 (5.59) 220 (5.59)	35 44	44 44
25 kV	1-3000	260 (6.60)	320 (8.13)	52	64
28 kV	1-3000	280 (7.11)	345 (8.76)	56	69
35 kV	1/0-3000	345 (8.76)	420 (10.7)	69	84

Tables derived from ANSI/ICEA S-93-639/NEMA WC 74-2000, *5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy;* ANSI/ICEA S-94-649-2000, *Standard for Concentric Neutral Cables Rated 5,000 – 46,000 Volts*; ANSI/ICEA S-97-682-2000, *Standard for Utility Shielded Power Cables Rated 5,000 – 46,000 Volts.*

All AC voltages are RMS values.

TABLE 6 (CONT.)
Medium-Voltage Cables
Acceptance Test Values

Table 6.3 Partial Discharge Requirements for Semiconducting Coating and Tape Designs Only		
Rated Circuit Voltage Phase-to-Phase Volts	**Minimum Partial Discharge Extinction Level, kV**	
	100% Insulation Level	**133% Insulation Level**
2001-5000	4	5
5001-8000	6	8
8001-15000	11	15

ANSI/ICEA S-93-639/NEMA WC 74-2000, *5-56 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.*

Table 6.4 Very Low Frequency Testing Levels 0.1 Hz Test Voltage (RMS)	
System Voltage Phase-to-Phase (kV) (RMS)	**Proof Phase-to-Ground (kV) (RMS)**
5	10
15	22
25	33
35	47

TABLE 7
Molded-Case Circuit Breakers
Values for Inverse Time Trip Test

(At 300% of Rated Continuous Current of Circuit Breaker)

Range of Rated Continuous Current Amperes	Maximum Trip Time in Seconds For Each Maximum Frame Rating[1]	
	250V	251 - 600V
0-30	50	70
31-50	80	100
51-100	140	160
101-150	200	250
151-225	230	275
226-400	300	350
401-600	----------	450
601-800	----------	500
801-1000	----------	600
1001-1200	----------	700
1201-1600	----------	775
1601-2000	----------	800
2001-2500	----------	850
2501-5000	----------	900

Reproduction of Table 5-3 from NEMA Standard AB4-1996.

[1] For integrally-fused circuit breakers, trip times may be substantially longer if tested with the fuses replaced by solid links (shorting bars).

TABLE 8
Instantaneous Trip Setting Tolerances for Field Testing
of Marked Adjustable Trip Circuit Breakers

	Tolerances of High and Low Settings	
Ampere Rating	**High**	**Low**
Adjustable	+40%	-30%
Non-adjustable	+25%	-25%

Reproduction of Table 5-4 from NEMA publication AB4-1996.

For circuit breakers with nonadjustable instantaneous trips, tolerances apply to the manufacturer's published trip range, i.e., +40% on high side, -30% on low side.

TABLE 9
Instrument Transformer Dielectric Tests
Field Acceptance

Nominal System (kV)	BIL (kV)	Applied Potential Tests Field Test Voltage (kV)	
		AC	DC[1]
0.6	10	3	4
1.2	30	7.5	10
2.4	45	11.25	15
5.0	60	14.25	19
8.7	75	19.5	26
15	95	25.5	34
15	110	25.5	34
25	125	30	40
25	150	37.5	50
34.5	150	37.5	50
34.5	200	52.5	70

Derived from Paragraph 8.8.2 and Tables 2 and 7 of ANSI/IEEE C57.13-1993 (Standard Requirements for Instrument Transformers).

[1] DC potential tests are not recommended for transformers rated higher than 200 kV BIL. DC tests may prove beneficial as a reference for future testing. In such cases the test direct voltage should not exceed the original factory test RMS alternating voltages.

TABLE 10
Maximum Allowable Vibration Amplitude

RPM @ 60 Hz	Velocity in/s peak	Velocity mm/s	RPM @ 60 Hz	Velocity in/s peak	Velocity mm/s
3600	0.15	3.8	3000	0.15	3.8
1800	0.15	3.8	1500	0.15	3.8
1200	0.15	3.8	1000	0.13	3.3
900	0.12	3.0	750	0.10	2.5
720	0.09	2.3	600	0.08	2.0
600	0.08	2.0	500	0.07	1.7

Derived from NEMA publication MG 1-1998, Section 7.8.1, Table 7-1. Table is unfiltered vibration limits for resiliently mounted machines. For machines with rigid mounting, multiply the limiting values by 0.8.

TABLE 11
Overpotential Test Voltages for Electrical Apparatus Other than Inductive Equipment

Nominal System (Line) Voltage[1] (kV)	Insulation Class	AC Factory Test (kV)	Maximum Field Applied AC Test (kV)	Maximum Field Applied DC Test (kV)
1.2	1.2	10	6.0	8.5
2.4	2.5	15	9.0	12.7
4.8	5.0	19	11.4	16.1
8.3	8.7	26	15.6	22.1
14.4	15.0	34	20.4	28.8
18.0	18.0	40	4.0	33.9
25.0	25.0	50	30.0	42.4
34.5	35.0	70	42.0	59.4
46.0	46.0	95	57.0	80.6
69.0	69.0	140	84.0	118.8

[1] Intermediate voltage ratings are placed in the next higher insulation class.

TABLE 12

U.S. Standard
Bolt Torques for Bus Connections
Heat-Treated Steel – Cadmium or Zinc Plated

Grade	SAE 1 & 2	SAE 5	SAE 7	SAE 8
Minimum Tensile (psi)	64K	105K	133K	150K
Bolt Diameter In Inches	Torque (Foot Pounds)			
1/4	4	6	8	8
5/16	7	11	15	18
3/8	12	20	27	30
7/16	19	32	44	48
1/2	30	48	68	74
9/16	42	70	96	105
5/8	59	96	135	145
3/4	96	160	225	235
7/8	150	240	350	380
1.0	225	370	530	570

Bolt Torques for Bus Connections
Silicon Bronze Fasteners[1]
Torque (Foot Pounds)

Bolt Diameter in (Inches)	Nonlubricated	Lubricated
5/16	15	10
3/8	20	14
1/2	40	25
5/8	55	40
3/4	70	60

[1] Bronze alloy bolts shall have a minimum tensile strength of 70,000 psi.

TABLE 12 (CONT.)

Bolt Torques for Bus Connections
Aluminum Alloy Fasteners[2]
Torque (Foot Pounds)

Bolt Diameter in Inches	Lubricated
5/16	8.0
3/8	11.2
1/2	20.0
5/8	32.0
3/4	48.0

[2] Aluminum alloy bolts shall have a minimum tensile strength of 55,000 psi.

Bolt Torques for Bus Connections
Stainless Steel Fasteners[3]
Torque (Foot Pounds)

Bolt Diameter in Inches	Uncoated
5/16	14
3/8	25
1/2	45
5/8	60
3/4	90

[3] Bolts, cap screws, nuts, flat washers, locknuts: 18-8 alloy.
Belleville washers: 302 alloy.

TABLE 13
SF_6 Gas Tests

Test	Method	Serviceability Limits[a]
Moisture	Hygrometer	Per manufacturer or 200 ppm[b]
SF_6 decomposition byproducts	ASTM D 2685	500 ppm
Air	ASTM D 2685	5000 ppm[c]
Dielectric breakdown Hemispherical contents	0.10” gap at atmospheric pressure	11.5 – 13.5 kV[d]

a. In the absence of consensus standards dealing with SF_6 gas tests, the NETA Standards Review Council suggests the above representative values.
b. According to some manufacturers.
c. Dominelli, N. and Wylie, L., *Analysis of SF_6 Gas as a Diagnostic Technique for GIS*, Electric Power Research Institute, Substation Equipment Diagnostics Conference IV, February 1996.
d. Per Even, F.E., and Mani, G. Sulfur Fluorides, Kirk, *Othmer Encyclopedia of Chemical Technology*, 4th ed., 11,428, 1994.

Reference: IEC 61634 High-Voltage Switchgear and Controlgear – *Use and Handling of Sulfur Hexafluoride (SF_6) in High-Voltage Switchgear and Controlgear.*

TABLE 14
Insulation Resistance Conversion Factors For
Conversion of Test Temperature to 20°C

Temperature		Multiplier	
°C	°F	Apparatus Containing Immersed Oil Insulations	Apparatus Containing Solid Insulations
0	32	0.25	0.40
5	41	0.36	0.45
10	50	0.50	0.50
15	59	0.75	0.75
20	68	1.00	1.00
25	77	1.40	1.25
30	86	1.98	1.58
35	95	2.80	2.00
40	104	3.95	2.50
45	113	5.60	3.15
50	122	7.85	3.98
55	131	11.20	5.00
60	140	15.85	6.30
65	149	22.40	7.90
70	158	31.75	10.00
75	167	44.70	12.60
80	176	63.50	15.80

TABLE 15 (not used)
High-Potential Test Voltage
Automatic Circuit Reclosers

Nominal Voltage Class, kV	Maximum Voltage, kV	Rated Impulse Withstand Voltage, kV	Maximum Field Test Voltage, kV, AC
14.4	15.0	95	35
14.4	15.5	110	50
24.9	27.0	150	60
34.5	38.0	150	70
46.0	48.3	250	105
69.0	72.5	350	160

Derived from ANSI/IEEE C37.61-1973(R1992), *Standard Guide for the Application, Operation, and Maintenance of Automatic Circuit Reclosers* and from C37.60-1981(R1992), *Standard Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems.*

TABLE 16 (not used)
High-Potential Test Voltage
for Acceptance Test of Line Sectionalizers

Nominal Voltage Class, kV	Maximum Voltage, kV	Rated Impulse Withstand Voltage, kV	Maximum Field Test Voltage, kV, AC	DC 15 Minute Withstand (kV)
14.4 (1 ∅)	15.0	95	35	53
14.4 (1 ∅)	15.0	125	42	53
14.4 (3 ∅)	15.5	110	50	53
24.9 (1 ∅)	27.0	125	60	78
34.5 (3 ∅)	38.0	150	70	103

Derived from ANSI/IEEE C37.63-1984(R1990) Table 2 (*Standard Requirements for Overhead, Pad-Mounted, Dry-Vault, and Submersible Automatic Line Sectionalizers of AC Systems*).

NOTE: Values of AC voltage given are dry test one-minute factory test values.

TABLE 17
Dielectric Withstand Test Voltages
Metal-Enclosed Bus

Type of Bus	Rated kV	Maximum Test Voltage, kV	
		AC	DC
Isolated Phase for Generator Leads	24.5	37.0	52.0
	29.5	45.0	--
	34.5	60.0	--
Isolated Phase for Other than Generator Leads	15.5	37.0	52.0
	25.8	45.0	--
	38.0	60.0	--
Nonsegregated Phase	0.635	1.6	2.3
	4.76	14.2	20.0
	15.0	27.0	37.0
	25.8	45.0	63.0
	38.0	60.0	--
Segregated Phase	15.5	37.0	52.0
	25.8	45.0	63.0
	38.0	60.0	--
DC Bus Duct	0.3	1.6	2.3
	0.8	2.7	3.9
	1.2	3.4	4.8
	1.6	4.0	5.7
	3.2	6.6	9.3

Derived from ANSI/IEEE C37.23-1987, Tables 3A, 3B, 3C, 3D, and paragraph 6.4.2. The table includes a 0.75 multiplier with fractions rounded down.

NOTE:

The presence of the column headed “DC” does not imply any requirement for a DC withstand test on AC equipment. This column is given as a reference only for those using DC tests and represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each class of bus.

Direct current withstand tests are recommended for flexible bus to avoid the loss of insulation life that may result from the dielectric heating that occurs with rated frequency withstand testing.

Because of the variable voltage distribution encountered when making DC withstand tests and variances in leakage currents associated with various insulation systems, the manufacturer should be consulted for recommendations before applying DC withstand tests to this equipment.

TABLE 18
Thermographic Survey
Suggested Actions Based on Temperature Rise

Temperature difference (TD) based on comparisons between similar components under similar loading	Temperature difference (TD) based upon comparisons between component and ambient air temperatures	Recommended action
1°C to 3°C	1°C to 10°C	Possible deficiency; warrants investigation
4°C to 15°C	11°C to 20°C	Indicates probably deficiency; repair as time permits
-- -- --	21°C to 40°C	Monitor until corrective measures can be accomplished
>15°C	>40°C	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on)T. In the absence of consensus standards for TD, the values in this table will provide reasonable guidelines.

An alternative method of evaluation is the standards-based temperature rating system as discussed in Chapter 8.9.2, Conducting an IR Thermographic Inspection, *Electrical Power Systems Maintenance and Testing*, by Paul Gill, PE, 1998.

It is a necessary and valid requirement that the person performing the electrical inspection be thoroughly trained and experienced concerning the apparatus and systems being evaluated as well as knowledgeable of thermographic methodology.

TABLE 19
Overpotential Test Voltages
Electrical Apparatus Other than Inductive Equipment

Nominal System (Line) Voltage[a] (kV)	Insulation Class	AC Factory Test (kV)	Maximum Field Applied AC Test (kV)	Maximum Field Applied DC Test (kV)
1.2	1.2	10	6.0	8.5
2.4	2.5	15	9.0	12.7
4.8	5.0	19	11.4	16.1
8.3	8.7	26	15.6	22.1
14.4	15.0	34	20.4	28.8
18.0	18.0	40	24.0	33.9
25.0	25.0	50	30.0	42.4
34.5	35.0	70	42.0	59.4

a. Intermediate voltage ratings are placed in the next higher insulation class.

TABLE 20
Rated Control Voltages and their Ranges
for Circuit Breakers

The maximum voltage is measured at the point of user connection to the circuit breaker [see Notes (9) (10)] with no operating current flowing, and the minimum voltage is measured with maximum operating current flowing.

Rated Control Voltages and their Ranges for Circuit Breakers					
RATED CONTROL VOLTAGE (8)	**Direct Current Voltage Ranges (1)(2) Volts, DC**		**OPENING FUNCTIONS ALL TYPES**	**RATED CONTROL VOLTAGE (60 Hz)**	**ALTERNATING CURRENT (1)(2)(3)(5) CLOSING, TRIPPING, AND AUXILIARY FUNCTIONS**
	CLOSING AND AUXILIARY FUNCTIONS				
	INDOOR CIRCUIT BREAKERS	**OUTDOOR CIRCUIT BREAKERS**		**SINGLE PHASE**	**SINGLE PHASE**
24	---	---	14-28	120	104-127 (4)
48	38-56	36-56	28-56	240	208-254 (4)
125	100-140	90-140	70-140	Polyphase	Polyphase
250	200-280	180-280	140-280		
---	---	---	---	208Y/120	180Y/104-
---	---	---	---	240	220Y/127
					208-254

Derived from Table 8, ANSI C37.06-2000, *AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis – Preferred Ratings and Related Required Capabilities.*

RATED CONTROL VOLTAGES AND THEIR RANGES FOR CIRCUIT BREAKERS Solenoid-Operated Devices	
RATED VOLTAGE	**Closing Voltage Ranges for Power Supply**
125 DC	90 – 115 or 105 – 130
250 DC	180 – 230 or 210 – 260
230 AC	190 – 230 or 210 - 260

Notes:

(1) Electrically operated motors, contactors, solenoids, valves, and the like need not carry a nameplate voltage rating that corresponds to the control voltage rating shown in the table as long as these components perform the intended duty cycle (usually intermittent) in the voltage range specified.

(2) Relays, motors, or other auxiliary equipment that function as a part of the control for a device shall be subject to the voltage limits imposed by this standard, whether mounted at the device or at a remote location.

(3) Includes supply for pump or compressor motors. Note that rated voltages for motors and their operating ranges are covered by ANSI/NEA MG-1-1978.

(4) Includes heater circuits.

(5) Voltage ranges apply to all closing and auxiliary devices when cold. Breakers using standard auxiliary relays for control functions may not comply at lower extremes of voltage ranges when relay coils are hot, as after repeated or continuous operation.

(6) Direct current control voltage sources, such as those derived from rectified alternating current, may contain sufficient inherent ripple to modify the operation of control devices to the extent that they may not function over the entire specified voltage ranges.

(7) This table also applies for circuit breakers in gas-insulation substation installations.

(8) In cases where other operational ratings are a function of the specific control voltage applied, tests in C37.09 may refer to the “Rated Control Voltage.” In these cases, tests shall be performed at the levels in this column.

(9) For an outdoor circuit breaker, the point of user connection to the circuit breaker is the secondary terminal block point at which the wires from the circuit breaker operating mechanism components are connected to the user’s control circuit wiring.

(10) For an indoor circuit breaker, the point of user connection to the circuit breaker is either the secondary disconnecting contact (where the control power is connected from the stationary housing to the removable circuit breaker), or the terminal block point in the housing nearest to the secondary disconnecting contact.

(11) Some solenoid operating mechanisms are not capable of satisfactory performance over the range of voltage specified in the standard; moreover, two ranges of voltage may be required for such mechanisms to achieve an acceptable standard of performance.

(12) The preferred method of obtaining the double range of closing voltage is by use of tapped coils. Otherwise, it will be necessary to designate one of the two closing voltage ranges listed above as representing the condition existing at the device location due to battery or lead voltage drop or control power transformer regulation. Also, caution should be exercised to ensure that the maximum voltage of the range used is not exceeded.

END OF SECTION

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SECTION 26 0923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0000 - General Electrical Requirements

B. Section 26 2726 – Wiring Devices

C. Section 26 5100 - Interior Lighting

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION OF SYSTEM

A. Provide devices such as snap switches, wall box dimmers, wall and ceiling mounted occupancy sensors, ambient light sensors, sensor power packs, etc., as shown on drawings.

B. Openings shall be covered with devices and matching plates.

C. Devices of same type shall be from same manufacturer.

1.04 REFERENCE STANDARDS

A. UL20 - General Use Snap Switches.

B. UL773A - Non-Industrial Photoelectric Switches for Lighting Control.

C. NEMA WD 7 - Occupancy Motion Sensors.

1.05 SUBMITTALS

A. Submit shop drawings for equipment provided under this Section.

B. Device color samples.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. Snap Switches: Cooper, Hubbell, Pass & Seymour
   2. Wall Box Dimmers: Hubbell, Lutron, Prescolite, Unenco
   3. Ceiling Sensors:
      a. Passive Infrared and Dual Technology (PIR and Ultrasonic) Occupancy Sensors: Crestron, Hubbell, Lutron, MyTech, Tork, Unenco, Wattstopper
      b. Ambient Light Sensors: Crestron, Hubbell, MyTech, Leviton, Lightolier (Insight Series), Uneco, Wattstopper
   4. Wall Sensors:
      a. Passive Infrared and Dual Technology (PIR and Ultrasonic) Occupancy Sensors: Crestron, Hubbell, Lutron, MyTech, Unenco, Wattstopper
   5. Power Packs: Light-O-Matic, Lightolier, Leviton, MyTech, Novitas, Tork, Unenco, Wattstopper
   6. Photocells: Intermatic, Paragon, Tork
   7. Time clocks: Intermatic ET1725C or approved equal.

B. It is the responsibility of Electrical Contractor to ensure devices submitted meet or exceed functional intent and design quality standards.

2.02 FABRICATION AND MANUFACTURE

A. Devices shall be UL listed for loads and voltages as shown on drawings.

2.03 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches: Heavy-duty (specification grade); back and side wired; flush or surface mounting; Body and Handle: thermoplastic with toggle handle; for connection to copper or copper-clad conductors:
   1. Ratings:
      a. Voltage: 120-277V, AC
      b. Current: 20 A
   2. Single pole
   3. Double pole
   4. Three-way
   5. Four-way
   6. Switches for Connections to Aluminum Conductors: Comply with UL 1567.

C. Color: Coordinate color of toggle and faceplate with Section 26 2726 – Wiring Devices.

2.04 WALL BOX DIMMERS

A. Dimmers shall:
   1. Operate in ambient temperature range of 32°F to 104°F.
   2. Be linear slide preset dimmers or push-button decora style with power-failure memory.
   3. Incorporate separate control of intensity and on/off.
   4. Include voltage compensation circuitry that adjusts firing angle of dimmer to compensate light output for variations in AC line voltage. Dimmers in which firing angle is held constant with varying AC line voltage shall not be acceptable.
   5. Provide smooth and continuous IESNA Square Law Dimming Curve throughout entire dimming range.
   6. Incorporate filter network to minimize interference (RFI) with radio, audio, and video equipment.
   7. Incorporate air-gap switch to meet requirements of UL 20 for air-gap switches in incandescent dimmers.

B. Fluorescent dimmers shall be:
   1. Rated to control 430 mA rapid start, 800 mA high output or 265 mA lamps.
   2. Be approved by ballast manufacturer for control of ballasts provided.
   3. Contain relay to automatically remove power to circuit feeding dimming ballast when dimmer is off.
   4. Incorporate circuitry to prevent lights from momentarily "flashing" when dimmer is turned on or off.
   5. Different lamp lengths or one and two lamp ballasts on same circuit shall track evenly with no perceptible difference in light levels for same type of lamps.
   6. Dimmers and lamps shall have a dimming range from 100% down to 10% light output.
   7. Refer to Section 26 5100 - Interior Lighting for solid state dimming ballast specification.

2.05 OCCUPANCY SENSORS

A. Occupancy Sensor shall:
   1. Match other devices in area.
   2. Operate with all lamp and ballast combinations, including magnetic, hybrid, and solid-state ballasts.
   3. Have LED to indicate occupant detection.
   4. Have adjustable time delays from 30 seconds to 15 minutes and adjustable sensitivity.

B. Ultrasonic circuit shall be:
   1. Solid-state crystal controlled.
   2. 32 kHz minimum.

C. Passive infrared occupancy sensors shall:
   1. Incorporate temperature compensated dual element sensor and multi element fresnel lens.
   2. Have daylight filter to ensure sensor is insensitive to short-wavelength waves emitted by sun.

D. Ceiling passive infrared occupancy sensors shall:
   1. Have round, square, or long rectangular coverage patterns to match floor plan layout.
   2. Operate within ceiling height of 12 ft.
   3. Be low voltage wired in parallel to common power pack.

E. Wall passive infrared occupancy sensors shall:
   1. Incorporate all features and performance of passive infrared sensors except for switching.
   2. Have switch for either off or auto for normal operation.
   3. Be completely self-contained to replace standard toggle switches.
      a. Switching mechanism shall be latching air gap relay.
      b. Units may be low voltage devices with sensor power packs similar to ceiling mounted devices.
      c. Power supply shall be internal transformer.
   4. Incorporate by-pass switch to enable lighting to be turned on if sensor fails.
   5. Have 170° radial spread pattern with minimum of 20 ft axial sensor coverage.
   6. Be user adjustable for normal operation.
      a. Sensor shall operate similar to toggle switch, tap on, and tap off, with sensor maintaining lighting during detection and time delay lights off.
      b. Alternate operation shall be sensor detection lights on, with sensor maintaining lighting during detection and time delay off.
   7. With ambient light sensor shall incorporate all features and performance of passive infrared sensors and ambient light sensors.
      a. Ambient light sensor shall be internal with range of 5 to 300 footcandles.
      b. Ambient light sensing component shall not permit lighting systems to be turned on if enough daylight is present.

F. Dual technology occupancy sensors shall:
   1. Include both ultrasonic and passive infrared sensors. Each sensing technology shall have independent sensitivity adjustments and LED to indicate detection.
   2. Include both microphonic and passive infrared sensors. Each sensing technology shall have independent sensitivity adjustments and LED to indicate detection.
   3. Be designed to be either wall or ceiling mounted as indicated on drawings.
   4. Sense motion from both technologies to turn lighting on but maintained detection from either technology will hold lighting on for set time delay.
   5. Be low voltage wired to sensor power packs.
   6. Contain isolated relay with normally open, normally closed, and common outputs for use with EMCS system, data logging, or other system control options.
   7. Have 360° coverage with ceiling height of 12 ft.
   8. Be low voltage wired in parallel to common power pack.
   9. Incorporate by-pass switch to enable lighting to be turned on if sensor fails.

G. Ambient light sensors shall:
   1. Incorporate photoconductive cell to measure light levels between 10 and 1,000 footcandles.
   2. Be adjustable with deadband feature to prevent cycling of lighting from minor changes in cloud cover.
   3. Have adjustable time delay range from 15 seconds to 5 minutes.
   4. Not permit lighting systems to be turned on if enough daylight is present.
   5. Incorporate by-pass switch to enable lighting to be turned on if sensor fails.
   6. Be low voltage wired in parallel to power packs.

H. Sensor power packs shall:
   1. Be self-contained transformer relay modules.
   2. Have dry contacts capable of switching 20 amp load at either 120VAC or 277VAC.
   3. Provide 24VDC output capable of controlling ultrasonic or passive infrared occupancy sensors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install devices at heights scheduled, and as indicated on drawings. Centerline of switches is to be 42” AFF unless otherwise noted.

B. Install wall devices vertically on latch side of door within 6” of frame edge, unless otherwise noted.

C. Install switches with handle operating vertically, with “ON” position up.

D. Group adjacent switches under single, multigang wall plates.

E. Install ceiling devices as shown on drawings and as recommended by device manufacturer.

F. Ceiling mounted occupancy sensors shall be located minimum of 6 ft from supply air diffusers where possible.

G. Install devices plumb, level with finished surfaces and free from blemishes.

H. Verify device locations prior to rough in.

I. Control wiring shall be low voltage, Class II wiring, electrically isolated from power wiring by a Class II transformer.

J. Provide separate neutral conductor for each dimmer.

K. Wiring shall be in conduit.

L. Electrical Contractor shall be responsible for final adjustment and testing of all devices.

   a. Switches: Label shall indicate switch voltage, phase, and amperage at top of cover plate, and panel, circuit number and switch designation at bottom of cover plate.

3.02 IDENTIFICATION

A. Comply with Section 26 0553 – Electrical Systems Identification.

B. Switches: Label shall indicate panel and circuit number at bottom of cover plate.

3.03 TESTING

A. Operate wall switches with circuits energized and verify proper operation.

B. Check dimmer preset control for proper operation.

C. Verify dimmers function without producing lamp flicker or audible noise.

D. Verify dimmers function without interference of audio and visual equipment.

E. Adjust occupancy sensors for a 5 minute time delay and medium sensitivity.

F. Verify proper operation of occupancy sensor switches and by-pass switches.

G. Adjust occupancy sensor sensitivity such that movement outside range of coverage shall not trigger sensor.

END OF SECTION

SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0526 - Grounding and Bonding for Electrical Systems

B. Section 26 0553 - Electrical Systems Identification

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. Section includes receptacles, hazardous (classified) location receptacles and device cover plates.

1.04 REFERENCE STANDARDS

A. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

B. IEEE C62.41.2 – Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits

C. IEEE C62.45 – Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits

D. NECA 1 – Good Workmanship in Electrical Contracting

E. NFPA 70 – National Electrical Code

F. NEMA WD-1 – General Color Requirements for Wiring Devices

G. NEMA WD-6 – Wiring Devices - Dimensional Requirements

H. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

I. UL 498 – Attachment Plugs and Receptacles

J. UL 943 – Ground-Fault Circuit-Interrupters

K. UL 1310 – Class II Power Units

L. UL 1436 – Outlet Circuit Testers and Similar Indicating Devices

1.05 SUBMITTALS

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

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Manufacturer’s Installation Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

D. Test Reports: Indicate field test and inspection procedures and interpret test results and corrective action taken for compliance with specification requirements.

E. Closeout Submittals:
   1. Project Record Documents:
      a. Record actual locations and ratings of wiring devices.
   2. Operation and Maintenance Data:
      a. Include in manufacturers’ packing label warnings and instruction manuals with labeling conditions.
      b. Include source and current prices of replacement parts and supplies.

1.06 QUALITY ASSURANCE

A. Obtain wiring devices from one source and by single manufacturer.

B. Regulatory Requirements:
   1. Comply with NFPA 70 for components and installation.
   2. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory unopened packaging until ready for installation.

1.08 WARRANTY

A. Refer to Division 01 and Section 26 0000 – General Electrical Requirements for general warranty requirements.

B. Manufacturer shall provide standard 1 yr warranty against defects in materials and workmanship for products specified in this Section. Warranty period shall begin on date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cooper Wiring Devices; a division of Cooper Industries, Inc.

B. Hubbell Incorporated; Wiring Device-Kellems

C. Pass & Seymour/Legrand; Wiring Devices & Accessories

2.02 RECEPTACLES

A. Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

B. Receptacles: 125 V, 20A, heavy-duty (specification grade**)**; back and side wired; flush or surface mounted; straight blade; 2 pole, 3 wire grounding; thermoplastic body; duplex configuration unless otherwise noted.
   1. Ground Fault Circuit Interrupter (GFCI):
      a. Additional compliance with UL 943 Class A.
      b. Leakage current trip level: 4 to 6 mA.
      c. Trip time: .025 seconds nominal.
      d. Feed-through type
      e. Reverse line-load function to prevent GFCI from functioning if wired incorrectly.
      f. Indicator Light: Lighted when device is tripped.
   2. Twist-locking:
      a. NEMA WD 6 configuration as indicated on drawings.
   3. Switched: Upper half switched, and lower half not switched.
   4. Dedicated: Labeled “Dedicated.”
   5. Special Purpose Receptacles: Specification grade, rated for voltage, amperage and NEMA configuration as noted on drawings.

2.03 DEVICE COVER PLATES

A. Single and combination types to match corresponding wiring devices:
   1. Attachment: Metal screws with head color to match plate finish.
   2. Material for Finished Spaces: Steel with baked enamel..
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Damp Locations: Cast aluminum with while-in-use hinged cover and listed and labeled for use in “wet locations.”

B. Weatherproof Cover Plates (Indoor Flush):
   1. Vertical Receptacles: Hubbell HBL5221 or approved equal.
   2. Horizontal Receptacles: Hubbell HBL5206WO or approved equal.

C. Weatherproof Cover Plates (Outdoor): NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with weatherproof while-in-use hinged cover with tab for locking with padlock.

2.04 FINISHES

A. Color:
   1. Receptacle faceplates, and device cover plates: As directed by Architect , except as follows:
      a. Receptacle faceplates connected to Essential Power System: Red.

PART 3 EXECUTION

3.01 COORDINATION

A. Special Purpose Receptacles: Coordinate final selections of NEMA configuration (locking, straight, blade, etc.) with configuration of plug on utilization equipment.

B. Receptacles for Owner-furnished equipment and equipment furnished under other divisions of specifications: Match plug configurations.

C. 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 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 device cover plate does not cross a joint
   4. Install wiring devices after all wall preparation, excluding painting, is complete. Install device cover plates after painting is complete.

3.02 EXAMINATION

A. Verify location of wiring devices with architectural interior elevation drawings, prior to rough-in.

B. Verify outlet boxes are installed at proper height.

C. Verify wall openings are neatly cut and completely covered by wall plates.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.03 PREPARATION

A. Clean debris from outlet boxes.

3.04 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise scheduled or indicated on drawings. Indicated dimensions are to center of device.

B. 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. Length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
   4. Do not place bare stranded conductors directly under device screws. Use crimp on fork terminals for device terminations.

C. Device Installation:
   1. Replace all devices that have been in temporary use during construction or show signs of installation prior to completion of building finishing operations.

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 last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6” 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 #10 AWG are installed on 20A circuits, splice #12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Install devices plumb, level with finished surfaces and free from blemishes.
11. Install devices above counters, 2” to the bottom of device above countertop or backsplash. Install all devices at same height above any one counter or fixed cabinet.
12. Install special purpose receptacles according to shop and rough-in drawings furnished by trade(s) producing such equipment. Verify locations prior to rough-in.
13. Install weatherproof GFCI receptacles:
    a. Within 25’-0” of roof-mounted mechanical equipment
    b. Outdoors
    c. As indicated on drawings
14. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor. Ground per requirements in Section 26 0526 – Grounding and Bonding for Electrical Systems.

D. Installation Orientations:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.
2. Unless otherwise indicated or where space problem occurs, mount devices flush, with long dimension vertical.

E. Device Cover 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.

3.05 IDENTIFICATION

A. Comply with Section 26 0553 – Electrical Systems Identification.
1. Receptacles (20A, 120V): Use hot, stamped, or engraved machine printing with black-filled lettering on white background on face of cover plate, and durable wire markers or tags inside outlet boxes. Indicate source panel identification and circuit number.
2. Receptacles (other than 20A,120V): Use hot, stamped, or engraved machine printing with black-filled lettering on white background on face of cover plate, and durable wire markers or tags inside outlet boxes. Indicate source panel identification, circuit number, voltage, phase, and amperage.
3. Essential Power Receptacles: In addition to above indicate “Emergency”, “Critical” or “Standby” depending on classification of system.
4. Engrave cover plates on all Owner-furnished equipment and equipment furnished under other divisions of these specifications with source panel identification, circuit number (where applicable) as specified in this section. This includes headwalls, gas columns and booms, patient consoles, medical rail systems, custom casework with electrical devices, etc. Include “Emergency”, “Critical” or “Standby” as required depending on classification of system.

3.06 FIELD QUALITY CONTROL

A. Inspect wiring devices for defects.

B. Verify receptacle device is energized.

C. Perform tests and prepare test reports:
   1. Test receptacle devices for proper polarity:
      a. Test every receptacle with receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot, and ground reversed, hot or neutral and hot open. Rewire receptacles with faults and retest.
   2. Test each GFCI receptacle device for proper operation:
      a. Perform testing using an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. Apply the test to the receptacle. “TEST” button operation will not be acceptable as a substitute for this test. Replace receptacles that do not shut off power with 5/1000 A within 1/40 second and retest.
   3. Test Instruments: Use instruments that comply with UL 1436.
   4. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

D. Tests for Convenience Receptacles:
   1. Line Voltage: Acceptable range is 105 V to 132 V.
   2. Percent Voltage Drop under 15A Load: A value of 5% 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 ones, and retest as specified above.

E. Operational Tests: Demonstrate the operation of each switch with the systems fully energized and operating. Each switch shall be demonstrated three times.

F. Interpret test results in writing and submit to Engineer.

3.07 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.08 CLEANING

A. Remove excess plaster from interior of outlet boxes.

B. Clean devices and cover plates after painting is complete. Replace stained or improperly painted devices and cover plates.

END OF SECTION

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SECTION 26 5000
LIGHTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 26 0000 - General Electrical Requirements

B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables

C. Section 26 0526 - Grounding and Bonding for Electrical Systems

D. Section 26 0533 - Raceway and Boxes for Electrical Systems

E. Section 26 0923 - Lighting Control Devices

1.02 REFERENCE

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION OF WORK

A. Provide luminaires as shown on Contract Drawing and Specifications.

B. Luminaires shall be provided complete with necessary accessories for proper installation.

C. Catalog numbers shown in luminaire schedule are basic luminaire types. Additional features, accessories and options specified or scheduled shall be included.

D. Provide lamps for luminaires as recommended by luminaire manufacturer and as scheduled.

E. Specifications and drawings convey the features, and functions of luminaires only and do not show every item or detail necessary for the work.

F. Work includes final aiming and focusing of luminaires under direction of the Architect/Engineer.

1.04 REFERENCE STANDARDS

A. NECA/IESNA 500 - Recommended Practice for Installing Indoor Commercial Lighting Systems (ANSI)

B. NECA/IESNA 501 - Recommended Practice for Installing Exterior Lighting Systems (ANSI)

C. NECD/IESNA 502 - Recommended Practice for Installing Industrial Lighting Systems (ANSI)

D. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility

E. UL 57 - Electrical Luminaires

F. UL 496 - Lampholders

G. UL 773 - Plug-in Photocontrols for use with area lighting

H. UL 924 - Emergency Lighting and Power Equipment

I. UL 1598 - Luminaires

1.05 QUALITY ASSURANCE

A. Luminaire and accessory components shall be constructed of materials appropriate for their use.

B. Luminaires, ballasts, lamps, and other components shall meet the requirements of all applicable State and Municipal energy codes.

C. Provide luminaires listed and labeled for their indicated use and installation conditions.

D. Contractor shall coordinate installation of lighting systems with all trades.

1. Manufacturers listed in the luminaire schedule shall be assumed capable of supplying listed luminaires. Any such exceptions shall immediately be brought to the attention of Architect and Lighting Consultant. Multiple Name Specification:
   a. When multiple manufacturers are listed, Electrical Contractor shall choose which of the listed products are to be provided.
   b. Products of the same type shall be of same manufacturer.
2. Single Name Specification:

a. When only one product is suitable for the application and/or no other known acceptable products exist, only one manufacturer/product is listed in the Luminaire Schedule. For such instances, Electrical Contractor shall provide the listed product with no exceptions.
b. Specifier has secured accurate pricing for all single name products prior to bidding and has shared this information with Architect/Owner's Representative. Contractor shall supply contractor net unit pricing for all single name products specified. Unit price shall be for equipment only and not include installation or miscellaneous electrical costs.

E. Substitution requests:
1. Will be evaluated prior to Bid.
2. Shall follow procedures set forth in this Section and in Section 01 2500 - Substitution Procedures.
3. Shall be made not less than 14 days prior to bid date.
4. Shall include the following information:
a. Specified and proposed manufacturer's product data sheet, noting options and features.
b. Provide dimensioned drawing of luminaire.
c. Provide photometric data in form of an electronic IES file.
5. Provide table-top samples and/or mockup of specified luminaire and proposed alternate.
6. Samples shall:
a. Be fully operable, complete with specified lamp(s) and ready for installation.
b. Remain available during construction.
7. Electrical Contractor shall be responsible for all costs incurred by substitution request sample and/or mockup production and review.
8. Equipment delivery lead time shall not be held as a valid reason for requesting luminaire substitution unless luminaire lead time from specified manufacturer is in excess of 14 weeks. It shall be the sole responsibility of the Electrical Contractor to determine necessary equipment lead times, deliver submittals for review in a timely fashion, and place orders accordingly to ensure timely delivery.
9. When requesting a substitution, Electrical Contractor shall provide unit and extended pricing for specified luminaire, unit, and extended pricing for proposed alternate, and unit and extended delta savings to owner to be realized by accepting proposed alternate. If requested, provide unit pricing for each luminaire type specified to provide a baseline comparison for substitution request.
10. Electrical Contractor shall guarantee pricing on all luminaire types for which a substitution request has been granted. This price guarantee shall be per unit and shall be maintained through the end of construction, regardless of quantity purchased.

1.06 SUBMITTALS

A. As soon as possible after award of Contract, submit complete list of lighting products to be furnished, with manufacturer and catalog designations, including currently quoted lead times for product delivery. Should Electrical Contractor anticipate delivery schedule of any specified product may adversely impact construction schedule, he shall bring it to the attention of the Owner at this time.

B. In addition to complying with requirements of Section 26 0000 - General Electrical Requirements, submittals shall include the following:
1. Manufacturer's product data
2. Installation instructions
3. Maintenance data
4. Parts list for each luminaire accessories
5. Photometric Data: photometric data for luminaire, including optical performance as follows:
a. Coefficients of utilization

b. Luminance table
c. Candela distribution data
d. Zonal lumens
e. Area and roadway luminaires shall include Isocandela Charts and IES Roadway Distribution Classification.

6. Ballast schedule indicating manufacturer, type, and catalog number for each luminaire
7. Ballast cut sheet for each ballast used, referencing luminaire type(s)
8. Lamp schedule indicating manufacturer, type, and catalog number for each luminaire
9. Lamp cut sheet for each lamp used, referencing luminaire type(s)
10. Documentation of lamp and ballast compatibility
11. Product color/finish
    a. Where specific finish or color is not specified and options exist, submit color or finish samples to Architect/Engineer for selection.

C. Shop Drawings for equipment provided under this Section shall include the following:
1. Detailed drawings of linear and suspended luminaires including dimensions, support spacing, suspension type, power feed type and locations, lamp combinations, ballast locations, luminaire joint locations and end plates.
2. Detailed drawings for each cove and linear wall system configuration including dimensions, power feed locations, ballast locations, luminaire joint locations, extension plates for end and corner sections and end plates.
3. Detailed drawings for nonstandard luminaires indicating dimensions, weights, method of field assembly, components, features, and accessories. Details shall be scaled at not less than half full size.
4. Photometric Data: Where indicated on luminaire schedule and Contract Drawings, supply complete photometric data for luminaire, including optical performance rendered by independent testing laboratory developed according to methods of the Illuminating Engineering Society of North America as follows:
    a. Coefficients of utilization
    b. Luminance table with data presented numerically, showing maximum luminaire luminance at shielding angles. Readings should be taken both crosswise and lengthwise in case of fluorescent luminaire or luminaire with an asymmetric distribution.
    c. Candela distribution data, presented graphically and numerically, in 5° increments (5°, 10°, 15°, etc.) Data developed for up and down quadrants normal, parallel, and at 11-1/2°, 45°, 67-1/2° to lamps if light output is asymmetric.
    d. Zonal lumens stated numerically in 10° increments (5°, 15°, etc.) as above.
    e. [Area and roadway luminaires shall also include isocandela charts and IES roadway distribution classification.]

D. Catalogue Cuts lacking sufficient detail will not be accepted.

E. No variation from the general arrangement and details indicated on drawings shall be made on shop drawings unless required by actual conditions. All variations shall be marked on drawings submitted for approval.

1.07 SAMPLES

A. Upon return of submittals, and prior to release for manufacturing, Contractor shall furnish one sample of each luminaire for which sample requirement is noted.

B. Shipping: Samples shall be complete with specified lamp(s), cord, and plug, ready for hanging, energizing, and examining, and shall be shipped, prepaid by Contractor, to Architect/Engineer, or as otherwise advised.

C. Samples will not be returned, nor included in quantities listed for project.

D. Sample must be actual working unit.

1.08 LUMINAIRE MOCK-UPS

A. Upon return of submittals, and prior to release for manufacturing, Contractor shall provide mock-up on site (or at another agreed upon location) in actual architectural conditions for review by Architect/Engineer and Owner.

B. Provide type and quantity of luminaires as requested by Architect/Engineer.

C. Mock-up shall include working luminaires and fastening devices.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Luminaires:
   1. As shown on Luminaire Schedule

B. LEDs
   1. Cree
   2. Lumileds
   3. Philips
   4. Samsung

2.02 FABRICATION AND MANUFACTURER

A. Luminaires:
   1. Construction
      a. Luminaires shall bear label indicating circuit voltage. Labels shall not be visible from normal viewing angles.
      b. Luminaires shall be constructed with joints made by means of welded, brazed, screwed, or bolted construction methods.
      c. Housings shall be so constructed that all electrical components are accessible and replaceable without removing luminaires from their mountings.
      d. Surface temperatures of luminaires with ballasts shall not exceed 90°C in 30°Cambient.
      e. Luminaires recessed in ceilings utilized as air handling plenums shall be certified as suitable for the purpose.
      f. Miter cuts shall be accurate, joints shall be flush and without burrs.
      g. Provide inscription for exit and stairway signs to conform to applicable codes.
   2. Lenses, Reflectors and Diffusers
      a. All lenses or louvers shall be removable but held so that normal motion will not cause them to drop out.
      b. All glass used in incandescent luminaires shall have thermal resistance characteristics equal to "Pyrex" glass.
      c. Optical lenses shall be free from spherical and chromatic aberrations.
      d. Acrylic lenses shall be 100% virgin acrylic material.
      e. Alzak reflectors and louvers shall be low iridescent equivalent to Coil Anodizers. All alzak parabolic cones shall be guaranteed against discoloration for a minimum of ten years.
   3. Optics and Adjustments
      a. Lamp sockets shall be suitable for the indicated lamps and shall be set such that lamps are positioned in optically correct relation to all luminaire components.
      b. Spread Lens Luminaire: Luminaires with spread lens shall contain lens orientation locking devices to insure that lens orientation is not disturbed during future lamp replacement or cleaning.
      c. Oval Beam Luminaire: Luminaires with oval shape beam pattern lamps shall contain lamp orientation locking devices to insure that beam orientation is not disturbed during lamp replacement or cleaning.
      d. Adjustable Angle Luminaire: Luminaires with adjustment beam angle shall contain reliable angle locking devices.
   4. Finishes

a. Provide luminaires with finish as shown in the luminaire schedule. Verify final finish requirements before releasing luminaires for fabrication.
b. Painted luminaires shall be painted after fabrication or "post painted".
c. Ferrous parts and supports shall be rust proofed after fabrication.

5. Wiring
   a. Luminaires shall be completely wired at the factory.
   b. Internal wiring shall contain no splices.
   c. Connections shall be made with insulated "wire nut" type mechanical connectors.
   d. Wire for connections to lamp sockets and lamp auxiliaries shall be minimum #16 ga. luminaire wire.
   e. Luminaires shall be provided with flexible conduit, pigtails, and equipment for external connections.
   f. Recessed luminaires installed in inaccessible ceilings shall be UL listed for through wiring with the junction box accessible from the luminaire opening.
   g. Provide dual-level switching for luminaires as indicated on luminaire schedule and where shown on Contract Drawings. Typically, first switch designation controls outboard lamps, and second switch designation controls inboard lamp(s), unless noted otherwise.
   h. Provide lamps for all luminaires.
6. Support:
   a. Rigid metallic pipe stems shall be utilized for the support of pendant mounted luminaires, unless otherwise noted.
   b. Stem hangers shall be equipped with aligner box covers or canopies so that stems hang vertically, irrespective of the angle of the surface they are mounted from.
   c. Wherever a luminaire or its hanger canopy is attached to a surface mounted outlet box, a finishing ring shall conceal the outlet box.
   d. Yokes, brackets, and supplementary supporting members needed to mount luminaires to suitable ceiling members shall be furnished and installed by Contractor. Verify mounting hardware required prior to installation.
7. Framing
   a. Verify type of ceiling construction prior to releasing luminaires for fabrication and delivery.
   b. Provide mounting appurtenance, flanges, sloped ceiling adaptors where required.
   c. Provide mounting assembly, clips or other mechanical mounting lugs as required for support of luminaires.
   d. Light leaks between ceiling trim of recessed luminaires and ceilings are not allowed.
   e. Ceiling opening frames shall be manufactured of nonferrous metal or be suitably rust proofed after fabrication.
   f. Ceiling opening frames for recessed luminaires shall be furnished by Electrical Contractor and installed by General Contractor.
8. All castings and extrusions shall be given mimimum one coat of baked-on clear lacquer unless painted finish is specified.
9. Aluminum surfaces shall receive a duronodic or polyester powder paint finish.
10. Cast-in Luminaire housings installed directly in concrete shall be fabricated of hot dip galvanized steel or cast aluminum or composite.
    a. Where cast aluminum housings are used, give two coats of asphaltum paint prior to installation.
    b. Provide solid neoprene grommets at each point light luminaire surfaces are mounted to concrete structure.

2.03 LAMPS

A. Provide lamps as noted on Luminaire Schedule.

B. Provide lamps of same type from same manufacturer.

C. Where a specific lamp manufacturer has been indicated in the Luminaire Schedule, lamps shall be supplied from named manufacturer only.

D. Provide all other lamp types and special purpose lamps as noted on Luminaire Schedule.

PART 3 EXECUTION

3.01 INSTALLATION

A. Marking:
   1. Voltage identification: Luminaires designed for voltages other than 110-125 volt circuits shall be clearly marked with rated voltage.
   2. Markings must be clear and shall be located to be readily visible to service personnel but invisible from normal viewing angles when lamps are in place.

B. Installation of Luminaires:
   1. Lamps, glassware, reflectors, and refractors shall be clean and free of chips, cracks, and scratches.
   2. Install decorative luminaires, reflector cones, baffles, aperture plates, lenses, trims, and decorative elements of recessed luminaires after completion of ceiling tile, plastering, painting, and general cleanup is completed. Where luminaire location or construction does not permit sequential installation, all reflectors, lenses, flanges, and other visible surfaces shall be carefully protected.
   3. Locations
      a. Install luminaires at locations and heights as indicated.
      b. Do not scale electrical drawings for locations of luminaires.
      c. Architectural reflected ceiling plans show locations of luminaires.
      d. Where noted on the drawings, the exact location of luminaires shall be confirmed (in the field) with the Architect/Engineer prior to installation.
      e. Where luminaires are to be concealed, or surface mounted in highly visible public spaces, a small sampling of luminaires shall be installed, adjusted, and aimed for Architect/Engineer's review approval, prior to installing remaining luminaire of same type.
      f. Mount all luminaires so as to maintain full range of motion.
      g. Install luminaires plumb, square, and level with ceilings and walls.
      h. Coordinate stem, rod, chain, or aircraft cable hanger lengths with job conditions.
      i. Industrial type luminaires in unfinished areas, which are near obstructions such as ducts and pipes, shall be:
         1). Suspended so that bottom of luminaire is no higher than bottom of obstruction
         2). Located at height of lowest luminaire
         3). Shall not be located until locations of obstructions are determined.
   4. Support
      a. Support surface mount luminaires from building structure.
      b. Metal decking shall not be pierced for luminaire support.
      c. Provide luminaires and/or luminaire outlet boxes with hangers to support luminaire weight.
      d. Provide plaster frames for recessed luminaires in plaster ceilings.
      e. Recessed luminaires shall be supported with 12 ga. wire hangers, 2 per luminaire, at diagonally opposite corners.
      f. Surface luminaires installed in grid ceilings shall be supported by independent support clips and 12 ga. wire.
      g. Exit signs installed in grid ceilings shall be supported by electrical box hanger and additional 12 ga. wire installed from box to structure.
      h. Support surface mounted luminaires greater than 2 ft in length at a minimum of each additional 2 ft, or as recommended by manufacturer.
      i. Brace suspended luminaires installed near ducts or other constructions with solid pendants or threaded rods.
      j. Rigidly align continuous rows of luminaires.

k. Luminaire types with remote mounted ballast shall have:
1). Proper support for ballast weight.
2). Mounting distance from remote ballast to luminaire per manufacturer's recommendations.

5. Mounting and Enclosures
a. Install flush mounted luminaires to eliminate light leakage.
b. For luminaires mounted adjacent to insulation, provide barrier to prevent insulation from coming in contact with luminaire, unless luminaire is approved for installation in contact with such insulation.
c. Provide approved fire rated enclosures around luminaires in fire rated ceilings.

6. Conduit and Wiring
a. Wire for connections to lamp sockets and auxiliaries shall be suitable for temperature, current, and voltage conditions.
b. Recessed luminaires shall have final connections made with flexible metal conduit, not in excess of 72”, with THHN conductors and green wire ground conductor.
c. Conduit shall be hidden from normal view in all possible cases. In public areas where surface mounted conduit must be used, contractor shall install conduit as unobtrusively as possible. Contractor shall obtain field approval by the architect for all exposed conduit runs prior to rough in.

C. Lamps:
1. Provide new lamps delivered in original manufacturer’s cartons.

D. Grounding:
1. Ground luminaires according to Division 26 Section "Grounding and Bonding for Electrical Systems".

E. Spare Parts:
1. Provide 5% spare lamps for each type in Luminaire Schedule
a. Spare lamps shall be delivered to Owner in new condition and in original packaging.
b. Manufacturer and model number shall match those installed in the project's luminaires.
2. Provide spare driver, 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Provide spare globes and guards, 1 for every 20 of each type and rating installed. Furnish at least one of each type.
4. Provide spare parabolic louvers and reflector cones, 1 for every 100 of each type. Furnish at least one of each type.
5. Provide spare plastic diffusers and lenses, 1 for every 100 of each type and rating installed. Furnish at least one of each type.

3.02 SUBSTANTIAL COMPLETION

A. Quality Control:
1. At Date of Substantial Completion, replace lamps which are not operating properly.
2. Replace any lamps used as worklights during construction phase.
3. Protection wrapping on louvered (parabolic) luminaires shall be removed before installation of furniture, but after finish work is complete.
4. Deliver spare lamps to Owner's representative.

B. Tests:
1. Give advance notice of dates and times for field tests.
2. Provide instruments to make and record test results.
3. Verify normal operation of each luminaire after luminaires have been installed and circuits have been energized.
4. Replace or repair malfunctioning luminaires and components, then retest. Repeat procedure until all units operate properly.
5. Report results of tests.

C. Adjusting and Cleaning:
   1. Clean luminaires of handling marks, dust, and dirt.
   2. Cleaning and touch-up work shall be performed in accordance with luminaire manufacturer's recommendations.
   3. Damaged luminaires or components shall be replaced with new.
   4. Keep luminaires clean and protected for remainder of construction period.
   5. Verify orientation of directional luminaires prior to installation.
      a. This includes wall washers, cove lighting, floodlights, exterior area lights and adjustable accent luminaires. Contractor shall provide electrician's services to aim, adjust, and focus luminaires, as required, at the direction of Architect/Engineer. These electricians shall be available at times designated by the Architect/Engineer and shall be provided at no extra charge to the Owner over base bid. Contractor shall provide equipment for luminaries' focus including ladders and mechanical lifting systems.
   6. Program preset dimming system lighting levels.
   7. No light leaks shall be permitted at the ceiling line from any visible part or joint.

D. Training
   1. Contractor shall provide qualified personnel onsite to provide a minimum of eight hours of training to Owner's representatives.
   2. This training shall cover:
      a. Luminaire use and maintenance
      b. Architectural lighting system use and maintenance
      c. Group relamping cycles

END OF SECTION

SECTION 27 0000
GENERAL COMMUNICATIONS REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section details references, standards, guidelines, requirements, and conditions common to all Division 27 work.

B. Work under this Section and related sections is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.02 DESCRIPTION

A. Intent of drawings and specifications is to obtain complete systems tested, adjusted, and ready for operation.

B. Except as otherwise defined in greater detail, terms "provide", "furnish" and "install" as used in Division 27 contract documents shall have the following meanings:
   1. "Provide" or "provided" shall mean "furnish and install".
   2. "Furnish" or "furnished" does not include installation.
   3. "Install" or "installed" does not include furnishing.

C. Include incidental details not usually shown or specified, but necessary for proper installation and operation.

D. Check, verify and coordinate work with drawings and specifications prepared for other trades. Include modifications, relocations, or adjustments necessary to complete work or to avoid interference with other trades.

E. Included in this contract are connections to equipment provided by others. Refer to Architectural, Electrical, Integrated Automation, Mechanical, Security and final shop drawings for equipment being furnished under other sections for exact locations of outlets and various connections required.

F. Information given herein and on drawings is as exact as could be secured but is not guaranteed. Do not scale drawings for exact dimensions.

G. Where architectural features govern location of work, refer to architectural drawings.

H. Perform work in "neat and workmanlike" manner as defined in ANSI/NECA 1 "Standard Practices for Good Workmanship in Electrical Contracting".

1.03 RELATED WORK

A. Related Division 27 Sections include:
   1. Section 27 0526 - Grounding and Bonding for Communications Systems
   2. Section 27 0528.29 - Hangers and Supports for Communications Systems
   3. Section 27 0528.33 - Raceway and Boxes for Communications Systems
   4. Section 27 0528.36 - Cable Tray for Communications Systems
   5. Section 27 0553 - Communications Systems Identification
   6. Section 27 1100 - Communications Equipment Room Fittings
   7. Section 27 1300 - Communications Backbone Cabling
   8. Section 27 1500 - Communications Horizontal Cabling
   9. Section 27 4100 - Audiovisual Systems
   10. Section 27 5223 - Nurse Call System

B. Related sections in other Divisions of Work:
   1. Section 26 0593 – Electrical Systems Firestopping
   2. Also refer to individual technical sections identified above.

C. Continuity of Service:
   1. No service shall be interrupted or changed without permission from Architect and Owner. Obtain written permission before work is started.

2. When interruption of services is required, persons concerned shall be notified and shall agree upon a time.

D. Demolition:
1. Division 01 - Selective Demolition.
   a. Not applicable to this Division of work.
2. Division 02 - Building Demolition
   a. Not applicable to this Division of work.
3. Perform demolition as required to accomplish new work.
   a. Remove abandoned wiring to source of supply.
   b. Disconnect abandoned outlets and remove devices.
   c. Remove abandoned outlets if conduit servicing them is abandoned and removed.
   d. Provide blank cover for abandoned outlets that are not removed.
   e. Disconnect communications systems in walls, floors, and ceilings scheduled for removal.
4. Accomplish work in neat workmanlike manner to minimize interference; annoyance or inconvenience such work might impose on Owner or other contractors.
5. Unless otherwise noted, remove from premises materials and equipment removed in demolition work.
6. Equipment noted to be removed and turned over to Owner shall be delivered to Owner at place and time Owner designates.
7. Where materials are to be turned over to Owner or reused and installed by Contractor, it shall be Contractor's responsibility to maintain condition of materials and equipment equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to Owner.
8. Where demolition work interferes with Owner's use of premises, schedule work through Architect, Owner and with other contractors to minimize inconvenience to Owner. Architect must approve schedule before Contractor begins such work.

E. Cleaning and Repair
1. Clean and repair existing materials and equipment that remain or will be reused.

F. Painting:
1. Furnish equipment with factory applied prime finish unless otherwise specified.
2. If factory finish on equipment furnished by Contractor is damaged in shipment or during construction, refinish equipment to satisfaction of Engineer.
3. Furnish one can of touch up paint for each factory finish, which will be final finished surface of product.
4. Contractor is responsible for painting of plywood in Telecommunications Equipment Rooms. Refer to Drawings.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

A. Rules and regulations of Federal, State, and local authorities and utility companies, in force at time of execution of contract shall become part of this specification.

1.05 REFERENCES AND STANDARDS

A. Design, cable and component selection, and installation practices shall conform with following:
1. ANSI/NFPA 70 - National Electrical Code
2. Local Electrical Code
3. Country, state and local health, safety and building codes
4. UL 444 - Communications Cables
5. Standards identified in individual Technical Sections.
6. BICSI Telecommunications Distribution Methods Manual (TDMM)
7. TIA 568.0-D through.4-D - Commercial Building Telecommunications Cabling Standard (including applicable Addenda)

8. TIA 569-E - Commercial Building Standard for Telecommunications Pathways and Spaces
9. Joliet Junior College Information Technology standards and requirements.
10. Joliet Junior College Facilities Services standards and requirements.

B. Agencies or publications referenced herein refer to the following:
1. ANSI American National Standards Institute
2. ASME American Society of Mechanical Engineers
3. ASTM American Society for Testing and Materials
4. BICSI Building Industry Consulting Services International
5. FIPS Federal Information Processing Standards
6. FCC Federal Communications Commission
7. ICEA Insulated Cable Engineers Association
8. IEEE Institute of Electrical and Electronics Engineers
9. NEC National Electrical Code
10. NECA National Electrical Contractors Association
11. NEMA National Electrical Manufacturers Association
12. NESC National Electrical Safety Code
13. NETA National Electrical Testing Association
14. NFPA National Fire Protection Association
15. NIST National Institute of Standards and Technology
16. OSHA Occupational Safety and Health Administration
17. TIA Telecommunications Industry Association
18. UL Underwriters Laboratories, Inc.

C. Work shall be in accordance with latest edition of codes, standards or specifications unless noted otherwise.

1.06 DEFINITIONS

A. The following definitions are applicable to communications environments and shall apply to this document and its companion sections for clarification and direction.
1. Entrance facility - an entrance to building for both public and private network service cables and/or wireless services including entrance point of building and continuing to Entrance Room.
2. Entrance Room - room where both public and private network service cables and/or wireless services are terminated. Service provider(s) point-of-demarcation (DEMARC) is typically located here.
3. Equipment Room (Telecom or AV): an environmentally controlled centralized space for telecommunications equipment that usually houses main or intermediate cross-connect. Backbone cabling, cabling to Building Entrance and horizontal cabling may be terminated here.
4. Guarantee - promise or an assurance that attests to quality or durability of product or service or that task will be performed in specified manner. Used interchangeably with "Warranty" in these documents.
5. Intra-building - within single building.
6. Inter-building - between 2 or more buildings.
7. IP Telephony – Use of Internet Protocol (IP) for two-way transmission of conversations. Sometimes referred to as “Voice over Internet Protocol (VoIP)”.
8. Rack Unit - standard measurement of vertical mounting space on an equipment rack. Each Rack Unit is 1-3/4” high.
9. Voice over Internet Protocol – Refer to IP Telephony.

B. Typical NEMA Enclosures and Usage
1. Refer to Section 26 0000 – General Electrical Requirements.
2. NEMA 1 - Indoors. Falling dirt
3. NEMA 2 - Indoors. Falling dirt. Falling liquids. Light splashing
4. NEMA 3 - Outdoors. Sleet, snow, rain. Windblown dust

5. NEMA 3X - Same as NEMA 3 plus corrosion resistant
6. NEMA 3S - Same as NEMA 3 plus mechanism operable when ice covered
7. NEMA 3SX - Same as NEMA 3S plus corrosion resistant
8. NEMA 3R - Outdoors. Rain, snow, sleet
9. NEMA 3RX - Same as NEMA 3R plus corrosion resistant
10. NEMA 4:
    a. Indoors - Falling dirt. Falling and light splashing liquids. Flying dust, lint, and fibers. Hose down
    b. Outdoors - Rain, sleet, snow. Windblown dust. Hose down
11. NEMA 4X - Same as NEMA 4 plus corrosion resistant
12. NEMA 5 - Indoors. Falling Dirt. Falling Liquids. Settling dust, lint, and fibers
13. NEMA 6:
    a. Indoors - Falling dirt. Falling and light splashing liquids. Flying dust, lint, and fibers. Hose down. Temporary submersion.
    b. Outdoors - Rain, snow, sleet. Windblown dust. Hose down. Temporary submersion.
14. NEMA 6P:
    a. Indoors - Same as NEMA 6 / Indoors plus corrosion resistant. Prolonged submersion.
    b. Outdoors - NEMA 6 /Outdoors plus corrosion resistant. Prolonged Submersion.
15. NEMA 7 - Indoors. Class I, Division 1 or 2, Groups A, B, C or D. (Flammable gas).
16. NEMA 9 - Indoors. Class II, Division 1 or 2. Groups E, R, or G. (Combustible dust).
17. NEMA 12 - Indoors. Falling Dirt. Falling liquids. Flying dust, lint, and fibers. Oil or coolant seepage.
18. NEMA 13 - Same as NEMA 12 plus oil or coolant spraying or splashing.]

1.07 ABBREVIATIONS AND ACRONYMS

A. The following abbreviations and acronyms shall apply to this document and its companion sections for clarification and direction.

1. AFF Above Finished Floor
2. ATM Asynchronous Transfer Mode
3. AV Audio Visual
4. AWG American Wire Gauge
5. BAS Building Automation Systems
6. BTU British Thermal Unit
7. CATV Community Antenna Television
8. CCTV Closed-Circuit Television
9. CDDI Copper Distributed Data Interface (Cisco Systems trade name for TP-PMD)
10. cm centimeters
11. °C degrees Celsius
12. °F degrees Fahrenheit
13. DTMF Dual Tone Multi Frequency
14. EIA Electronic Industries Alliance
15. EF Entrance Facility
16. ER Entrance Room
17. EIDF Equipment Intermediate Distribution Facility
18. FDDI Fiber Distributed Data Interface
19. ft feet
20. GbE Gigabit Ethernet
21. Hz Frequency in Hertz (k = kilo, M = Mega, G = Giga)
22. ID Inside Diameter
23. in inch
24. IPT IP Telephony
25. kg kilogram
26. lbs pounds

27. LAN Local Area Network
28. MATV Master Antenna Television
29. MC Main Cross-connect
30. m meters
31. mm millimeters
32. Mbps Megabits per second
33. µm micrometer (10^{-6} meter)
34. OD Outside Diameter
35. PBX Private Branch Exchange (Telephone Switch)
36. pF pico-Farad (10^{-12} Farad)
37. PVC Polyvinyl Chloride
38. RU Rack Unit
39. sq ft square feet (area)
40. TP-PMD Twisted Pair Physical Medium Dependent
41. WAN Wide Area Network
42. WLAN Wireless Local Area Network
43. VoIP Voice over Internet Protocol

B. Refer also to technical sections for additional terminology.

1.08 LISTING

A. Refer to technical sections of this Division of work for listing requirements.

1.09 SUBMITTALS

A. Submit shop drawings for equipment provided under this Section:
1. Refer to Division 01 - Submittal Procedures.
2. Note that for satisfying submittal requirements for Division 27, "Product Data" is usually more appropriate than true "Shop Drawings" as defined in Division 01. However, expression "Shop Drawings" is generally used throughout specification.
3. Mark catalog sheets and drawings to indicate specific items submitted.
   a. Markings shall be reproducible (e.g. arrow, boxed, encircled, checkmark).
   b. Where sheet includes multiple product options, mark proposed option(s).
4. Include proper identification of equipment by name and/or number, as indicated in specification and shown on drawings.
5. When manufacturer's reference numbers are different from those specified, provide correct cross-reference number for each item. Mark and annotate submittals accordingly.
6. Group submittals by Section to include complete documentation of related systems, products and accessories. Where applicable, dimensions shall be marked in units to match those specified.
7. Submittals shall be in electronic form or on paper per Division 01.
   a. Documents in electronic form shall be ADOBE *Acrobat* PDF.
   b. Paper documents shall be original catalog sheets or photocopies thereof.
   c. Facsimile (fax) sheets will not be accepted.
8. Engineer’s Review is to confirm compliance with performance, interoperability, physical, and other pertinent requirements of project. Review is not to confirm quantities nor that all required items have been submitted.
9. When equipment and items specified include accessories, parts and additional items under one designation, submittals shall be complete and include required components.
10. Include wiring diagrams for electrically powered or controlled equipment.
11. Submit equipment room layouts drawn to scale, including equipment, raceways, accessories and clearance for maintenance.
12. Where submittals cover products containing potentially hazardous non-metallic materials, include "Material Safety Data Sheet" (MSDS) from manufacturer stating physical and chemical properties of components and precautionary considerations required.
13. Submit shop drawings or product data as soon as practicable after signing contracts. Submittals must be approved before installation of materials and equipment.

14. Submittals, which are not complete, not permanent, or not properly checked by Contractor, will be returned without review.
15. "Coordination Drawings", which are normally prepared by Contractor to coordinate work among various trades and to facilitate installation, shall not be submitted for Division 27 work unless specifically requested in technical sections. These types of drawings typically include dimensioned piping, ductwork, communications and/or electrical raceway layouts.
    a. Unless specifically requested in Division 27 technical sections, submittals of coordination drawings will be returned without review.

B. Certificates and Inspections:
1. Obtain and pay for inspections required by authorities having jurisdiction and deliver certificates approving installations to Owner unless otherwise directed.

C. Operation and Maintenance Manuals:
1. Refer to Division 01 - Operation and Maintenance Data.
2. Upon completion of work but before final acceptance of system, submit to Architect for approval, 3 copies of operation and maintenance manuals in loose-leaf binders. If "one copy" is larger than 2” thick or consists of multiple volumes, submit only one set initially for review. After securing approval, submit 3 copies to Owner.
3. Manuals shall be organized by specification section number and shall have table of contents and tabs for each piece of equipment or system.
4. Manuals shall include the following:
    a. Copies of shop drawings
    b. Manufacturer's operating and maintenance instructions. Include parts lists of items or equipment. Where manufacturer's data includes several types or models, applicable type or model shall be designated.
    c. CD ROM's of O&M data with exploded parts lists where available
    d. Phone numbers and addresses of local parts suppliers and service companies
    e. Internet/WEB page addresses where applicable
    f. Wiring diagrams
    g. Start up and shut down procedure
    h. Factory and field test records
    i. Additional information, diagrams or explanations as designated under respective equipment or systems specification section
5. Instruct Owner's representative in operation and maintenance of equipment. Instruction shall include complete operating cycle on all apparatus.
6. O&M manuals and instructions to Owner shall be provided prior to request for final payment.

D. Record Documents:
1. Refer to General Conditions of Contract, and Division 01 - Closeout Procedures. Prepare complete set of record drawings in accordance with Division 01.
2. Use designated set of prints of contract documents as prepared by Architect to mark-up for record drawing purposes.

1.10 JOB CONDITIONS

A. Building Access:
1. Arrange for necessary openings in building to allow for admittance of all apparatus.

B. Cutting and Patching:
1. Refer to General Conditions of Contract, and Division 01 - Cutting and Patching.
2. Perform cutting and patching required for complete installation of systems unless otherwise noted. Patch and restore work cut or damaged to original condition. This includes openings remaining from removal or relocation of existing system components.
3. Provide materials required for patching unless otherwise noted.

4. Do not pierce beams or columns without permission of Architect and then only as directed. If openings are required through walls or floors where no sleeve has been provided, hole shall be core drilled to avoid unnecessary damage and structural weakening.

C. Housekeeping and Cleanup:
   1. Refer to Division 01 - Closeout Procedures.
   2. Periodically as work progresses and/or as directed by Architect, remove waste materials from building and leave area of work broom clean. Upon completion of work, remove tools, scaffolding, broken and waste materials, etc. from site.

1.11 WORK BY OWNER

A. Owner will provide:
   1. Active electronics for interface with building voice and data cabling systems
   2. Connections from telephone and data equipment to Contractor provided cabling
   3. Connections from Backbone Voice Cables to Horizontal Voice Cables
   4. Passive Broadband distribution hardware (coaxial cable taps and splitters)
   5. Active Broadband headend and distribution hardware (e.g. video processing, distribution amplifiers)
   6. Equipment Racks and/or Cabinets (in existing IDF)

1.12 QUALITY ASSURANCE

A. Refer to the individual technical sections for general product quality requirements, manufacturer qualifications, and contractor qualifications and certification requirements.

1.13 GUARANTEE

A. Refer to Division 01 for general Guarantee (Warranty) requirements.

B. Refer to technical sections for Guarantee requirement for each system.
   1. Where no guarantee requirements are called out, guarantee as called out in Division 01 equipment, materials, and workmanship to be free from defect.

C. Repair, replace or alter systems or parts of systems found defective at no extra cost to Owner.

D. Wherein fulfilling requirements of any guarantee, if Contractor disturbs any work guaranteed under another contract, restore such disturbed work to condition satisfactory to Architect and guarantee such restored work to same extent as it was guaranteed under such other contract.

E. Guarantees shall include labor, material and travel time.

PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

A. Refer to Division 01 - Product Requirements.

PART 3 EXECUTION

3.01 GENERAL

A. Verify elevations and measurements prior to installation of materials.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 01.

B. Store and protect products under provisions of Division 01.

C. Store in clean, dry space.

D. Maintain factory wrapping or provide cover to protect units from dirt, water, construction debris, and traffic.

E. Handle in accordance with manufacturer's written instructions.

F. Handle carefully to avoid damage to components, enclosure, and finish. Lift only with lugs provided for the purpose.

3.03 FLOOR, WALL, ROOF AND CEILING OPENINGS

A. Coordinate location of openings, chases, furred spaces, etc. with appropriate Contractors. Provide during progress of construction sleeves and inserts that are to be built into structure.

B. Temporary sleeves, if used to form wall openings, shall be removed prior to installation of permanent materials. Permanent sleeves for wall penetrations shall be minimum 24 ga. galvanized sheet metal unless otherwise noted.

C. Steel sleeves, when required, shall be Schedule 40 carbon steel pipe with integral water stop.

D. For core drilled holes, size and location shall be reviewed and approved by Structural Engineer prior to execution.

E. Submit product data and installation details for penetrations of building structure. Submittal shall include schedule indicating penetrating materials, (including steel conduit, PVC conduit, cables, cable tray), sizes of each, opening sizes and sealant products intended for use.

F. Where penetrations of fire-rated assemblies are involved, seal penetrations with appropriate firestopping systems as specified in Division 26.

G. Submit complete penetration layout drawings showing openings in building structural members including floor slabs, bearing walls, shear walls. Indicate and locate, by dimension, required openings including those sleeved, formed or core drilled. Drawings shall be approved by the structural engineer prior to preparing openings in structural member.

H. Openings for penetrations shall be minimum 1/2” larger on all sides than outside dimensions of raceways or cables. However, where fire resistant penetrations are required, size openings in accordance with recommendations of firestopping systems manufacturer.

I. Seal non fire-rated floor penetrations with non-shrink grout equal to Embeco by Master Builders, or urethane caulk, as appropriate.

J. Seal non-rated wall openings with urethane caulk.

K. Where penetrations occur through exterior walls into building spaces, use steel sleeves with integral water stop, similar to type "WS" wall sleeves by Thunderline Corporation. Seal annular space between sleeves and pipe with "Link-Seal" modular wall and casing seals by Thunderline Corporation, or sealing system by another manufacturer approved as equal by Architect. Sealing system shall utilize Type 316 stainless steel bolts, washers and nuts.

L. Finish and trim penetrations as shown on details and as specified hereinafter.

M. Provide chrome or nickel plated escutcheons where raceways pass through walls, floors or ceilings and are exposed in finished areas. Size escutcheons to fit raceways for finished appearance. Finished areas shall not include mechanical/electrical rooms, janitor’s closets, storage rooms, etc., unless suspended ceilings are specified.

3.04 EQUIPMENT ACCESS

A. Install raceways, junction and pull boxes, and accessories to permit access to equipment for maintenance. Relocation of raceways, or accessories as required to provide access, shall be provided at no additional cost to Owner.

B. Install equipment with ample space allowed for removal, repair or changes to equipment. Provide ready accessibility to equipment and wiring without moving other equipment, which is to be installed or which is already in place.

C. Access doors in walls, chases, or inaccessible ceilings will be provided under Division 08 - Access Doors and Frames, unless otherwise indicated. Access doors shall be for purpose of providing access where equipment requiring servicing, repairs or maintenance is located in walls, chases or above inaccessible ceilings.

D. Provide necessary coordination and information to Trade Contractor under Division 08 - Access Doors and Frames. This information shall include required locations, sizes and rough-in dimensions, without limitations.

E. Provide access doors where equipment, requiring access for servicing, repairs and maintenance is located in walls, chases or above inaccessible ceilings, unless otherwise noted.

Access frames and doors shall be as manufactured by Milcor, Incorporated, or similar, of style applicable to surface. Access doors used in fire-rated construction shall have UL label. Access doors shall be steel, prime coated, except use stainless steel doors in ceramic tile walls, toilet rooms, locker rooms, and in areas subject to excessive moisture. Access doors shall be of sufficient size to allow for total maintenance. Location of access doors shall be coordinated with General Contractor and location of equipment shall be roughed in accordingly.

F. Locate communications outlets and equipment to fit details, panels, decorating or finish at space. Architect reserves right to make minor position changes of outlet locations before work has been installed.

G. Verify room door swings before installing wall-mounted communications outlets and install boxes on latch side of door unless otherwise noted.

3.05 EQUIPMENT SUPPORTS

A. Provide supporting steel not indicated on drawings as required for installation of equipment and materials including angles, channels, beams, hangers.

B. Concrete anchors, used for attachment to concrete, shall be steel shell with plug type. Plastic, rawhide or anchors utilizing lead are not allowed.

C. Do not support equipment or cable pathways from metal roof decking.

3.06 SUPPORT PROTECTION

A. In occupied areas, mechanical rooms and areas requiring normal maintenance access, certain equipment must be guarded to protect personnel from injury.

B. Provide minimum 1/2” thick Armstrong Armaflex insulation or similar product applied with Armstrong 520 adhesive on lower edges of equipment, including bus duct, cable tray, pull boxes and electrical supporting devices suspended less than 7 ft above floors, platforms or catwalks in these areas.

C. Threaded rod or bolts shall not extend beyond supporting element and shall be protected as described above.

3.07 CABLE PROTECTION

A. Protect cabling and termination components from contact with, and potential application of, foreign materials.
   1. Foreign material is defined as material that is not part of cabling assembly and termination components when delivered from manufacturer.
   2. Examples include paint overspray and drywall compound.

B. Cabling and components that come into contact with foreign materials shall be replaced at no cost to project.
   1. Solvents and other cleaning agents shall not be used to remove foreign materials that have already accumulated on cabling and components.

3.08 HOUSEKEEPING PADS

A. Not applicable to this Division of work.

3.09 ACCEPTANCE TESTING

A. Prior to testing, submit to owner (or Owner’s representative) and Engineer, proposed schedule for acceptance testing.
   1. This notification shall be minimum of ten (10) working days in advance to allow for participation by Owner and/or Engineer.

B. Prior to testing, submit written description of intended test procedures and submit sample test forms to Engineer.
   1. Submitted information shall include proposed file naming format to be used in identifying cable, pair or optical fiber which is subject of test record.

2. Failure to provide above information shall be grounds for Engineer or Owner to reject any Documentation of related testing and to require repeat of affected test.

C. Conduct tests during course of construction when identifiable portion(s) of installation is complete.
   1. Alternatively, testing can be conducted after entire installation is complete if this does not delay project schedule.

D. Provide equipment and personnel necessary to conduct acceptance tests.

E. Testing shall be completed and accepted by Owner and Engineer before Owner furnished equipment and cross connects are installed.

F. Document tests.

G. When equipment or systems fail to meet minimum test requirements, replace or repair defective work or materials as necessary and repeat inspection and test. This shall be at no additional cost to the owner. Replacement materials shall be new.

H. This Contractor is responsible for certifying, in writing, equipment and system test results. Certification shall include identification of portion of system tested, date, time, test criteria and name and title of person signing test certification documents.

I. Maintain copies of certified test results, including those for failed tests, at project site. At completion of project, include copies of test records and certifications in O&M Manuals.

3.10 START-UP

A. Systems and equipment shall be started, tested, adjusted and turned over to Owner ready for operation.
   1. This includes "Owner-Furnished, Contractor-Installed" (OFCI) and "Contractor-Furnished, Contractor-Installed" (CFCI) systems and equipment.

B. Follow manufacturer's pre-start-up checkout, start-up, trouble shooting and adjustment procedures.

C. Contractor shall provide services of technician/installer knowledgeable in start-up and checkout of types of systems and equipment on project.

D. Provide start-up services, by manufacturer's representative where specified or where Contractor does not have qualified personnel.

E. Coordinate start-up with trades.

3.11 DOCUMENTATION

A. Upon completion of installation, Contractor shall provide System Documentation. Documentation shall include:
   1. Acceptance Test Results
   2. Record Drawings
   3. All Approved Submittals
   4. Manufacturer’s Warranty Documents

B. Submit System Documentation in accordance with Division 01 "Project Record Documents".
   1. Documents shall be submitted in same electronic format in which they were received from Architect and Engineer.
   2. Document updates shall be performed in native software format matching original design team documents.
      a. Scans of hand marked documents shall not be allowed.
   3. Update documents to reflect installed conditions for equipment shown on documents.

C. Submit documentation within ten (10) working days of the completion of testing of each testing phase (e.g. subsystem, cable type, area, floor) or 3 weeks prior to scheduled occupancy of subject area, whichever is sooner. This is inclusive of Test Result and draft Record Drawings.
   1. Draft drawings may include mark-ups done by hand.
   2. Machine generated (final) copies of Record Drawings shall be submitted within 30 working days of completion of each testing phase.

3. Documentation will include all aspects of systems covered by these specifications that are required for systems to be fully functional.
4. For structured cabling this includes the horizontal link from the TO to the HC, backbone cabling from the HC to the MC, cross-connections, interconnections and/or patch cords that are the responsibility of the contractor.

D. Submit Acceptance Test Results in electronic form for review and distribution.
1. Interim documentation of Test Results (if applicable) may be submitted via email or on CD-ROM.
2. Final documentation of Test Results shall be submitted on CD-ROM.
3. Test results shall be submitted in format(s) native to test instrument(s) used in performing testing.
4. Where unique software (other than an MS-Word® compatible Word Processor or MS-Excel® spreadsheet) is required for viewing of test results, Contractor shall provide along with above documentation, one (1) licensed copy of such software. Software shall run on MICROSOFT Windows-based personal computer.

E. Acceptance Test results shall include description of sub-system tested, equipment/cable/outlet I.D., reference and test setup, test equipment type/model and serial number(s), equipment location and direction of test (if applicable), test frequencies/wavelengths, date and operator name(s).

F. Engineer or Owner may request that 10% random re-test be conducted on cable system - at no additional cost - to verify documented findings. Tests shall be a repeat of those defined above and in technical sections.
1. Owner may also perform independent testing to verify results.
2. If findings contradict documentation submitted by Contractor, additional testing can be requested to extent determined necessary by Engineer or Owner, including 100% re-test. This re-test shall be at no additional cost to Owner.

G. Documentation - including hard copy and electronic forms of Test Data and Record Drawings - shall become property of Owner.

H. Refer also to Technical Sections for requirements specific to covered subsystems.

3.12 CLEANING

A. After installation is complete, Contractor shall clean all systems.

B. Vacuum debris from system components, enclosures, junction boxes and pull boxes prior to testing and again prior to completion.

C. Thoroughly clean equipment of stains, paint spots, dirt and dust. Remove temporary labels not used for instruction or operation.

END OF SECTION

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SECTION 27 0526
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes product and execution requirements for Grounding and Bonding that are unique to communications systems and not included in Division 26 sections.

1.02 DESCRIPTION

A. Grounding and Bonding infrastructure for communications includes Cabling, Busbars and Connectors.

1.03 RELATED WORK

A. Related Division 27 Sections include:
   1. Section 27 0000 - General Communications Requirements
   2. Section 27 0528.33 - Raceway and Boxes for Communications Systems
   3. Section 27 0528.36 - Cable Tray for Communications Systems
   4. Section 27 0553 - Communications Systems Identification
   5. Section 27 1100 - Communications Equipment Room Fittings
   6. Section 27 1300 - Communications Backbone Cabling
   7. Section 27 1500 - Communications Horizontal Cabling
   8. Section 27 4100 - Audiovisual Systems
   9. Section 27 5223 - Nurse Call System

B. Related sections in other Divisions of Work:
   1. Section 26 0526 - Grounding and Bonding for Electrical Systems

1.04 REFERENCES AND STANDARDS

A. Refer to Section 27 0000 - General Communications Requirements which identifies pertinent References and Standards.

B. In addition, the following apply:
   1. IEEE/ANSI 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
   2. IEEE 837 - Standard for Qualifying Permanent Connections Used in Substation Grounding.
   3. UL 467 Electrical Grounding and Bonding Equipment
   4. ANSI J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
   5. ANSI J-STD-607-D - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

1.05 DEFINITIONS

A. Refer to Section 27 0000 - General Communications Requirements which provides information on Definitions used in this and related sections.

B. Additional definitions (per referenced standards):
   1. Telecommunications Main Grounding Busbar: Busbar placed in convenient and accessible location and bonded by means of bonding conductor for telecommunications to building service equipment (power) ground.
   2. Telecommunications Grounding Busbar: Interface to building telecommunications grounding system generally located in telecommunications room. Common point of connection for telecommunications system and equipment bonding to ground and located in telecommunications room or equipment room.
   3. Telecommunications Bonding Conductor: Conductor that interconnects telecommunications bonding infrastructure to building's service equipment (power) ground.

4. Telecommunications Bonding Backbone: Conductor that interconnects telecommunications main grounding busbar to telecommunications grounding busbar.
5. Grounding Equalizer: Conductor that interconnects elements of telecommunications grounding infrastructure.
6. Exothermic Weld: Method of permanently bonding two metals together by controlled heat reaction resulting in molecular bond.
7. Irreversible Compression: Permanent mechanical bond between conductors or conductor and connector using mechanical or hydraulic tool.

1.06 ABBREVIATIONS AND ACRONYMS

A. Refer to Section 27 0000 - General Communications Requirements which provides information on Abbreviations and Acronyms used in this and related sections.

B. Additional abbreviations and acronyms (per referenced standards):
1. Telecommunications Main Grounding Busbar - TMGB
2. Telecommunications Grounding Busbar - TGB
3. Telecommunications Bonding Backbone - TBB
4. Grounding Equalizer - GE

1.07 WORK BY OWNER

A. Refer to Section 27 0000 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this section.

1.08 SUBMITTALS

A. Refer to Section 27 0000 - General Communications Requirements which provides general guidelines for product or installation information to be submitted by Contractor.

1.09 QUALITY ASSURANCE

A. Refer to Section 27 0000 - General Communications Requirements which identifies general quality assurance requirements for the Project.

1.10 GUARANTEE

A. Refer to Division 01, General Conditions, and General Requirements - Guarantee Documents for general warranty requirements.

PART 2 PRODUCTS

2.01 TELECOMMUNICATIONS BUSBARS

A. Material: Copper (aluminum not permitted)
1. 1/4” thick

B. Pre-drilled
1. 3/8” Diameter
2. Hole spacing per ANSI Joint Standard J-STD-607-A
3. Hole pattern shall accommodate two-hole lugs

C. Insulators and stand-off brackets shall electrically isolate busbar from wall or other mounting surface.

D. Busbars shall be listed by nationally recognized testing laboratory.

E. Size:
1. Wall mounted - Telecommunications Grounding Busbar (TGB) – 12” x 2” (minimum)
2. Rack mounted - ground bar 19” wide by 1” high

2.02 CONDUCTORS

A. Material: Stranded copper (aluminum not permitted)

B. Bonding Conductors shall be insulated.
1. Green Jacket or Black Jacket marked with Green Tape or Green adhesive labels per NEC Guidelines

C. Size:

1. Telecommunications Bonding Backbone (TBB; TMGB to TGB):
   a. Up to 66 ft - 2/0 AWG
   b. Greater-than 66 ft - 3/0 AWG
2. Grounding Equalizer (GE): [As indicated on Project Drawings]
   a. Up to 66 ft **-** 2/0 AWG
   b. Greater-than 66 ft - 3/0 AWG

2.03 CONNECTIONS

A. Mechanical Connectors
   1. Connector Body shall:
      a. Be high-strength, high-conductivity cast copper alloy
      b. Be 2 bolt type
   2. Bolts, nuts, washers, and lock-washers: Silicon Bronze
      a. Shall be supplied as part of connector body
      b. Split bolt connector types are not allowed
   3. Connector shall:
      a. Meet or exceed UL 467
      b. Be clearly marked with catalog number, conductor size and manufacturer.

B. Compression Connectors
   1. Connector Body: pure wrought copper.
      a. Conductivity shall be no less than 99% by IACS standards.
   2. Connector shall:
      a. Meet or exceed performance requirements of IEEE 837, latest revision
      b. Be factory filled with an oxide-inhibiting compound
      c. Be clearly marked with manufacturer, catalog number, conductor size and required compression tool settings
   3. Connection shall be irreversible.

C. Exothermic Weld Connections
   1. Not Allowed

PART 3 EXECUTION

3.01 SEQUENCING AND SCHEDULING

A. Permanently attach communications grounds prior to energizing communications equipment.

3.02 TOPOLOGY

A. Refer to the project drawings.

3.03 INSTALLATION

A. Provide required elements and miscellaneous hardware necessary to establish Telecommunication Grounding infrastructure as specified.

B. Install Products in accordance with manufacturer's instructions.
   1. Install Compression Connectors with compression, tool and die system, as recommended by manufacturer of connectors.

C. Grounding connections shall be tight and shall be made with UL listed grounding devices, fittings, bushings, etc.

D. On the Telecommunications Bonding Conductor, Telecommunications Bonding Backbone (TBB) and Grounding Equalizer (GE) all connections shall be Compression type.

E. Locate TGB per drawings.

F. Telecommunications Bonding Backbone (TBB) shall be continuous and not interrupted by Telecommunications Grounding Busbars (TGB).
   1. TGBs shall be bonded to TBB via tap off of TBB.
      a. Exception is "last" TGB on TBB (e.g. furthest from TMGB).
   2. Grounding Equalizer(s) (GE) shall connect to TGBs to be interconnected.

G. Insulate Busbars from their support.

H. Connections shall be bare metal to bare metal contact.
   1. Clean surfaces of paint, dirt, oil, etc.

I. Connections shall be exposed and visible for inspection at all times.
   1. Do not install insulation over ground connections.

J. Terminate each grounding conductor on its own terminal lug.
   1. Multiple conductors on single lug not permitted.

3.04 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

B. Test resistance of each TGB to ground.
   1. Maximum resistance to ground shall be less than 5 Ohms.

3.05 DOCUMENTATION

A. Accurately record actual locations of grounding electrode(s), busbars, and backbone grounding conductors.

END OF SECTION

SECTION 27 0528.29
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes product and execution requirements for items unique to communications systems and not included in Division 26 sections.

B. Refer to Section 27 0000 – General Communications Requirements and 26 0529 - Hangers and Supports for Electrical Systems - Part 1 for requirements for Reference Standards, Submittals, Quality Assurance, Delivery/Storage/Handling, and Guarantee.

1.02 RELATED WORK

A. Related Division 27 Sections include:
1. Section 27 0000 - General Communications Requirements
2. Section 27 0528.33 - Raceway and Boxes for Communications Systems
3. Section 27 0528.36 - Cable Tray for Communications Systems
4. Section 27 1100 - Communications Equipment Room Fittings
5. Section 27 1300 - Communications Backbone Cabling
6. Section 27 1500 - Communications Horizontal Cabling
7. Section 27 4100 - Audiovisual Systems
8. Section 27 5223 – Nurse Call System

B. Related sections in other Divisions of Work:
1. Section 26 0529 - Hangers and Supports for Electrical Systems
2. Section 26 0548 - Vibration And Seismic Controls For Electrical Systems

1.03 REFERENCES AND STANDARDS

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

PART 2 PRODUCTS

2.01 PRODUCTS COMMON WITH ELECTRICAL SYSTEMS

A. Refer to Section 26 0529 - Hangers and Supports for Electrical Systems - Part 3 for:
1. Hanger Rods
2. Beam Clamps
3. Wall Anchors
4. Metal Framing

2.02 J-TYPE CABLE SUPPORT HOOKS

A. Cable support hooks shall be a wide-base type for use in a non-continuous pathway.

B. Hook material shall be Galvanized metal or Nylon for smooth cable pull and corrosion resistance.
1. Hook may be coated to reduce cable friction.
2. Hook material shall be rigid. Flexible material not allowed.

C. Hooks shall:
1. Comply with UL, cUL, NEC and TIA requirements for structured cabling systems.
2. Be designed to limit cable bending per cable manufacturers’ recommendations.
3. Be capable of being installed in a single- or multiple-hook (“tree”) configuration.
4. Incorporate a latch or other mechanism to retain cable.

PART 3 EXECUTION

3.01 PRODUCTS COMMON WITH ELECTRICAL SYSTEMS

A. Refer to Section 26 0529 - Hangers and Supports for Electrical Systems - Part 3 for all products identified in Part 1.

3.02 J-TYPE CABLE SUPPORT HOOKS

A. Where installed free-air above suspended ceiling or below raised floor, support cables using J-hook type cable supports installed in accordance with manufacturer's installation requirements.

B. Support hooks from structure. Do not support from ceiling grid, conduit, or other trades work.

C. Space J-hook cable supports every 4 ft or in accordance with cable manufacturer's specifications, whichever distance is shorter.

D. J-hook fill capacities shall be per manufacturer's recommendations and shall consider diameter of cable type(s) being installed.

END OF SECTION

SECTION 27 0528.33
RACEWAY AND BOXES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section includes product and execution requirements for items unique to communications and not included in Division 26 sections.

1.02 DESCRIPTION

A. Refer to Section 26 0533 - Raceway and Boxes for Electrical Systems - Part 1 for requirements for Standards, Submittals, Quality Assurance, Delivery/Storage/Handling, and Guarantee for:
   1. Outlet Boxes
   2. Pull and Junction Boxes
   3. Raceways and Wireways (including sleeves, expansion fittings, penetrations, and seals)
   4. Floor Boxes
   5. Cable Supports

1.03 RELATED WORK

A. Related Division 27 Sections include:
   1. Section 27 0000 - General Communications Requirements
   2. Section 27 0526 - Grounding and Bonding for Communications Systems
   3. Section 27 0528.29 - Hangers and Supports for Communications Systems
   4. Section 27 0528.36 - Cable Tray for Communications Systems
   5. Section 27 0553 - Communications Systems Identification
   6. Section 27 1100 - Communications Equipment Room Fittings
   7. Section 27 1300 - Communications Backbone Cabling
   8. Section 27 1500 - Communications Horizontal Cabling
   9. Section 27 4100 - Audiovisual Systems
   10. Section 27 5223 - Nurse Call System

B. Related sections in other Divisions of Work:
   1. Section 26 0533 - Raceway and Boxes for Electrical Systems

1.04 REFERENCES AND STANDARDS

A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

PART 2 PRODUCTS

2.01 PRODUCTS COMMON WITH ELECTRICAL SYSTEMS

A. Refer to Section 26 0533 - Raceway and Boxes for Electrical Systems - Part 2 for Outlet Boxes for Communications, Pull and Junctions Boxes for Communications, Raceways for Communications, and other products identified in Part 1.

B. Refer to Section 27 5223 - Nurse Call and Nurse Call Schedule for box size(s) and configuration for Nurse Call system rough-in.

2.02 COMMUNICATIONS RACEWAYS

A. OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY (INNERDUCT)
   1. UL 2024; flexible type, approved for plenum or riser installation
   2. Indoor Innerduct: Corrugated
   3. Color:
      a. Riser: Orange
      b. Plenum: White
   4. Manufacturers: Carlon; Pyramid; or Approved equal

PART 3 EXECUTION

3.01 PRODUCTS COMMON WITH ELECTRICAL SYSTEMS

A. Refer to Section 26 0533 - Raceway and Boxes for Electrical Systems - Part 3 for Outlet Boxes for Communications, Pull and Junctions Boxes for Communications, Raceways for Communications, and other products identified in Part 1.

3.02 COMMUNICATIONS RACEWAYS

A. Optical Fiber Communications Cable Raceway (Innerduct):
   1. Minimum innerduct size: 1”, unless otherwise noted on drawings.
   2. Extend innerduct to termination and/or storage enclosure.
   3. Provide couplings designed for innerduct size and type where innerduct enters a termination and/or storage enclosure.
   4. Splice innerduct segments using couplings designed for that purpose, where not installed in a continuous length.
   5. Provide 200 lb nylon pull cord in empty innerduct. Leave at least 24” of slack at each end of pull wire. Cap innerduct at both ends.
   6. Label innerduct with tags indicating cable type and cables contained therein.
      a. Label in each maintenance hole, pull box and communications equipment room, where exiting a conduit and at 20 ft intervals in cable tray or where otherwise exposed.

END OF SECTION

SECTION 27 0553
COMMUNICATIONS SYSTEMS IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section details product and execution requirements for labeling of communications cabling, termination components, pathways, and spaces for Communications Systems.

1.02 DESCRIPTION

A. All components shall be clearly labeled to identify them as unique throughout the project.

B. Labeling requirements include identification of Rooms, Equipment Racks, Telecommunications Outlets, Horizontal and Backbone Cabling, Termination Hardware (Patch Panels, Blocks) and Grounding.

1.03 RELATED WORK

A. Related Division 27 Sections include:
1. Section 27 0000 - General Communications Requirements
2. Section 27 0526 - Grounding and Bonding for Communications Systems
3. Section 27 1100 - Communications Equipment Room Fittings
4. Section 27 1300 - Communications Backbone Cabling
5. Section 27 1500 - Communications Horizontal Cabling
6. Section 27 4100 - Audiovisual Systems
7. Section 27 5223 - Nurse Call System

B. Related sections in other Divisions of Work:
1. Refer to individual technical sections identified above (if applicable).

1.04 REFERENCES AND STANDARDS

A. Refer to Section 27 0000 - General Communications Requirements which identifies pertinent References and Standards.

B. Other applicable references and standards include:
1. TIA-606-C - Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

1.05 DEFINITIONS

A. Refer to Section 27 0000 - General Communications Requirements and Section 27 1000 - Structured Cabling which provide information on Definitions used in this and related sections.

1.06 ABBREVIATIONS AND ACRONYMS

A. Refer to Section 27 0000 - General Communications Requirements and Section 27 1000 - Structured Cabling which provide information on Abbreviations and Acronyms used in this and related sections.

1.07 WORK BY OWNER

A. Refer to Section 27 0000 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this section.

1.08 SUBMITTALS

A. Refer to Section 27 0000 - General Communications Requirements and Section 27 1000 - Structured Cabling which provide general guidelines for product and/or installation information to be submitted by contractor.

B. Prior to installation, provide samples of label types planned for the project.
1. Samples shall include examples of lettering to be used and shall follow standards detailed below.

1.09 QUALITY ASSURANCE

A. Refer to Section 27 0000 - General Communications Requirements which identifies general quality assurance requirements for the project.

PART 2 PRODUCTS

2.01 GENERAL

A. Labels and markings shall be physically and chemically resistant to damage that would make label unreadable.

B. Cable labels shall be self-laminating, White/Transparent Vinyl (or other substrates facilitating easy application and flex as cables are bent) and incorporate an integrated clear lamination which covers printed part of label when label is wrapped around cable.
   1. If cable jacket is white, provide cable label with printing area that is a color other than white to easily distinguish label from cable jacket.
   2. Labels shall be of adequate size to accommodate circumference of cable(s) being marked and properly self-laminate over full extent of printed area of label.
   3. Labels on larger cables (e.g. Copper Backbone) may be wrapped with clear non-removable tape.

C. Labels shall use aggressive adhesives that stay attached even to the most difficult to adhere to jacketing. Tags shall be non-removable.
   1. Exceptions:
      a. Telecommunications Outlet labels that are placed in recessed label holders.
      b. Telecommunications Ground tags secured with cable ties.
      c. Innerduct Tags secured with cable ties.

D. Labels for 110-type Termination Blocks shall be Color-coded to indicate the cable type (inter-building, intra-building backbone, horizontal, etc.). Refer to Part 3.

PART 3 EXECUTION

3.01 GENERAL

A. Labeling shall be by mechanical means.
   1. Hand lettered designations are not allowed.

B. Tags shall be non-removable.
   1. Exceptions:
      a. Telecommunications Outlet labels that are placed in recessed label holders.
      b. Telecommunications Ground tags secured with cable ties.
      c. Innerduct Tags secured with cable ties.

C. Characters shall be Black Ink and printed on background of contrasting color.

D. Labels shall match hardware layout and design.

E. Labels shall be as large as practicable while fitting properly.

F. No lettering shall be smaller than 10-point.

G. Label cables with tag which is wrapped around cable sheath.
   1. Clean cable sheath thoroughly before applying label.
   2. Labels shall not be obscured by termination hardware.

3.02 ROOM IDENTIFICATION

A. Label Communications Backboard or Equipment Rack closest to entry door with unique identifying code.

B. Characters shall be 1”minimum.

C. Room ID shall be X-####, where:
   1. X is the building identifier
   2. #### is the room number

3.03 EQUIPMENT RACK IDENTIFICATION

A. Label each Equipment Rack with [a unique alpha character starting at “A”] [unique identifying code as follows:
   1. TR.R#, where:
      a. "TR" is identifier for room where rack is located
      b. "R#" is sequential number for rack starting at "1".

B. Position Labels at top of rack.

C. Characters shall be 1-inch minimum.

3.04 TELECOMMUNICATIONS OUTLET

A. Label each Telecommunications Outlet (TO) connector with unique identifying code.

B. Telecommunications Outlet connector numbering shall result in logical numbering sequence in work area.
   1. Labeling plans that results in random TO numbering in work area are not acceptable.

C. Place Faceplate labels on outside of cover.

D. Position Labels in recessed label holders on faceplate and covered with clear plastic covers.
   1. Where Communications Outlet Faceplates not incorporating recessed holders are allowed, faceplate labels shall be protected with clear laminate.

E. Telecommunications Outlet labeling code shall be as follows:
   1. X####-X-X#, where:
      a. “X” (beginning) is identifier for building that the room is located.
      b. “####” is identifier for room that faceplate is located
         1) Number assigned to room.
      c. "X" (middle) is position of faceplate within room starting at door and circling the room clockwise from immediate left of door upon entering.
         1) Character starting at “A”.
      d. "X#" is sequential position of Jack in faceplate
         1) X is the faceplate position identifier within room. Refer to “c” above.
         2) # is the identifier of jack position within faceplate.
         3) Position sequence shall be Left-Right and Top-Bottom.
   2. Example: "T1002-B-B3" represents 3rd jack position in 2nd faceplate within room 1002 of building T".
      e. Faceplate labels can use common identifiers on each label strip. For example, two data jacks in positions 3 and 4 in the 2nd faceplate in building T room 1002 sharing common label strip may be represented by:

T1002-B	
B3	B4

3.05 HORIZONTAL CABLING

A. Label each horizontal cable at Telecommunications Outlet and at horizontal cross-connect with unique identifying code.

B. Cable shall be labeled at both ends within 4" of cable choke (end of jacket).

C. Horizontal labeling code shall be same as identified for Telecommunications Outlet above

3.06 MODULAR PATCH PANEL

A. Label each patch panel and port at horizontal cross-connect with unique identifying code.

B. Patch panel labeling code shall be same as identified for Telecommunications Outlet above.

3.07 BACKBONE COPPER CABLE

A. Label each backbone cable at both ends at termination point with unique identifying code.

B. Label cable sheath:
   1. At point where sheath ends

2. At point on cable where viewing of label is not obscured by termination blocks or other visual barrier.

C. Label shall be on plastic tag tie-wrapped to cable sheath or placed on adhesive labels adhered to cable sheath.
1. If adhesive labels are used, place clear plastic tape over label to protect it and maintain adhesion to sheath.

D. Label Intra-building cables with:
1. From and to locations,
2. Pair numbers
a. Where multiple cables are installed between same end-points, labeling shall indicate sequential pair numbering.
1) For example, 400-pair provided as two 200-pair cables would be labeled "001-200" and "201-400".
3. Date installed.
a. Example 200-pair cable from ER106 to TR3164 installed October 2009:

ER106-TR3164
001-200
10/2009

E. Label Inter-building (between buildings) cables with:
1. From and to locations,
2. Pair numbers
a. Where multiple cable is installed between same end-points, labeling shall indicate sequential pair numbering.
1) For example, 400-pair provided as two 200-pair cables would be labeled "001-200" and "201-400".
3. Date installed.
a. Example 600-pair Cable from Building 108 ER to Building 110 ER installed October 2009:

ER108-ER110
001-600
10/2009

3.08 TERMINATION BLOCKS

A. Provide color-coded designation strips with Termination Blocks.

B. Label termination positions on designation strips with position identifier.

C. Horizontal Cabling Blocks shall incorporate BLUE Designation Strips and shall identify:
1. Telecommunications Outlet / Jack I.D.s

D. Intra-Building (within building) Backbone Cabling Blocks shall incorporate WHITE Designation Strips.
1. Label Designation Strips with:
a. Cable Origin & Destination
1) Repeat on every designation strip.
b. Pair Count.
1) Label 1st and 25th Positions on each row (e.g. 001 & 025, 026 & 050, etc.).
2. Example ER106 to TR3164:

001	ER106-TR3164	025
026	ER106-TR3164	050

E. Inter-Building (between buildings) Backbone Cabling Blocks shall incorporate BROWN Designation Strips.
1. Label Designation Strips with:

a. Cable Origin & Destination
   1) Repeat on every designation strip.
b. Pair Count
   1) Label 1st and 25th Positions on each row (e.g. 001 and 025, 026 and 050, etc.).

2. Example cable linking Building 123 ER and Bldg. 456ER:

001	123ER-456ER	025
026	123ER-456ER	050

F. Feed Blocks (from Access/Service Provider) shall incorporate GREEN Designation Strips.
1. Label Designation Strips with:
   a. Designation as "FEED CABLE"
   b. Pair Count.
2. Example (Verizon as Service Provider):

1201	FEED (VERIZON)	1225
1226	FEED (VERIZON)	1250

G. Telephone system Equipment Blocks shall incorporate PURPLE Designation Strips.
1. Label Designation Strips with:
   a. Designation (e.g. System or Equipment Type)
   b. Pair Count.
2. Example (PBX):

001	PBX	025
026	PBX	050

3.09 BACKBONE FIBER OPTIC CABLING

A. Label each backbone cable at both ends at termination point with unique identifying code.

B. Label shall be placed on adhesive labels adhered to cable sheath.

C. Label Intra-building cables with:
1. From and to locations,
2. Fiber type (core/cladding diameter)
3. Fiber count
   a. Where multiple cable is installed between same end-points, labeling shall indicate sequential fiber numbering.
      1) For example, 144-fibers provided as two 72-fiber cables would be labeled "001-072" and "073-144".
4. Date installed.
5. Example 72-fiber cable from ER106 to TR3164 installed October 2009:

ER106-TR3164
50/125 001-072
10/2009

D. Label Inter-building cables with:
1. From and to locations,
2. Fiber type (core/cladding diameter)
3. Fiber count
   a. Where multiple cable is installed between same end-points, labeling shall indicate sequential fiber numbering.
      1) For example, 144-fibers provided as two 72-fiber cables would be labeled "001-072" and "073-144".
4. Date installed.
5. Example 72-fiber cable from Building 108 ER to Building 110 ER installed October 2009:

ER108-ER110
50/125 001-072
10/2009

3.10 FIBER OPTIC PATCH PANELS

A. Label each fiber coupling in patch panel or workstation outlet with unique identifying code.

B. Patch panel labels shall be visible from front of panel without opening panel cover.

C. Place labels in manufacturer designated labeling areas.

D. Label Fiber Optic Patch Panels with unique labeling code to identify:
   1. [Cable Destination] [Cable Number]
   2. Fiber type (core/cladding diameter)
   3. Fiber (or coupler) number of each panel position.
      a. Port I.D. shall be from Top to Bottom, Left to Right,
      b. Manufacturers port labeling is acceptable.

E. Label Fiber Optic Patch Panels with unique labeling code to identify:
   1. Patch panel number in rack
   2. Fiber (or coupler) number of each panel position.
      a. Port I.D. shall be from Top to Bottom, Left to Right,
      b. Manufacturers port labeling is acceptable.

F. Room number is not required on fiber optic patch panels.

G. Equipment Rack number is not required on fiber optic patch panels.

3.11 INNERDUCT

A. Innerduct containing fiber optic cable installed under this project shall be labeled where exposed.
   1. Includes areas where innerduct is installed in trays and in equipment rooms.

B. Label innerduct with durable Yellow Polyethylene tag that reads "CAUTION FIBER OPTIC CABLE"
   1. Tag shall provide blank spaces for adding fiber count and cable destination information.

C. Label Tag to include:
   1. Identifier(s) of cable(s) contained therein.
      a. Use Backbone Cable labeling formats as described above.

D. Hand lettering is acceptable on tag
   1. Use an indelible type ink.

E. Tag shall be secured to Innerduct using self-locking ties.

3.12 TELECOMMUNICATIONS GROUNDS

A. Label Grounds as close as practicable to point of termination.

B. Labels shall be non-metallic and include the following:

WARNING
IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER.

END OF SECTION

SECTION 27 1100
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section details product and execution requirements for Communications Equipment Room Fittings for Communications Systems.

1.02 DESCRIPTION

A. Communications Equipment Room Fittings include:
   1. Cabinets, Racks, Frames and Enclosures
   2. Cable Runway
   3. Patch Panels
   4. Cable Management

B. Refer to Project Drawings for Equipment Room layout and equipment placement.

1.03 RELATED WORK

A. Refer to Section 27 0000 - General Communications Requirements which identifies related specification sections in this and other Divisions (if applicable).

1.04 REFERENCES AND STANDARDS

A. Work under this Section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

B. Related Division 27 Sections include:
   1. Section 27 0000 - General Communications Requirements
   2. Section 27 0526 - Grounding and Bonding for Communications Systems
   3. Section 27 0528.29 - Hangers and Supports for Communications Systems
   4. Section 27 0528.33 - Raceway and Boxes for Communications Systems
   5. Section 27 0553 - Communications Systems Identification
   6. Section 27 1300 - Communications Backbone Cabling
   7. Section 27 1500 - Communications Horizontal Cabling
   8. Section 27 4100 - Audiovisual Systems
   9. Section 27 5223 – Nurse Call System

C. Related sections in other Divisions of Work:
   1. Refer to individual technical sections identified above (if applicable).

1.05 DEFINITIONS

A. Refer to Section 27 0000 - General Communications Requirements which provide information on Definitions used in this and related sections.

1.06 ABBREVIATIONS AND ACRONYMS

A. Refer to Section 27 0000 - General Communications Requirements which provide information on Abbreviations and Acronyms used in this and related sections.

1.07 WORK BY OWNER

A. Refer to Section 27 0000 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this section.

1.08 SUBMITTALS

A. Refer to Section 27 0000 - General Communications Requirements which provide general guidelines for product or installation information to be submitted by Contractor.

1.09 QUALITY ASSURANCE

A. Refer to Section 27 0000 - General Communications Requirements which identify general quality assurance requirements for the Project.

1.10 GUARANTEE

A. Refer to Division 01, General Conditions, and General Requirements - Guarantee Documents for general warranty requirements.

PART 2 PRODUCTS

2.01 CABINETS, RACKS, FRAMES AND ENCLOSURES

A. Manufacturers: Panduit

B. Equipment racks shall be:
1. Manufacturer part number: RP2
2. Constructed of painted aluminum
3. Color Black
4. Supplied with ground bar strip (19” wide by 1” high) and #6 AWG ground lugs
5. Supplied with minimum of 12 releasable cable support ties (e.g. "hook and loop")
6. Supplied with spare screws (minimum of 50)
7. Configured with Channel uprights spaced to accommodate industry standard 19” mounting

C. Free Standing Equipment Rack shall comply with general requirements above and shall:
1. Be 84” in height
   a. Have minimum of 45 usable rack mounting units (RU)
2. Be self-supporting
3. Have Minimum base footprint of 15” x 20”
4. Be double-sided drilled and tapped to accept 12-24 screws
   a. Uprights shall be drilled on back to accept cable brackets, clamps, power strip(s).
   b. Hole pattern on rack front and back shall be per EIA/TIA specifications (5/8” – 5/8” – 1/2”).

D. Cable Management
1. Manufacturers: Panduit
2. Horizontal Cable Management Panels shall:
   a. Manufacturer part number: WMPH2E
3. Vertical Cable Management shall:
   a. Manufacturer part number: WMPV45E

E. Equipment Rack Ground Strip
1. Material: Copper
2. Mounts horizontally in rack
3. Mounting configuration EIA universal mounting hole pattern tapped #12-24.

F. Miscellaneous
1. Releasable Cable Support Ties shall be:
   a. Hook & Loop type
   b. Individual units with latch
      1) Roll of hook & loop material is not acceptable.

2.02 CABLE RUNWAY

A. Manufacturers: Panduit, CPI, B-Line

B. Cable Runway shall:
1. Be constructed of 0.065” thick steel
2. Utilize tubular stringers to support rungs.
   a. Stringers shall be 1-1/2” high.
   b. Rungs shall be welded to stringers and shall be spaced 9” on center.
3. Be painted with black epoxy.
4. Runway width shall be 12”.

2.03 MODULAR COPPER PATCH PANELS

A. Manufacturers: Panduit

B. Panels shall:
   1. Manufacturer’s part number: CPP48FMWBLY

C. Modular Jacks in Panel shall:
   1. Be non-keyed, 8 position, 8-conductor (8P8C).

2.04 FIBER OPTIC PATCH PANELS

A. Manufacturers: Panduit

B. Panels shall:
   1. Be enclosed assemblies
   2. Incorporate hinged or retractable front cover
   3. Be rack mountable on standard TIA 19” equipment racks
   4. Provide for strain relief of incoming cables
   5. Incorporate radius control mechanisms to limit bending of fiber to manufacturer's recommended minimums of 1.2”, whichever is larger
   6. Provide protection to both "facilities" and "user" sides of couplings.
   7. Be configured to require only front access when patching
   8. Incorporate patch cable routing space internal to patch panel enclosure.
      a. Routing space shall be front-accessible.
   9. Include provisions for permanent labeling of fiber optic cables.
      a. Labeling shall be accessible from front of patch panel and shall not require disassembly of patch panel enclosure or removal of front cover.

C. Couplings shall be mounted on assembly that snaps into patch panel enclosure.
   1. This assembly shall be designed to accept variety of coupler types including, ST, SC, duplex SC, and high-density mini-connectors.
   2. Coupling type shall be duplex LC
   3. Coupling Color shall be as follows:
      a. Multimode: BEIGE
         1) Exception: LASER-optimized 50/125 Multimode couplings shall be AQUA
      b. Single-mode: BLUE

D. Access to inside of panel enclosure during installation shall be from front and rear.
   1. Panels that require disassembly of cabinet to gain entry will not be accepted.

E. Incoming cables shall not be accessible from patching area of panel.
   1. Enclosure shall provide physical barrier to access of such cables.
   2. Where factory-terminated cable assemblies ("pigtails") are spliced to cable, enclosure shall incorporate hardware for securing of splice tray and required cable, buffer tube and pigtail slack.

PART 3 EXECUTION

3.01 GENERAL

A. Refer to project Drawings for communications and AV equipment room layout and equipment placement.

B. New communications and AV equipment rooms must be free from dust, dirt, and other foreign materials before installation of any termination hardware or termination of copper or fiber optic cables.
   1. Door to room must be closed during termination if area outside room is not dust-free.

C. Follow manufacturer’s recommended installation and termination practices.

D. Provide necessary assistance to allow Owner or Carrier personnel to establish service on new cable system.
   1. Includes general wiring overview, cable pair identification, and cross connect documentation (if applicable).

3.02 EQUIPMENT RACKS AND CABLE MANAGEMENT

A. Provide equipment racks as shown on project Drawings.

B. Assemble racks per manufacturer's recommendations. Remove paint at the point(s) of contact of assembly hardware or use internal-external tooth lock washers to pierce paint to maintain ground continuity.

C. Bolt racks to floor.

D. Secure racks to cable runway as described below.

E. Provide Horizontal and Vertical Cable Management in equipment racks as follows:
   1. Provide horizontal cable management above and below each rack mounted patch panel.
   2. Provide vertical cable management between adjacent equipment racks and at rack row ends.

F. Provide each rack with:
   1. Ground bar strip and #6 AWG Ground lug,
   2. Minimum of fifty (50) 12/24 mounting screws,
   3. Minimum of twelve (12) releasable (e.g. "hook & loop") cable support ties.

G. Bond each rack mounted ground bar to telecommunications ground bus bar (TGB).
   1. Use #6 AWG or larger copper conductor (green jacket).

3.03 CABLE RUNWAY

A. Provide cable runway and accessories necessary for complete system.

B. Size and layout of cable runway shall be as shown on project Drawings.

C. Install above equipment racks at 7'-6".

D. Align with equipment racks as follows:
   1. Where parallel to rack row, align center of runway with center of rack.
   2. Where at right-angle to rack, align center of runway with center of rack.

E. Brace to racks with support brackets made by runway or rack manufacturer intended for this purpose.

F. Brace ends of runway to walls with support brackets made by runway or rack manufacturer intended for this purpose.

G. Use radius drops where cables drop from tray to rack and at elevation changes of 6" or more.

H. Maximum allowable deviation of runway from level horizontal plane measured across length of cable runway shall be 1/2", with tray loaded to capacity.

I. Where cable runway is supported from building structure:
   1. Provide 3/8" threaded rods for support of 12" wide or smaller runway.
   2. Provide 1/2" threaded rods for support of runway greater than 12" in width.

J. Bond runway components together using manufacturer's standard accessories.

K. Fasten cables to runway at intervals not to exceed 4 ft.

3.04 MODULAR PATCH PANELS

A. Provide panels to accommodate an additional 20% growth at each location.

B. Mount patch panels in 19" equipment racks.

C. Position cables in sequence of:
   1. Telecommunications Outlet ID for horizontal cabling
   2. Pair number for backbone cabling

D. Terminate cables using 568B wiring standard.

E. Provide horizontal management above and below each patch panel.

F. Provide minimum of 4 screws to secure each patch panel onto rack.

G. Bond F/UTP cable shield and drain wire to connecting hardware per manufacturer's instructions. Bond connecting hardware to the Telecommunications grounding system.

3.05 FIBER OPTIC PATCH PANELS

A. Provide Fiber Optic Patch Panels and coupling assemblies [as shown on drawings] [at horizontal and main cross-connect locations] [XXX].
   1. Provide minimum of 4 screws to secure each patch panel onto rack.

B. Provide couplings in coupling assemblies and mount coupling assemblies and blank covers in patch panels.

C. Position fibers consecutively - starting with lowest number - and mapped "position for position" between patch panels.
   1. There shall be no transpositions in cabling.

D. Keyways on duplex couplings shall be oriented to establish "cross-over" in cabling system.
   1. Convention defined by TIA-568-C.0 (Annex B, Section B.3.2) shall be used.
   2. Reverse-pair positioning shall not be used.

E. Provide blank covers for unused coupling assembly spaces in panels.

F. Follow manufacturer's guidelines for connector type(s) provided.
   1. Clean connectors with specialized dry-cleaning product from Fluke or Cletop.

G. Provide dust caps for couplings.

H. Where factory-terminated cable assemblies ("pigtails") are spliced to cable, prepare and splice cables and fibers per manufacturers' guidelines.

3.06 FIELD TESTING

A. General
   1. Refer to Section 27 0000 - General Communications Requirements for guidelines regarding documentation requirements.
   2. Refer to referenced technical sections for detailed requirements to testing of each cable sub-system.

3.07 DOCUMENTATION

A. General
   1. Refer to Sections 27 0000 - General Communications Requirements for guidelines regarding documentation requirements.

END OF SECTION

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SECTION 27 1300
COMMUNICATIONS BACKBONE CABLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section details product and execution requirements for backbone cabling for Communications Systems.

1.02 DESCRIPTION

A. Backbone Cabling links telecommunications rooms or floor distribution terminals, entrance facilities, and equipment rooms within or between buildings.

B. Backbone cable types include:
   1. Fiber Optic

C. Refer to Project Drawings which detail Backbone Cable System topology and conductor/fiber counts.

1.03 RELATED WORK

A. Related Division 27 Sections include:
   1. Section 27 0000 - General Communications Requirements
   2. Section 27 0526 - Grounding and Bonding for Communications Systems
   3. Section 27 0528.29 - Hangers and Supports for Communications Systems
   4. Section 27 0528.33 - Raceway and Boxes for Communications Systems
   5. Section 27 0553 - Communications Systems Identification
   6. Section 27 1100 - Communications Equipment Room Fittings
   7. Section 27 1500 - Communications Horizontal Cabling
   8. Section 27 4100 - Audiovisual Systems

B. Related sections in other Divisions of Work:
   1. Refer to individual technical sections identified above (if applicable).

1.04 REFERENCES & STANDARDS

A. Refer to Section 27 0000 - General Communications Requirements which identify pertinent References and Standards.

1.05 DEFINITIONS

A. Refer to Section 27 0000 - General Communications Requirements which provide information on Definitions used in this and related sections.

1.06 ABBREVIATIONS AND ACRONYMS

A. Refer to Section 27 0000 - General Communications Requirements which provide information on Abbreviations and Acronyms used in this and related sections.

1.07 WORK BY OWNER

A. Refer to Section 27 0000 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this section.

1.08 SUBMITTALS

A. Refer to Section 27 0000 - General Communications Requirements which provide general guidelines for product or installation information to be submitted by Contractor.

B. In addition, submit:
   1. One 3 ft section of each cable type from cable reels sent to site for Engineer's final approval.
      a. Section shall have manufacturer's cable markings visible.

1.09 QUALITY ASSURANCE

A. Refer to Section 27 0000 - General Communications Requirements which identify general quality assurance requirements for the Project.

1.10 GUARANTEE

A. Refer to Division 01, General Conditions, and General Requirements - Guarantee Documents for general warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Cables and Termination hardware shall be technically compliant with and installed in accordance with referenced TIA documents.

B. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of National Electrical Code and shall meet specifications of NEMA (low loss), UL 444, and ICEA (where applicable).

2.02 FIBER OPTIC CABLE

A. General
   1. Manufacturers (Cable): Panduit
   2. Fibers utilized in installed cable shall be traceable to manufacturer.

B. Optical Fiber - General
   1. Optical fibers shall:
      a. Be sufficiently free of surface imperfections and occlusions to meet optical, mechanical, and environmental requirements of this specification.
      b. Have been subjected to minimum tensile proof test by fiber manufacturer equivalent to 100 kpsi.
   2. Factory optical fiber splices are not allowed.
   3. Coatings shall be mechanically strippable without damaging optical fiber.

C. Single-mode Optical Fibers:
   1. Single-mode Optical Fibers:
   2. Fiber Type: Single-mode
   3. Strand Count: as shown on Drawings
   4. Transmission Windows: 1310 nm, 1550 nm
   5. Core Diameter: 8.3 micron
   6. Cladding Diameter: 125 micron ± 1 micron
   7. Coating Diameter: 245micron± 10 micron
   8. Maximum Attenuation:
      a. 1310 nm: 0.5 dB/km (at 23° ± 5°C)
      b. 1550 nm: 0.4-dB/km (at 23° ± 5°C)
      c. When tested in accordance with FOTP 3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical cable, and Other Passive Fiber Optic Components", average change in attenuation over rated temperature range of cable shall not exceed 0.05 dB/km at 1550 nm. Maximum attenuation change shall not exceed 0.15 dB/km at 1550 nm.
      d. [Water Peak Attenuation: 1383 ± 3 nm (dB/km) ≤ 0.4]
   9. Point Discontinuity: < 0.1 dB at specified wavelengths

D. Indoor Backbone Fiber Optic Cable
   1. Cable shall:
      a. Be suitable for installation in free air, in building risers, in conduit, in cable tray and in innerduct.
      b. Be dielectric materials (no conductive materials).
   2. Cable shall meet the following specifications:
      a. Buffer Diameter: 900 micron (tight buffer)
      b. Jacket Color
         1). Single-mode: YELLOW
      c. Cable Rating: OFNP
      d. Strength Member: Aramid Yarn

e. Storage Temperature: -40°F to 158°F (no irreversible change in attenuation)
f. Operating Temperature: -34°F to 158°F (no irreversible change in attenuation)
g. Humidity Range: 0 to 100%
h. Maximum Tensile Strength:
   1). During Installation – 2700 N (no irreversible change in attenuation)
   2). Long Term – 1000 N
i. Bending Radius:
   1). During Installation - 20 times cable diameter
   2). No Load - 10 times cable diameter

2.03 FIBER OPTIC CONNECTORS

A. Manufacturers: Panduit.

B. Connectors shall:
1. Be LC-type.
2. Accept fibers having clad diameter of 125 micron.
3. Accept fibers having buffered diameter of 900 micron.
4. Sustain minimum of 200 mating cycles.

C. Connector ferrule shall be [ceramic or glass-in-ceramic] [or composite (polymer)].

D. Connectors shall meet the following performance criteria:

	Test Procedure	Max. Attenuation Change
1.	Cable Retention (TIA-455-6)	0.2 dB
2.	Durability (TIA-455-21)	0.2 dB
3.	Impact (ANSI/TIA/EIA-455-2)	0.2 dB
4.	Temperature Life (TIA/EIA-455-4)	0.2 dB
5.	Humidity (TIA/EIA-455-5)	0.2 dB

E. Optical fiber shall be:
1. Secured within connector ferrule with adhesive, or
2. Mechanically secured and mated to a factory-installed fiber stub that is fully bonded into the ferrule. Mechanical “splice” inside connector shall include an index matching gel.

F. Attenuation per connector shall not exceed 0.5 dB.

G. Reflectance (maximum) when mated with patch-cord made up of connectors of comparable design shall be as follows:
1. Single-mode: -26 dB

H. Color of LC Connector shall be as follows:
1. Single-mode: BLUE

PART 3 EXECUTION

3.01 CABLE INSTALLATION AND TERMINATION

A. General
1. Provide cables as shown on Project Documents.
2. Size cables as shown on Project Documents.
3. Refer to Section 27 0000 - General Communications for general cable installation requirements.

B. Fiber Optic Cable
1. Route backbone fiber optic cable in innerduct.
2. Ground metallic cable sheath (if applicable) per Code.
   a. Provide armored fiber ground kit for armored cable terminations. Install as directed by kit manufacturer.
      1). Ground inter-building cable at one end
      2). Ground intra-building cabling at both ends
   b. Connect armored fiber ground kit to rack mounted grounding reference.

3. Terminate fiber strands on Fiber Optic Connectors mated to couplings mounted in Fiber Optic Patch Panels.
   a. Terminate all fibers.
4. Follow manufacturer's guidelines for connector type(s) provided.
   a. Clean connectors with specialized dry-cleaning product from Fluke or Cletop.
5. Fibers with coatings <900 micron shall be furcated (fanned-out) to minimum of 900 micron before termination.
   a. Provide buffer tube fan-out kits for fibers terminated in patch panel couplings.
6. Provide cable slack in each backbone fiber optic cable.
   a. Slack shall be in addition to length of fiber required for termination requirements.
   b. Store cable slack in enclosure designed for this purpose.
   c. Slack required shall be as follows:
      1). Backbone Intra-Building: Minimum of 16 ft (each cable if applicable) coiled and secured at one end (preferably at Telecom Room).

3.02 FIELD TESTING

A. General
   1. Refer to Section 27 0000 - General Communications Requirements for general guidelines regarding requirements for scheduling and performance of compliance testing.
      a. Contractor shall be responsible for testing each system end-to-end.

B. Backbone Fiber Optic Cable Testing
   1. Pre-Installation Testing
      a. Pre-installation testing shall be done at contractor option.
      b. Submit cable manufacturer's test report for each reel of cable provided.
         1). Verify fiber attenuation, bandwidth and length values as specified on cable data sheets supplied with cable reels.
      c. Visually inspect reels and packaging for damage.
   2. Post-Installation Testing
      a. Clean fiber optic connectors before beginning testing.
         1). Using fiber tester capable of fiber end face inspection is strongly encouraged to help minimize requirement for retesting due to dirty connectors.
      b. Testing shall include:
         1). Optical Attenuation
         2). Optical Time Domain Reflectometry (OTDR)
      c. Optical Attenuation
         1). Light Source: FP LASER for 1300 nm tests
         2). Measure Optical Attenuation on terminated fibers.
            a). Include optical connectors and couplings installed at fiber endpoints.
         3). Test single-mode fibers using TIA 526-7-A. Annex E (Method A).
         4). Test fibers in both transmission directions.
         5). Test single-mode fibers at 1310 ± 10 nm and 1550 ± 10 nm wavelengths.
         6). Fiber lengths less than or equal to 300 ft shall test to ≤ 2.0 dB loss.
         7). Fiber lengths greater than 300 ft shall test to loss value less than link loss budget for installed connectors and fibers.
      d. Optical Time Domain Reflectometry (OTDR)
         1). OTDR testing shall not be used as the sole method for establishing optical attenuation link loss.
         2). Verify fiber integrity using an Optical Time Domain Reflectometer (OTDR).
            a). Includes terminated and (if applicable) un-terminated fibers.
         3). OTDR(s) shall incorporate high-resolution optics and short pulse-width options optimized for viewing of short cable sections.
            a). Pulse-width shall be 10-ns or less for cable lengths greater than 100 meters.

b). Pulse-width shall be 5-ns or less for cable lengths less than 100 meters.

4). OTDR traces shall be performed in one direction using access jumpers at transmit and receive ends.

a). Remote end of tail cord has no requirement for reference grade termination

5). OTDR traces shall be performed in two directions using access jumpers at transmit and receive ends

a). Remote end of tail cord shall meet same reference grade requirements as launch end cord.

b). Perform bi-directional OTDR measurements according to requirements of TIA-526-7-A, clauses H.6 and H.7.

c). Minimum length of access jumper at launch end shall be minimum 990 ft long for single-mode, unless recommended otherwise by test equipment manufacturer.

6). Test single-mode fibers at 1310 ± 10 nm wavelengths.

7). Examine traces for continuity and anomalies to confirm fiber link integrity.

a). Point discontinuities in excess of 0.1 dB for single-mode fibers shall be cause for rejection of cable.

b). Any reflection in trace - except at patch panels - shall be cause for rejection of cable.

c). Submitted test results shall show only fiber under test and shall have trace boundaries set to show fiber under test and not launch cords or other extraneous data.

d). Set event markers to accurately reflect overall attenuation of installed fiber optic cable and connectors.

8). OTDR tested links showing excessive backscatter immediately following connector shall have connector cleaned and/or re-polished and then retested.

3.03 DOCUMENTATION

A. General
1. Refer to Section 27 0000 - General Communications Requirements for general guidelines regarding documentation requirements.

B. Backbone Fiber Optic Cable
1. Files containing Attenuation and OTDR traces of individual optical fiber "signatures" shall be so named as to identify each individual fiber by location in cable system and fiber number or color.
2. OTDR test results shall be consistent in format and presentation, including:
   a. Scale
      1). Scale or window of test result view shall show only enough trace to view fiber under test plus launch cords at both ends.
      2). View shall not show backscatter beyond end of fiber.
   b. Pulse width
   c. Units (English or Metric)
   d. Cursor placement
   e. Labeling

END OF SECTION

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SECTION 27 1500
COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section details product and execution requirements for Horizontal (Station) Cabling subsystem for Communications Systems.

1.02 DESCRIPTION

A. Horizontal cabling subsystem is portion of communication link that connects horizontal or intermediate cross-connect (typically at Telecom Room) and Telecommunications Outlet.

B. Horizontal Cable types include:
   1. 4-pair Copper Unshielded Twisted Pair (UTP)

1.03 RELATED WORK

A. Related Division 27 Sections include:
   1. Section 27 0000 - General Communications Requirements
   2. Section 27 0526 - Grounding and Bonding for Communications Systems
   3. Section 27 0528.29 - Hangers and Supports for Communications Systems
   4. Section 27 0528.33 - Raceway and Boxes for Communications Systems
   5. Section 27 0553 - Communications Systems Identification
   6. Section 27 1100 - Communications Equipment Room Fittings
   7. Section 27 1300 - Communications Backbone Cabling
   8. Section 27 4100 - Audiovisual Systems
   9. Section 27 5223 - Nurse Call System

B. Related sections in other Divisions of Work:
   1. Refer to individual technical sections identified above (if applicable).

1.04 REFERENCES AND STANDARDS

A. Refer to Section 27 0000 - General Communications Requirements which identifies pertinent References and Standards.

1.05 DEFINITIONS

A. Refer to Section 27 0000 - General Communications Requirements which provide information on Definitions used in this and related Sections.

B. In this section, "Telecommunications Outlet" is considered to consist of Frame/Faceplate into which Modular Jacks or other couplings snap, Modular Jacks, blanks fitted to unused jack positions, and labeling/identification components.

1.06 ABBREVIATIONS AND ACRONYMS

A. Refer to Section 27 0000 - General Communications Requirements which provide information on Abbreviations and Acronyms used in this and related Sections.

1.07 WORK BY OWNER

A. Refer to Section 27 0000 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this section.

1.08 SUBMITTALS

A. Refer to Section 27 0000 - General Communications Requirements which provide general guidelines for product or installation information to be submitted by Contractor.

B. In addition, submit:
   1. Samples of each Telecommunications Outlet Faceplate type to confirm color and material.
   2. One 3 ft section of each cable type from cable reels sent to site for Engineer's final approval.
      a. Section shall have manufacturer's cable markings visible.

3. Nominal Velocity of Propagation (NVP) for 4-pair Horizontal Copper Cable.

1.09 QUALITY ASSURANCE

A. Refer to Section 27 0000 - General Communications Requirements which identify general quality assurance requirements for the Project.

1.10 GUARANTEE

A. Refer to Division 01, General Conditions, and General Requirements - Guarantee Documents for general warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL

A. Cables and Termination hardware shall be technically compliant with and installed in accordance with referenced TIA documents.

B. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of National Electrical Code and shall meet specifications of NEMA (low loss), UL 444, and ICEA (where applicable).

C. Horizontal (Station) Cable and Termination Components (Jack, Patch Panel) are specified to function as System.
   1. Where required for warranty purposes, manufacturers of cabling and termination components used (if more than one) shall recognize each other in their Certification Programs.
   2. Components shall be specified as compatible with the Panduit TX6 PLUS Copper Cabling System

D. 4-Pair Horizontal Copper Cables and Modular Jacks are application independent (e.g. no distinction between “voice” and “data”).

2.02 4-PAIR HORIZONTAL COPPER CABLE

A. Manufacturers: Panduit
   1. Manufacturer’s part number: PUP6504WH-UY

B. Cables shall be CMP rated

C. Cabling shall be packaged to minimize tangling and kinking of cable during installation.

D. Configuration:
   1. Number of Pairs: 4 twisted pair
      a. Pair twists of any pair shall not be same as any other pair.
      b. Pair twist lengths shall be selected by manufacturer to ensure compliance with crosstalk requirements of TIA 568.
   2. Conductors: insulated solid annealed copper pairs
      a. Category 6 & 6A: 23 AWG
      b. Pairs of 4-pair cables shall be identified by banded color code in which conductor insulation is marked with dominant color and banded with contrasting color.
         1). By pair number, pair colors or dominant band are:
            a). Pair 1: Tip - White/Blue; Ring - Blue (or Blue/White)
            b). Pair 2: Tip - White/Orange; Ring - Orange (or Orange/White)
            c). Pair 3: Tip - White/Green; Ring - Green (or Green/White)
            d). Pair 4: Tip - White/Brown; Ring - Brown (or Brown/White)
   3. Shield: None
      a. Drain Wire: None
   4. Cable Rating: NEC Article 800 Type CMP, UL listed
   5. Maximum outside diameter:
      a. Category 6: 0.26 inches

E. Horizontal Voice and Data Cable:

1. Shall meet or exceed TIA Category 6 performance requirements.
2. Shall not incorporate an overall shield.
3. Jacket Color: White

2.03 TELECOMMUNICATIONS OUTLET

A. Manufacturers: Panduit
   1. Manufacturer's part number:
      a. Panduit MINI-COM TX6 Plus - modular insert – Black: CJ688TGBL-24
      b. Panduit MINI-COM TX6 Plus - modular insert – White: CJ688TGWH-24

B. Connectors (modular jacks) shall snap onto faceplate.
   1. In surface-mount designs (if applicable) Jacks and connectors may mount to frame onto which coverplate is mounted.

C. Work Area Faceplate
   1. Wall-mounted faceplates intended to be used in general work areas shall:
      a. Manufacturer's part number:
         1). Panduit Mini-Com Classic Faceplate Frame, Single Gang 4 Port White: CFP4WH
      b. Be configured to mount on standard, single gang opening when wall mounted.
      c. Accommodate a minimum of four (4) modular jacks and connectors.
         1). Open ports of faceplates shall be equipped with blank inserts:
            a). Panduit MINI-COM - Modular insert (blank) - Black: CMBBL-X
            b). Panduit MINI-COM - Modular insert (blank) – White: CNBWH-X
      d. Be constructed of high impact plastic (except where otherwise noted).
      e. Incorporate recessed designation strips at top and bottom of frame for identifying labels.
         1). Triple row faceplates with no provisions for labeling of middle outlet row are not acceptable.
         2). Designation strips shall be fitted with clear plastic covers.
         3). Designation strips and covers shall be positioned over faceplate mounting screws.
   2. Faceplate Color: White.

D. Faceplate - Wireless Access Point Location
   1. Faceplates supporting Wireless Access Point (AP) shall:
      a. Manufacturer's part number:
         1). Panduit Mini-Com Classic Faceplate Frame, Single Gang 2 Port White: CFP2WH
      b. Accept two (2) modular jacks or connectors.
      c. Be mounted in an enclosure designed for AP.
      d. Be made of High Impact thermoplastic.
      e. Incorporate recessed designation strips at top and bottom of frame for identifying labels.
   2. Faceplate Color: White.

PART 3 EXECUTION

3.01 GENERAL

A. Refer to project Drawings for outlet locations.

B. Provide Modular Jacks in faceplates as shown on Project Documents.
   1. Provide one (1) faceplate per Telecommunications Outlet symbol shown on Project Documents.

C. Maximum 4-pair Category-rated horizontal cable length shall not exceed 295 feet (90 m) measured from horizontal cross-connect (typically at TR) to Telecommunications Outlet.
   1. Includes slack required for installation and termination.

2. Contractor is responsible for installing station cable to avoid unnecessarily long runs.
3. Any area that cannot be reached within above constraints shall be identified and reported to Engineer prior to installation.

D. Follow manufacturers recommended termination practices.

3.02 CABLE INSTALLATION AND TERMINATION

A. General
1. Refer to Section 27 0000 - General Communications Requirements for general cable installation requirements.
2. Provide "Service Loop" for every Horizontal Cable in ceiling above outlet.
a. Loop length shall be 3.3 ft
b. Total length of 4-pair Category-rated horizontal cable including loop shall not exceed 295 feet (90 m).
c. Place loop in ceiling at last support (e.g. J-Hook) before cables enter fishable wall, conduit, surface raceway or box.
d. Coil loop in figure 8 configuration.
e. Loop radius (minimum) shall be 4X minimum bend radius for cable.
3. During installation, minimum bend radius shall be eight times outside diameter of UTP cables and 20 times outside diameter of fiber cables.
4. Limit size of cable bundles along cable pathways and in communications equipment rooms to maximum of 12-24 cables.

B. Horizontal Copper Twisted-Pair Cabling
1. Provide horizontal copper twisted pair cable between horizontal cross connect (typically at Telecommunications Room) and Telecommunications Outlet.
2. At Telecommunications Outlet, terminate each 4-pair Horizontal Cable on 8P8C Modular Jack.
a. Terminating one cable on more than one jack is not allowed.
3. At horizontal cross-connect, terminate:
a. Each 4-pair cable on 8P8C Modular Jack in Jack Panel.
4. Terminate cables using 568B wiring standard.
5. Cable jacket shall be continuous to within 1/2” of termination.
6. Preserve pair twists to point of termination.
7. Refer to Section 27 1100 - Communications Equipment Room Fittings for termination instructions for Modular Jack Panel.

3.03 TELECOMMUNICATIONS OUTLET

A. Faceplates shall be configured to provide connectivity as required by location.

B. Mount modular jacks and connectors into faceplates and secure faceplates to outlet box, raceway or floor box.
1. Provide blank(s) in unused jack/connector positions. Match color of blank to faceplate color.

C. Position Telecommunications Outlet for wall-mounted telephone in area clear of other utilities and wall mounted hardware.
1. Coordinate with other trades to maintain 8” clear space (minimum) on all sides from faceplate centerline.

3.04 FIELD TESTING

A. Refer to Sections 27 0000 - General Communications Requirements for guidelines regarding testing requirements common to all Division 27 Structured Cabling sections.
1. In addition, refer to sub-sections below for cable type under test.

B. 4-Pair Horizontal Copper Cable
1. Test from:
a. Horizontal Cross-connect (HC) to Jack at Telecommunications Outlet (TO).
2. Testing shall be per TIA-568 Permanent Link test configurations.

3. Maximum length of station cable shall not exceed 295 ft.
4. Cables shall be free of shorts within pairs, and be verified for Continuity, Pair Validity and Polarity, and Wire Map (Conductor Position on Modular Jack).
    a. Identify and correct defective, split or mis-positioned pairs.
5. In addition to above, Performance Testing shall be performed on all cables. Testing of Transmission Performance shall include the following:
    a. Length
    b. Insertion Loss / Attenuation
    c. Pair-to-pair NEXT
    d. PSNEXT
    e. Pair-to-pair ELFEXT (Equal Level Far End Cross-talk)
    f. PSELFEXT
    g. Return Loss
    h. Propagation Delay
    i. Delay Skew
6. Test cables to maximum frequency defined by standards covering specified performance category.
7. Perform Transmission Performance Testing using test instrument designed for testing to specified frequencies.
    a. Test records shall verify "PASS" on each cable and display specified parameters - comparing test values with standards based "templates" integral to unit.

3.05 DOCUMENTATION

A. Refer to Sections 27 0000 - General Communications Requirements for documentation guidelines.

B. Information added by Contractor to Record Drawings relating to Horizontal Cabling shall include cable routes, outlet locations and numbering and other detail necessary to document cable installation.

END OF SECTION

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SECTION 27 4100
CLINICAL ASSESSMENT SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section includes:
   1. General provisions – Functional description of audiovisual systems.
   2. Product descriptions and requirements.
   3. Execution, standards, and commissioning requirements.

B. Related Requirements
   1. Section 260500: Common Work Results for Electrical Systems
   2. Section 27 1500: Communications Horizontal Cabling\
   3. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this Section.

1.02 REFERENCES

A. Definitions
   1. When the following abbreviations and definitions are used in relation to the work for this section, they shall have the following meanings:
      a. AEI NW: Affiliated Engineers NW, Inc.
      b. AHJ: Authority Having Jurisdiction
      c. AV Consultant, Consultant, Engineer: AEI NW
      d. AVSC: Audiovisual Systems Contractor
      e. Boxes: Outlet, Junction or Pull Boxes
      f. Code: All applicable codes currently enforced at project location
      g. Compression: Compressed using leverage powered (hydraulic or equivalent) crimping tool.
      h. Connection: All materials and labor required for equipment to be fully operational
      i. Exterior Location: Outside of or penetrating the outer surfaces of the building's weather protective membrane.
      j. Fully Operational: Tested, approved, and operating to the satisfaction of the AHJ, contract documents, and the Consultant.
      k. Furnish: Deliver to the job site
      l. Install: To enter permanently into the project and make fully operational.
      m. Mfr.: Manufacturer
      n. NEC: National Electrical Code, National Fire Protection Association, Publication #70
      o. Noted: Shown or specified in the contract documents
      p. Provide: Furnish and install
      q. Required: As required by code, AHJ, contract documents, or manufacturer for the installation to be fully operational
      r. Shown: As indicated on the drawings or details

B. Reference Standards
   1. The referenced codes establish a minimum level of requirements. Where provision of the various codes conflict with each other, the more stringent provision shall govern. If any conflict occurs between referenced codes and this specification, the codes are to govern. Compliance with code requirements shall not be construed as relieving the AVSC from complying with any requirements of the drawings or specifications which may exceed the requirements of the governing codes and rules and not contrary to same.
   2. Perform all work and provide materials and equipment in accordance with the latest referenced codes and standards of the following organizations:
      a. ANSI - American National Standards Institute
      b. ASTM - American Society for Testing and Materials
      c. BICSI - Building Industry Consulting Services International
      d. EIA - Electronics Industries Association

e. FCC - Federal Communications Commission
f. IBC – International Building Code
g. ICEA - Insulated Cable Engineers Association
h. IEEE - Institute of Electrical and Electronics Engineers
i. ISO - International Organization for Standardization
j. NEMA - National Electrical Manufacturer's Association
k. NFPA - National Fire Protection Association
l. NFPA 70 – National Electrical Code
m. NEC - National Electrical Code
n. TIA - Telecommunications Industry Association

3. Install the AV systems based on the following:
   a. ANSI/INFOCOMM Standard 10.2013, AV Systems Performance Verification
   b. AVIXA F501.01.2015, Cable Labeling for Audiovisual Systems
   c. AVIXA F502.01:2018, Rack Building for Audiovisual Systems.
   d. “Dashboard for Controls Design Guide”, April 2005, InfoComm International
   e. IEEE 802.3af and 802.3bt, Power-over-Ethernet Standards.

1.03 SYSTEM DESCRIPTION

A. The systems integrator will provide complete and working systems, based on the operational requirements set forth in the specification.

B. Work Includes:
   1. Provision of complete clinical assessment recording, playback, and control systems.
   2. Generate all shop drawings and information for the complete installation and wiring of the system.
   3. Provide (or sub-contract for) the on-site installation and wiring and provide on-going supervision and coordination during the implementation phase.
   4. Initial adjustment of the systems as herein prescribed and provision of all test equipment for the system checkout and acceptance tests.
   5. Training in the operation and maintenance of the systems for personnel designated by the Owner.

C. Contract Drawings:
   1. The work of this Section and related sections is shown on the TA-xx series of drawings and equipment schedules.
   2. The drawings do not show all requirements of the specifications. The drawings and specifications are complementary and what is called for (or shown) in either is required to be provided as if called for in both. If in conflict, the specifications shall take precedence. Notify the Consultant immediately of any conflicts.
   3. Equipment racks, connection panels, and all other associated devices are shown diagrammatically only and indicate the general character and approximate location. Furnish, install, and place in satisfactory condition all AV equipment, cabling and all other materials required for the systems shown or noted in the contract documents, so that it is a complete system which is fully operational and fully tested.

D. Operation:
   1. Patient Stations (Exam Rooms)
      a. The facility will be used for Respiratory Therapy skills instruction and practice.
      b. All mannequins will be provided by the Owner. No more than two simultaneous simulations will be run at any time.
      c. Each patient station will be equipped with an AV monitor which will display procedural and training information and patient stats and driven by the simulation software. This monitor will be furnished by the Owner.
      d. Each patient station will be equipped with ceiling-mounted IP-based camera with digital pan/tilt/zoom controls. Video will be recorded to for later review with the student. Cameras will be provided by the Owner.

e. Each patient station will use a microphone and loudspeaker for hands-free communications with the instructor in the control room. This audio will also be recorded for later review.

2. Control Room
   a. Instructors will be able to view any of the six beds in the room and to control the simulators at each bed.
   b. Each control seat will be capable of viewing video of any of the six beds as selected at the control position.
   c. Each control seat will be able to view the same procedural, training, and patient status as displayed at the bedside.
   d. Each control seat will be equipped with a desktop PC, keyboard, mouse, and USB headset that will allow hands-free communication with the student at each bed location. This equipment will be provided and set up by the Owner.
   e. Audio, video, and statistics will be recorded for future review with the student in the Debrief Room.
   f. All audio and video feeds will be recorded to the Owner's Panopto system for later review.
   g. Sessions will also be streamed live and viewable in the debrief room.
3. Debrief Room
   a. This room will be used by instructors and students to observe current simulations as well as playback and review previous recordings with the student. The room will also be used for meetings.
   b. The room will be equipped with a Microsoft Surface Hub.
4. Media Room
   a. This room will house the AV equipment needed to operate the systems in the Lab, Control Room, and Debrief Room as well as clinical system network switch. The switch will be provided and programmed by the Owner.
   b. An equipment rack will be provided by others for this purpose.
   c. The room will be connected to the IDF on this floor for interface with the campus network.
5. Audiovisual Control System
   a. The audiovisual control system will enable an operator in the control room to select, for each control position, which exam bed will be used for practice and assessment and will start and stop recording of each session.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination
   1. Conform to Section 013113 for coordination of work with other Sections.
   2. The AVSC shall continually interface and coordinate the work with the work of other Contractors and/or other trades and shall examine all drawings and specifications of other trades including the mechanical, architectural, and structural for construction details and coordination.
   3. Obtain submittals, shop drawings, and other information for all equipment to be furnished by the Owner or under other divisions of the specifications.
   4. Prior to roughing-in, verify the exact location of all devices with Architect.
   5. Provide coordination to the Owner in relation to special installation details associated with all AV hardware. This will include but is not limited to mounting details of loudspeakers, I/O panels, equipment, projectors, equipment racks, and any other project related coordination between the AV integration and building construction.
   6. Special attention is called to the following items for coordination.
      a. Conduit, cable tray, boxes, and other raceway components.
      b. Location of casework, cabinets, counters, doors, and equipment racks so that all equipment is clear of and in proper relation to these items.

c. Mounting, recessing, and concealing cameras, video projectors, video displays, loudspeakers and loudspeaker clusters, and other associated equipment in specially constructed casework and niches.

7. The AVSC will not be paid for work associated with the relocation of equipment, conduits, cabling, or any other materials requiring removal or reinstallation resulting from a lack of coordination prior to installation.

B. Pre-Installation Meetings
1. Arrange in accordance with Section 013119
2. Attendance: AVSC, installer, Owner, Architect, AV Consultant, and those requested to attend.
3. Meeting time: Minimum four (4) weeks prior to beginning work of this Section and work of related Sections affecting work of this Section.
4. Location: Project site.

C. Sequencing and Scheduling
1. Conform to Section 013216 for sequencing and scheduling to meet Progress Schedule Critical Path and long lead items.
2. The AVSC shall schedule its work to prevent conflicts with other activities in the building and shall execute without claim for extra payment moderate moves or changes as are necessary to accommodate other equipment or preserve symmetry and pleasing appearance.

1.05 SUBMITTALS

A. A complete set of submittal documents will include shop drawings, product data, and network device inventory, as described below, and submitted simultaneously for review and comment.

B. Submit under provisions of Section 013300.

C. The AVSC agrees that submittals and shop drawings processed by the AV Consultant are not change orders. The purpose of submittals and shop drawings by the AVSC is to demonstrate to the AV Consultant that the AVSC understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install, and by detailing the fabrication and installation methods he intends to use.

D. The AVSC alone accepts all responsibility for assuring that all materials furnished under this Division of the specifications meet in full all requirements of the contract documents. The AV Consultant's review is for general conformance with the design concept and contract documents. Markings or comments shall not be construed as relieving the AVSC from compliance with the project plans and specifications, nor departures there from. The AVSC remains responsible for details and accuracy for confirming and correlating all quantities and dimensions, for selecting fabrication processes and for techniques of assembly.

E. Submittals and shop drawings that are incomplete or that contain insufficient information will be returned without review, for re-submittal.

F. Shop Drawings:
1. Floor plans, showing the layout of devices, cabling, and wiring within raceway systems. Include the number of cables, type of cables, and size of raceway for each run.
2. Wiring diagrams showing point to point connections between components. Include wire numbers and color-coding for each connection point, with numbers corresponding to those of the wire-run list.
3. Rack panel layout for each equipment cabinet.
4. Scaled and dimensioned drawings of all custom assemblies and fabricated items, including but not limited to the following. Include details of all components, materials, finishes, and colors.
   a. Control panel mounting
   b. Projector and display mounting frames and hardware
   c. Input and output panels, including mounting of panels in casework.
   d. Speaker clusters

5. Preliminary cable numbering lists.

G. Product data:
1. Equipment list based on specified equipment list and other additional equipment or materials needed for complete systems. Include:
   a. Manufacturer
   b. Model number
   c. Descriptions
   d. Quantity
   e. Specification reference
2. Product data by system or room, with brochures and/or catalog cuts for all items of equipment and hardware. Provide as PDF documents downloadable from the project website, on USB memory stick, or on CD/DVD ROM.
3. Provide a single product data sheet for any devices used in multiple rooms.
4. For each item, indicate listing by UL or other approved testing agency. For audio power amplifiers, indicated the NEC Class of output wiring.
5. Printouts from web pages are not acceptable.
6. Itemize variations from the specification in a separate enclosure. Refer to section, paragraph, and item of the specifications and clearly state the variation.

H. Networked Device Inventory
1. Inventory of all network-attached devices in the project. Include:
   a. Device, manufacturer, and model number
   b. Physical location
   c. Default gateway IP address
   d. Addressing scheme
   e. IP address
   f. Subnet mask
   g. Host name
   h. DNS server(s)
   i. Ports required
   j. Transport protocol
   k. Multicast/Unicast
2. Provide Networked Device Inventory in Microsoft Excel 2010 format.

1.06 CLOSEOUT SUBMITTALS

A. Conform to provisions of Section 017700.

B. Maintenance and Operating Data and Instructions to Owner’s Personnel: Conform to Section 017824.

C. The AVSC shall prepare Operations and Maintenance Manuals for each system or facility provided under these specifications. The information included must be the exact equipment installed, not the complete "line" of the manufacturer. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets.

D. The manuals shall contain all the information needed to operate and maintain all systems and equipment provided in the project. It shall be presented and arranged in a logical manner for efficient use by the Owner's operating personnel. The information provided shall include but not be limited to the following:
1. Equipment manufacturers, makes, model numbers, serial numbers, sizes, etc. Include addresses and telephone numbers for each manufacturer. List loose items separately.
2. A copy of the delivery receipt for Loose Items.
3. Description of system configuration and operation including component identification and equipment interconnect diagram.
4. Manufacturers’ recommended operation instructions for each item of equipment.
5. Overall system operating instructions, custom written for this specific project.

6. Warranty Information, including but not limited to:
    a. An overall Statement of Warranty from the AVSC for the complete systems.
    b. A copy of the Manufacturers' warranties for each item of equipment so covered.
    c. Instructions for obtaining warranty service from the AVSC, and from each Manufacturer.
    d. Service manuals for each item of equipment as published by the manufacturers, and other manufacturers' servicing data.
    e. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriate). Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable.
    f. "As-built" Shop Drawings, including point to point wiring diagrams.
    g. "As-built" Cable Numbering Lists.
7. Service manuals for each item of equipment as published by the manufacturers, and other manufacturers' servicing data.
8. Complete parts list including reordering information, recommended spares and anticipated useful life (if appropriated). Parts list shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by equipment supplier not acceptable.
9. "As-built" Shop Drawings, including point to point wiring diagrams.
10. "As-built" Cable Numbering Lists.
11. Copies of all test results. Include the names of the individuals performing and witnessing the tests, and the manufacturer and model of each item of test equipment which was used. Include block diagrams of the test setup for tests which involve more than one item of test equipment.
12. Wiring diagrams for each system shall be complete drawings for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless marked to indicate the exact field installation.
13. Networked Device Inventory
    a. Inventory of all network-attached devices in the project, including:
        1). Device Properties
        2). Manufacturer
        3). Model number
        4). Description
        5). Software version(s)
        6). Firmware version(s)
        7). MAC address
    b. Inter-Device Communication
        1). Transport protocol
        2). Multicast/unicast
        3). Codec
        4). Incoming and outgoing peak bps
        5). Average incoming and outgoing bps
    c. Routing and Addressing
        1). Physical location
        2). Default gateway IP address
        3). Addressing scheme
        4). IP address
        5). Subnet mask
        6). Host name
        7). DNS server(s)
        8). Ports required
14. Provide Networked Device Inventory in Microsoft Excel 2010 format.

E. The information contained in the manuals shall be grouped in an orderly arrangement by specification index. The manuals shall have a typewritten index and divider sheets between categories with identifying tabs. The completed manuals shall be bound in heavy-duty slant-ring binders (3 "D" rings), or with hardboard covers and screw-post bindings. O & M manuals shall not exceed 5" thickness. Provide two or more volumes if required.

The covers shall be labeled with the name of the job, Owner, Architect, Engineer, Contractor, and year of completion. The spine shall be labeled with the name of the job, Owner, and year of completion. Labeling may be laser-printed inserts in clear plastic overlays or imprinting by silk-screening or hot stamping. Include the following information:

1. Project Title
2. Project Number
3. Owner/Operator (Owner's Name)
4. Architect (Architect's Name)
5. Engineer (AEI NW)
6. Contractor
7. Completion Date

F. Submit a preliminary copy 15 days prior to substantial completion of the project for checking and review.

G. Project Record Documents: Conform to provisions of Section 017839.

1. Continually record the actual "as-built" installation on a set of prints kept readily available at the project during construction. These prints shall be used for this purpose alone. At the completion of the work, Contractor shall furnish the Architect a set of reproducible record drawings (Xerox type) and the set of mark-ups. Final payment to the Contractor will not be authorized until these prints have been submitted to and accepted by the Architect.
2. Record drawings shall include, at a minimum, updates of all sheets of the Shop Drawings.

1.07 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer's Qualifications: Firm (material producer) with not less than five years of production experience whose published literature clearly indicates general compliance of products with requirements of this section.
2. Equipment Suppliers: Audio, video, and control components shall be supplied and installed by an authorized factory distributor of specified products. Submit statement of distributorship/dealership prior to acceptance of bid.
3. AVSC Qualifications:
   a. Work in this section shall be performed by an AVSC with the following qualifications:
      1). Complies with the requirements of Division 1.
      2). Is licensed to perform work of this type in the project jurisdiction
      3). Has at least five (5) years of verifiable direct experience with the devices, equipment, and systems of the type and scope specified herein.
      4). Fully staffed and equipped maintenance and repair facility.
   b. The AVSC or their employees shall hold the following certifications:
      1). INFOCOMM CTS-D (Certified Technology Specialist-Design)
      2). INFOCOMM CTS-I (Certified Technology Specialist-Installation)
      3). Video switching and routing system
      4). AV control system programming
      5). Audio DSP Programming
      6). Synergetic Audio Concepts Sound Reinforcement for Technicians
   c. Provide copies of all certifications with bid

d. The AVSC shall be a factory-authorized dealer for the major components specified including items such as microphones, audio processing equipment, power amplifiers, loudspeakers, video interfaces, video switchers and processors, video displays, and integrated audiovisual control system.
e. The AVSC shall appoint a designated supervisor with the appropriate certifications. The supervisor shall be present and in responsible charge of all work in the fabrication shop and on the project site during all phases of the installation and testing of the system(s).
To ensure continuity, this supervisor shall be the same individual throughout the execution of the work unless illness, loss of personnel, or other reasonable circumstances intervene.
f. The AVSC shall use skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this Section. These personnel shall have at least three years direct experience in similar work, evidence of which shall be verified in writing with appropriate references at the time of bid.
g. Other contractors bidding this work who cannot meet the above qualifications must employ the services of a qualified AVSC who meets the above qualifications. This AVSC shall supervise the installation and perform all wiring connections.

B. System Performance Requirements
1. Audio System
a. Systems shall provide clear, natural sound uniformly distributed throughout the listening areas. The entire electro-acoustic system shall be carefully balanced and equalized to provide a high order of intelligibility and gain without feed back or reverberant coloration. Adequate power capability shall be provided to insure the necessary dynamic range and prevent distortion at peak levels.
b. Acoustic Frequency Response: 50 Hz to 15 kHz, 3dB/octave roll-off above 2000 Hz ±2dB. Measured at continuous one-third octave bands at seated ear height.
c. Intelligibility: Greater than 0.75 STI at any exam station.
d. Noise: System noise shall not exceed an equivalent input noise of -120dBu based on a 20 kHz noise bandwidth. Predominant noise component in the system output under any operating condition will be that of the input stages. Adjustment of any system controls shall produce no audible clicks, pops, thumps, or other spurious noises.
e. Acoustic Signal-to-Noise Ratio (including crosstalk and hum at all input/output levels): 60dB.
f. Dynamic Range:
1). General: All systems shall include a 10dB peaking factor to any location at standing ear height and at less than 5% total acoustic harmonic distortion. When the system is driven to maximum output, clipping shall occur first in the power amplifiers.
2). Conference Rooms: The system shall deliver a minimum sound pressure level of 75 dB
g. Total Harmonic Distortion: 0.05% maximum from 20Hz to 20kHz.
h. Polarity: A positive pressure at any system microphone shall produce a positive pressure from the speakers.
2. Digital Video System
a. Audio & Video Switching
1). Provide 12.8 Gbps of backplane throughput to support 1080p 36-bit (Deep) Color video resolutions without compression.
2). Support at least 6.75Gbps of data transfer on each input and output to support 1080p 36-bit (Deep) Color video resolutions without compression.
3). Support 8 channel audio.
4). Support audio breakaway from video.
5). Insert less than 5us of latency from AV input to AV output.

6). Support the HDMI specification of less than 1 in $1x10^{-9}$ bit errors at 1080p 36-bit (Deep) Color.
7). Down-mix multi-channel audio into 2-channel audio to route audio content to both multi-channel and 2-channel sinks.
8). Dither between standard and deep color video signals on each input and output.
9). Support the following AV signal inputs:
    a). HDMI 1.3a (High Definition MultiMedia Interface)
    b). DVI 1.1 (Digital Visual Interface)
    c). Display Port Multimode 1.1
    d). Analog RGB
    e). YPbPr
    f). S-Video
    g). CVBS
    h). SPDIF
10). Analog Stereo Audio
11). Transcode and scale the AV signals to a single signal type for distribution.
12). Support the following digital video formats and data rates (Gbps)
    a). 1080p Deep Color: 6.75
    b). 1600x1200: 4.86
    c). 1920x1200: 4.62
    d). 1080p: 4.44
    e). 1360x768: 2.54
    f). 720p/1080i: 2.22
    g). 1024x768: 1.91
13). Audio & Video Signal Distribution
    a). Route AV signals from any input to any output.
14). Use shielded twisted pair structured cabling to carry the AV signals.
15). Use shielded twisted pair structured cabling specified to 1.2GHz of bandwidth or greater.
16). Transmit the following control signals for AV sources and sinks over the same cable plant:
    a). RS-232
    b). Infrared
    c). Ethernet
    d). USB Human Interface Device-class devices
    e). Contact closure
17). EDID Management
    a). Allow configuration of the EDID presented to sources on each AV input.
    b). Configure each input independently.
    c). Present an EDID to each input that includes only the video timings and audio formats common all sinks connected to the outputs.
    d). Allow the user to enter each input's EDID video timings individually.
    e). Allow the user to enable and disable support for the following items in each input's EDID.
    f). Deep color
    g). 3D support
18). HDCP Management

a). Support HDCP 1.1 or greater.
b). Detect the number of KSVs supported by each source.
c). Cache the KSVs from each connected sink.
19). Signal Detection
a). Report the following incoming signal information to an AV control system:
b). Signal detect
c). Horizontal and vertical resolution
d). Signal refresh rate
e). Presence of HDCP
20). Report the following information to an AV control system:
a). HDCP authentication status for each source and sink
b). EDID Preferred video timing for each sink

C. Control System
1. System shall utilize a remote-controlled switching and processing system for control of audiovisual system components.
2. The system shall provide controls for selecting system on/off, audio and video input selection, audio volume, and signal routing and processing.
3. User Interfaces:
a. The control panel interface layout will conform to the InfoComm International “Dashboard for Controls Design Guide”, published April 2005.
b. Control system user interface conforms to control functions described in Paragraph 1.3. D of this specification.
c. AVSC will coordinate with the Owner and the Consultant on all aspects of design and layout of the user interface for this system.
4. Connections to other systems:
a. All IP-controlled equipment properly configured with IP addresses, host names, time servers, gatekeeper addresses, network configurations, and subnets as applicable. All system connections are operational and devices communicating correctly.
b. All control system programming installed and communicating properly with the equipment as intended.
c. Confirm control system interfaces exist and are functional for devices outside the scope of this section such as activation of lighting control presets, drapes, shades, screens, security, life safety, and HVAC systems.
5. Power Cycling: Confirm the control system will restart and resume full operation following cycling of AC power to the control system.

1.08 SITE CONDITIONS

A. Ambient Conditions: Verify field measurements before beginning fabrication or installation.

1.09 WARRANTY

A. Refer to warranty provisions specified in Section 017836.

B. Manufacturer: Include all provisions of the standard manufacturer’s backed warranty for each piece of equipment and remain in effect for a period as stated by the manufacturer. AVSC shall be an authorized service representative for all equipment supplied as part of this project unless appropriate approval from owner has been granted prior to equipment procurement or installation. The warranty shall also cover the accuracy of technical documentation, and signal quality as specified and documented during the testing process of this project.

C. AVSC: Guarantee all work installed under this specification. Make good, repair, or replace, at the Contractor's own expense, any defective work, materials, or parts which may show themselves within one year after final acceptance, if in the opinion of the Architect or Engineer said defect is due to imperfection in material, design, or workmanship.

D. During the warranty period, respond to any warranty calls within four hours of having received and logged any requests for service.

E. Special Warranty: Provide the cost of an additional one-year warranty beyond what is described in this specification.

PART 2 PRODUCTS

2.01 GENERAL

A. Quality of Materials and Equipment
1. All materials and equipment supplied by the Contractor shall be new and shall meet or exceed the latest published specification of the manufacturer in all respects.
2. At the time of submittal, the Contractor shall supply the latest model for each piece of equipment.
3. All equipment shall be UL listed, or equivalent.

B. Manufacturer:
1. All accessories, including rack mounting hardware, power supplies, etc., shall be obtained from the original equipment manufacturer. Unless otherwise noted or specified, third party accessories shall not be used.
2. Do not provide an assortment. For each category, provide products of the same manufacturer; for each item, provide the same model for all pieces.

C. Substitutions:
1. No substitutions will be allowed.

D. Product Options:
1. Where these specifications include model or series numbers, the provided equipment shall meet or exceed the manufacturer's published specifications for the specified model or series the same as if the manufacturer's published specifications were enumerated within these project specifications.
2. This requirement is in addition to the other requirements given in the project specifications.
3. This requirement is not intended to apply to characteristics (such as color or appearance) which do not affect the performance, function, or reliability.

E. Owner-Furnished or Owner-Supplied Equipment
1. The AVSC, as needed, shall be responsible for removing and/or obtaining OFE equipment from the Owner's location and transporting it to his shop. At the AVSC's facility, he shall ascertain that the OFE equipment is performing at or above factory specifications.
2. If the equipment is not operating "as-new" or is missing accessories necessary to properly integrate the equipment into the system as intended, the AVSC shall provide a proposal, including a timeline, for returning the equipment to "as-new" condition and providing the needed accessories.

2.02 EQUIPMENT SCHEDULE

A. Refer to the attached Equipment Schedule, 274100.1.

2.03 EQUIPMENT RACKS

A. Provide hardware as required for standard 19" rack mounting of equipment.
1. Equipment that does not include manufacturer-provided rack hardware shall utilize a factory-made rack-mount kit such as manufactured by Middle Atlantic Products.

2.04 POWER DISTRIBUTION

A. Provide plug strips or plug mold as required to connect AC power to all associated equipment in racks, equipment consoles and custom mounting enclosures. Provide a minimum of one plug strip or plug mold per rack.

B. Provide DC power supplies or power distribution devices, with appropriate voltage and power requirements, for all equipment not provided with an integrated IEC receptacle.

C. Where applicable use rack manufacturer part or plug strip kit.

2.05 POWER OVER ETHERNET

A. All cable and connecting components that comprise the TIA horizontal cabling “Permanent Link” from Horizontal Cross-connect to Telecommunications Outlet shall be compliant with the applicable requirements for “DTE Power via the MDI” to provide at least [25.5W][51W][71W] at the Powered Device as defined by the [IEEE 802.3at][IEEE 802.3bt] standard.

B. Cabling shall be UL-LP listed at a minimum of 0.5A.

C. Connecting hardware shall comply with IEC 60512-99-[002][001] for engaging and separating connectors under electrical load and connectors used in twisted pair communication cabling with remote power.

2.06 CABLE

A. Refer to the attached schedule, 274100.2: Cables and Connectors

B. Provide wire and cables which are UL-listed and marked for their Class of wiring, per NEC.

C. Trade numbers shown are for general-purpose cables for use in raceway and where otherwise allowed by NEC and other codes. Prior to installation, the AVSC shall verify, for each installation situation, with the local authority having jurisdiction that non-plenum and non-riser rated cables are acceptable. If plenum or riser-rated cables are required, provide cables so rated with equivalent electrical characteristics to those specified below.

PART 3 EXECUTION

3.01 GENERAL

A. Conform to manufacturer’s instructions and provisions of Contract Documents. Where in conflict, assume requirements that are more stringent and verify with Architect before beginning work.

3.02 EXAMINATION

A. Verification of Conditions: Verify conditions as satisfactory to receive work of this Section before beginning.

3.03 INSTALLATION

A. In the installation of equipment and cable, consideration shall be given not only to operational efficiency, but also to overall aesthetic factors.

B. Equipment Mounting
   1. Equipment (except portable equipment) shall be firmly held in place. Fastenings and supports shall be adequate to support their loads with a safety factor of at least three. Equipment shall be braced for seismic conditions according to applicable codes and regulations.
   2. Rack-mounted equipment:
      a. Install vent panels between amplifiers.
      b. Install blank panels to fill any unused rack spaces.
      c. Mount mixers, controls, and patch panels at working height.
      d. Within racks, install cables and wiring neatly, forming straight lines and smooth corners. Bundle separately, or install in separate plastic ducts, the microphone, line-level audio, speaker, control, video, and power wiring.
   3. Loudspeakers:

a. Do not support speaker enclosures with lay-in tiles or GWB. Provide adequate support (using attachments to structural elements and/or metal mounting bars) for back-boxes so that no perceptible sag will occur once speaker and grille are mounted. Assume a loudspeaker weight of 10 pounds, at a minimum.
b. Caulk enclosures to ceiling surface (e.g. lay-in tile or GWB) to form an airtight seal.
c. Verify polarity of each speaker voice coil prior to installation and connect to maintain uniform polarity.
d. Tap 70-volt transformers as shown, or to provide an amplifier load between 60% and 90% of rated capacity with all speaker-line attenuators (if any) set for minimum attenuation.
e. Install speaker and baffles to provide tight seal with ceiling and enclosure. Do not caulk baffle to ceiling.
f. Install so speaker grille is centered in tile or building element, with sides of grille or line between mounting fasteners parallel to ceiling grid or building lines.

C. Raceway
1. Install wire and cable only within raceway systems. Do not install wire or cable in wall cavities or ceiling plenums/attic spaces without the use of raceway (conduit or cable tray), without the explicit written permission of Owner, or as otherwise noted on the drawings.
2. Maintain conduit fills equal to or less than those given by Table 1 of Chapter 9 of the NEC, regardless of the class of wiring.

D. Cable Installation
1. Install wire and cable only within the raceway systems provided under Division 26. Do not install wire or cable in wall cavities or ceiling plenums/attic spaces without the use of raceway (conduit or cable tray) unless otherwise noted on the drawings.
2. Maintain conduit fills equal to or less than those given by Table 1 of Chapter 9 of the NEC, regardless of the class of wiring.
3. Use only cable lubricants that are compatible with the jacket materials.
4. Upon completion of pull, clean exposed cables, and surfaces to be completely free of lubricant and residue.
5. Protect installed conductors from painting, overspray, and taping or patching compounds.
6. Cable splices are allowed only in accessible junction boxes, using insulated crimp-on connectors, soldering covered with heat shrink, or other methods approved by the Engineer.
   a. Do not splice in conduits or cable tray.
   b. Splicing with wire nuts is prohibited.
7. Install cables and wiring neatly, forming straight lines and smooth corners, without deformation, kinks, scrapes, or cuts of the jacket or insulation.
   a. Maintain the minimum bend radius of cables as recommended by the manufacturer.
   b. Do not use cable ties in the cable tray or overhead junction boxes, except where otherwise shown or otherwise directed in writing by the Engineer.
   c. Do not cinch cable ties tightly; leave loose enough so each cable can be easily moved through the cable bundle. There should be no deformation of the outer cable jacket.
   d. Where installed without raceway, support cables with D-rings or J-hooks at minimum intervals of 24”. Do not put J-hooks at equal distances; space randomly.
   e. Where bundles are subject to flexing, enclose bundle with nylon webbing or spiral wrap; do not use cable ties.
   f. Where cables are installed vertically, provide support at regular intervals. Maximum distance between supports shall not exceed 80 percent of the manufacturers' recommended maximum vertical drop, or 50% of the recommended maximum pulling tension, whichever is less.
   g. At a minimum, support cables at each floor with clamping strain relief.

8. Cable assemblies run in conduit and/or cable trays should provide for a minimum of five (5) feet of excess cable on each end to allow for relocation of equipment or re-termination of cable in the future.

E. Signal Separation:
1. All AV system cables shall be grouped according to the signals being carried and installed in separate raceways. To reduce signal contamination, separate groups shall be formed for the following cable families:
   a. Audio cables carrying signals less than – 20dBm (microphone circuits)
   b. Audio cables carrying signals between – 20dBm and +20dBm (analog line-level circuits)
   c. Audio cables carrying signals above +20dBm (including Class 1 and Class 2 loudspeaker circuits)
   d. Analog video and broadband CATV cables
   e. Digital audio, video, network, or telephone cables
   f. Power and lighting cables
   g. Control cables
2. Minimum separation from other circuits:
   a. From power and switched lighting circuits: at least 24”.
   b. From dimmed lighting circuits: at least 48”.
   c. Where runs are adjacent for less than 80 ft, the required spacing may be halved 12”, or 24” from dimmed lighting circuits.
   d. Where runs are adjacent for less than 6 ft, or where circuits cross at right angles, separations of 2” may be used.
   e. Where AV circuits cross or intersect with power or lighting circuits, cross at 90 degrees (plus or minus 2 degrees) to the greatest extent possible.

F. Rack Cable Installation
1. Equipment and rack cabling will be performed in compliance with AVIXA Standard F502.01:2018 – Rack Building for Audiovisual Systems.

G. Connections and Terminations
1. Prior to connection, verify freedom from shorts or grounds of all conductors (including shields and drain wires) of all cables.
2. All cables shall have proper connector housing.
3. All AV system wire, after being cut and stripped, shall have the wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means.
4. Serve shielded cables with heat shrink tubing to insulate shield and drain wire. Unused wires at the end of a cable shall remain un-stripped and shall be laid back and held in place with wire ties.
5. Make connections to plugs, receptacles, connectors, or solder terminals with rosin-core solder using temperature-controlled solder stations.
6. Ensure that no un-insulated wire is exposed beyond its pin.
7. Utilize only multi-core flux resin with 60/40 tin-lead non-corrosive construction, designed for electronic equipment use.
8. Soldering shall utilize good engineering practices and completed solder connections shall appear shiny and smooth with no visible imperfections, cracks, or cold-solder joints.
9. Make connections to screw connections using insulated spade lugs or Phoenix-style connector blocks. Ensure that no un-insulated wire is exposed beyond its pin.
10. For all crimp-type connectors and pins, utilize only crimp tools rated for the crimp pin type, size and wire gage being assembled. Consult the manufacturer’s specifications and recommendations for crimping.
11. Utilize only gold-plated crimp pins.

12. If a signal path requires that the signal pass through more than one device, each device must have looping input capability, or a distribution amplifier must be used to feed the signal to the devices. Do not use a video "T" in place of a video distribution amp to route signals to more than one device.
13. All audio circuits shall be balanced (high, low, shield) except where otherwise indicated. Where cable runs between equipment exceed 20 feet, balance boxes shall be used to convert unbalanced circuits to balanced circuits.
14. Wire all three and five pin audio connectors and quarter-inch phone jacks (mono and stereo) in accordance with IEC-268.
    a. For three pin connectors, Pin 1 is ground, Pin 2 is positive, and Pin 3 is negative.
    b. For five pin connectors, Pin 1 is ground, Pin 2 is left positive, Pin 3 is left negative, Pin 4 is right positive, and Pin 5 is right negative.
    c. For quarter-inch stereo phone jacks, Tip is positive, Ring is negative, and Sleeve is ground.
    d. For quarter-inch mono phone jacks, Tip is positive, and Sleeve is ground.
15. The strain relief of the connector shall fully engage cable jacket.

H. Cable Labeling
1. Label all cabling in conformance with INFOCOMM Standard F501.01:2015, Cable Labeling for Audiovisual Systems.

I. Grounding and Shielding
1. Rack Grounding:
    a. Install a single-point grounding system for each system. Where multiple systems are installed in a single grouping of racks, they shall be considered one system for grounding purposes.
    b. Verify integrity of grounding systems and isolated receptacles prior to connection of equipment.
    c. Prior to installing or connecting equipment, temporarily disconnect ground wires (installed under Division 26) from equipment cabinet(s), and measure impedance between each ground wire and its cabinet. Verify electrical isolation (minimum resistance of 1 Megohm) between rack cabinets and raceway and conductive structure. Record results for test report. Reconnect ground wires.
2. Connect shield and grounding conductors as follows:
    a. Connect shields of microphone wiring to receptacle and patch panel common.
    b. Insulate shields from connector shell, plates, boxes, and raceway.
    c. Connect shields of wiring from patch panel to control console inputs only to control console (insulate at patch panel).
    d. Connect shields of balanced line level circuits at patch panel only; insulate at the opposite end of the cable. For balanced circuits that do not terminate at patch panels, connect shields at input ends only; insulate at output ends. Use this standard as needed to correct ground hum issues.
3. Maintain shield and drain wire continuity through junction boxes and intermediate termination points. Insulate shields from raceway or other conductive building elements. Maintain shields to within 3 inches of connected devices and maintain twisting of pairs of wires to within 1/2 inch of connector or device termination.
4. Make any modifications to grounding and shielding which are necessary to eliminate extraneous noise and RFI, prevent parasitic oscillations, and other signal instabilities, and to meet overall systems noise specifications. Record any deviations from the above guidelines, and the reasons that each deviation was deemed necessary.
5. Do not remove or defeat grounding terminal of 3 conductor power cords and maintain safety grounding and bonding as required by the NEC.
6. The overall governing requirements are that the wiring systems shall not induce or pick up perceptible noise, and that the predominant components of the noise floor of all signal paths shall be normal "thermal" noise of the upstream devices.

7. Because of the great number of possible variations in grounding systems, it shall be the responsibility of the AVSC to follow good engineering practice, as outlined above, and to deviate from these practices only when necessary to minimize crosstalk and to maximize signal-to-noise ratios in the audio, video, and control systems.

J. Cutting Building Construction
   1. Obtain permission from the Architect or Owner and coordinate with other trades prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills or concrete saws except where space limitations prevent the use of such tools.
   2. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that building trade.

K. Penetrations of Fire Rated Elements
   1. Must be provided such as to retain that rating.

L. Painting
   1. The AVSC will repaint or arrange to repaint existing building components such as walls, frames, etc. which are scratched or marred by the AVSC during installation.
   2. The AVSC will repaint or refinish equipment, loudspeaker grilles, microphones, or other AV system components which are scratched or marred by the AVSC during installation.

3.04 SYSTEM START-UP

A. System Start-Up: Conform to provisions of Section 017500.

3.05 SYSTEM TESTS AND ADJUSTMENTS

A. Inspect and adjust after installation.

B. Repair or replace defective equipment or installations.

C. Testing and adjustment of equipment shall be performed by qualified technicians with general knowledge of video and audio systems alignment and trouble shooting, and knowledge of specific equipment and systems in this project.

D. Manuals: All manufacturers' maintenance or alignment manuals shall be present during testing and adjustment procedures.

3.06 TEST EQUIPMENT

A. Test Equipment:
   1. Test equipment shall be in good mechanical and electrical condition.
   2. Non-professional test equipment or home-built kit equipment is not acceptable.
   3. This list constitutes the minimum instrumentation required to perform the tests in the checklists and does in no way imply a comprehensive list for engineered AV systems testing. Additional instrumentation may be required to verify performance on an item of equipment, or to quantify environmental and other issues to expedite corrective actions by others.
      a. Sensitive AC voltmeter, -80 dBu sensitivity, 20-30 kHz response, able to measure signal to noise ratio, THD, electrical audio levels within the system. Note that some systems require measurements up to 100 volts and may require an external pad.
      b. Sound pressure level meter, ANSI Type II, with A and C weighting filters, fast or time-averaged.
      c. Audio signal generator, 20-30 kHz, sine wave, pink noise.
      d. Amplified loudspeaker 100 mm producing 60 dBA at one meter, and 70 dBA at one-meter, pink noise, sine wave, speech files.
      e. 200 MHz oscilloscope, with TV sync.
      f. Analog video signal generator NTSC/PAL, plus computer patterns at all required resolutions and refresh rates required for the systems under test. For systems with composite video, include PLUGE pattern.

g. Digital video signal generator for computer patterns for all resolutions and refresh rated required for the systems under test, HDMI/DVI.
h. The ability to measure STI-PA (source and analyzer).
i. Colorimeter/luminance meter, 10% accuracy.
j. Infrared thermometer.
k. Test media with known levels (audio, video, etc.): CDs, VHS, DVDs, etc.
l. AC/DC multimeter.
m. Light meter, lux/foot-candles.
n. Outlet tester (to test power outlet wiring).
o. Cable sets, cable assemblies, adapters as required to sample and measure in or out of circuit as required.
p. Patch and jumper cables
q. Reference standards required for testing
r. Software to adjust remotely controlled signal processors, with necessary computer and related hardware. Provide enough cabling to permit controlling computer to be in loudspeaker service areas while signal processors remain in equipment cabinets.

B. Test Instrument Calibration
1. Testing firm shall have calibration program which assures test instruments are maintained within rated accuracy.
2. Accuracy shall be directly traceable to the National Institute of Standards and Technology (NIST).
3. Instruments shall be calibrated in accordance with the following frequency schedule:
a. Field instruments: Analog, 6 months maximum: Digital, 12 months maximum.
b. Laboratory instruments: 12 months.
c. Leased specialty equipment: 12 months where accuracy is guaranteed by lessor.
4. Dated calibration labels shall be visible on test equipment.
5. Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
6. Up-to-date instrument calibration instructions and procedures shall be maintained for test instrument.
7. Calibrating standard shall be of higher accuracy than instrument tested.

3.07 MEASUREMENTS AND PERFORMANCE TESTING

A. Verify that the systems are in conformance with the performance criteria in Section 27 41 00 – Audiovisual Systems, paragraph 1.9.B and 1.9.C.

B. Work Includes:
1. Provide all test equipment necessary for system checkout and acceptance tests.
2. Perform initial system testing and adjustment as herein prescribed.
3. Prepare and submit Audiovisual System Testing Report. Use 27 4100.3 – Audiovisual Systems Commissioning Checklist.
4. Participate in and assist with operational system commissioning as herein prescribed.

C. Successful completion of tests and inspections shall determine suitability for first beneficial use by the Owner.

D. Systems to be inspected and tested:
1. Sound systems, including:
a. System inputs and outputs
b. Wired microphone systems
c. Audio program sources
d. Preamplifiers, mixers, analog signal processors, and digital signal processors
e. Audio signal distribution network
f. Distribution amplifiers and power amplifiers
g. Loudspeakers
h. Recording equipment

2. Video presentation systems, including:
    a. Video program sources
    b. Video switchers and routers
    c. Video signal processing equipment
    d. Video distribution equipment
    e. Video displays and projection systems
3. Audiovisual control systems
    a. Control system network
    b. Control system processors
    c. Control system interface panels
    d. Control system software interfaces

E. The AVSC shall:
1. Coordinate testing schedule with Construction Manager, Owner, and Engineer.
2. Notify Owner and Engineer two weeks before testing.
3. Perform initial system testing and adjustments.
4. Prepare test results with comparison to specified performance and technical requirements, industry standards, and manufacturer's values and tolerances.
5. Assure system equipment is installed in accordance with contract documents, is operational, and within industry and manufacturer's tolerances.
6. Participate in and assist with systems acceptance testing.
7. Assure suitability for operation.

F. The Engineer shall:
1. Participate in and assist with systems acceptance testing.
2. Recommend acceptance or rejection of the installed systems prior to final completion.

G. The Construction Manager/Owner shall:
1. Ensure facilities are ready for the work described in this section.
2. Participate in and assist with systems acceptance testing.

H. Preliminary Systems Testing and Adjustment Report
1. Provide one copy of preliminary testing report in Acrobat PDF format. Test report shall include the following:
    a. Signed statement on Contractor's letterhead that preliminary systems testing, and adjustment has been completed and the system is ready for acceptance testing by the Engineer.
    b. Completed AV Systems Commissioning Checklist for each system or room.
    c. Recorded measurements of all systems.
    d. List of equipment used to perform tests. Identify the following:
        1). Type
        2). Manufacturer
        3). Model number
        4). Serial number
        5). Date of last calibration
        6). Documentation of calibration leading to NIST standards
    e. Name(s) of personnel performing tests
    f. Signature of project manager responsible for performance and oversight of system testing and adjustments.
2. Provide completed reports to Engineer no later than 10 days after completion of checklists, testing, and adjustments unless otherwise directed.

I. Audio:
1. Verify that the system is completely free from hum, noise, parasitic oscillation, and RFI.

2. Measure and record the impedance of each speaker load at the main junction box or rack cabinet and total load on each amplifier. At a minimum, make measurements at 100, 1000, and 10,000 Hertz. Make corrections as required so that the load impedance of each loudspeaker circuit is equal to or greater than rated load impedance of the amplifier.
3. Verify that positive pressure at any microphone produces positive pressure from each loudspeaker. Verify that signal polarity is correct and consistent for all circuits and paths. Reverse polarity if required, and record which circuit was reversed.
4. With signal processors in bypass mode, adjust gain controls so all components except power amplifiers reach rated nominal output simultaneously. For components which have rated maximum outputs between 18 and 25dBm and line level inputs, adjust each component for unity gain.
5. Set audio distribution amplifiers for unity gain unless otherwise specified by the Engineer. Record final settings of each unit.
6. Adjust power amplifier input attenuators so power amplifiers reach clipping at 10dB above 0VU on the mixing console output meter.
7. Re-adjust gains if required for proper operation of each system and component. Measure and record any such re-adjustments; also record the reason adjustment was deemed necessary.
8. Measure and record the electronic signal-to-noise ratio of each complete signal path with all microphone inputs at full gain, or at gain settings which correspond to the onset of ringing for a single microphone, whichever is lower gain, and other controls at normal settings. During test, terminate microphone receptacles with 200-ohm resistors.
9. Adjust bandwidth, filter slopes, time offset correction, and signal levels of each crossover. Measure and record final settings of each unit.
10. Adjust equalizers to optimize the specified frequency responses. Measure and record the electronic frequency response and the acoustic frequency response of the system before and after adjustments.
11. Adjust automatic mixers, automatic level controllers, and other signal processors to optimize use of microphones for speech.
12. Measure and record the impedance of each speaker load at the main junction box or rack cabinet and total load on each amplifier. At a minimum, make measurements at 100, 1000, and 10,000 Hertz.
13. Make corrections as required so that the load impedance of each loudspeaker circuit is equal to or greater than rated load impedance of the amplifier.
14. Slowly sweep all low frequency and full range speaker systems with sine waves at 25% of rated maximum amplifier power output, or at 50% of rated continuous power capacity of loudspeakers, whichever is less, from 20 Hz to 20 kHz. Observe for audible or perceptible vibration or rattling of speaker components, mounting apparatus, or building elements. Under this Section, correct vibration or rattling of speakers or mounting apparatus to the satisfaction of the Engineer. Report vibration or rattling of other building elements to the Engineer; include frequency, characterization of observed rattling or vibration, and recommendations for correcting the rattling or vibration in the report.
15. Verify speech intelligibility specified in this section. Perform tests with the measuring microphone at the seated ear height of the audience All interior finishes and furnishings shall be in place during measurements.
16. Make the above measurements for all loudspeaker systems.
17. Set gain of initial input stage to match nominal output level of program sources (Microphones, program sources, etc.)

J. Digital Video
1. Demonstration and acceptance tests shall be done by a Crestron DMC-E Certified Engineer.
2. Verify the AV switching equipment has been installed and configured correctly. Measure and record the following information in electronic format:
   a. Number of HDCP KSVs “Keys” supported by each source

b. Video timing, HDCP use, and audio format of each source when operating
c. Video timings and supported audio formats for each connected sink
d. Video timings and supported audio formats presented in the EDID to each source. The preferred video timing shall be indicated.
e. Cable length on all shielded twisted pair cable used for AV distribution
f. Data rate supported by each shielded twisted pair cable used for AV distribution

K. Control Systems
1. Verify all systems connections are operational and devices pass signal as specified.
2. Audio and video network devices: Verify all IP-connected signal processing equipment is properly configured with IP addresses, gatekeeper addresses, network configurations, and subnets as applicable.
3. Control system network devices: Verify all IP-connected signal processing equipment is properly configured with IP addresses, gatekeeper addresses, network configurations, and subnets as applicable.
4. Control system communications: Confirm all control system programming installed and properly communicating with intended equipment or systems.
5. Control system user interface:
a. Confirm user interface conforms to user or specified requirements.
b. Confirm all pages and buttons operate as intended.
6. Control system power cycling and recovery: Confirm control system will restart and resume full operation following cycling of AC power to the control system.
7. Document results of all system testing.

3.08 SYSTEM ACCEPTANCE TESTING

A. When the work is complete and ready for Acceptance Testing, notify the Architect and the Consultant in writing. Include copies of final inspection certificates.

B. Include:
1. Letters from the AVSC and all AV Subcontractors, on their respective letterheads, certifying that the AV systems are substantially complete, fully tested and adjusted, fully operational, and ready for inspection, final testing, and tuning.
2. Preliminary audiovisual systems commissioning checklist.
3. Digital photographs of the completed installation. Include photographs of:
a. An elevation view of the front wall of each room equipped with projection screen(s), showing the screen, loudspeakers, and other system elements.
b. A view of each equipment room, showing the equipment racks, backboards, terminal cabinets, and other installed materials.
c. An elevation view of each equipment rack cabinet taken with the front door (if any) fully open, and a view of the interior of each equipment rack cabinet.
d. A view of each type of wall-mounted device, including cameras, monitors, control panels, etc.
e. A view of each type of ceiling-mounted device, including loudspeakers, etc.
f. Close-up views of each type of input panel and output panel.
g. Close-up views of each type of floor box/pocket with the covers open, and with the covers closed.
h. Professional photographs are not required; color snapshots with minimum size of 3” x 5” is acceptable. Photographs shall be legible, well lighted, and well-focused, and composed to fill the image with the intended subject as much as possible.
4. List of discrepancies and corrective action taken.

C. Acceptance Testing
1. The Engineer will schedule a site visit once the AVSC’s Completion Report has been submitted and approved. Allow at least 10 calendar days between receipt of Completion Report by Engineer and the earliest desired date for the site visit by Engineer. The AVSC is encouraged to communicate informally with the Engineer prior to submission of Completion Report to coordinate the scheduling of the Engineer’s site visit.

2. The AVSC will assist the Engineer in performing acceptance tests, equalization, and other system adjustments.
3. The AVSC will assist the Engineer in making final tests, equalization, and other adjustments. This shall include listening and viewing tests, including subjective tests by observers and various positions, under various operating conditions.
4. All final, as-built drawings, run sheets, manuals, and other required documents shall be on hand.
5. Manuals: All manufacturers' maintenance, service, and alignment manuals shall be present during testing and adjustment procedures.
6. System Acceptance Tests will be supervised by the Engineer and will consist of the following:
    a. A physical inventory will be taken of all equipment on site and will be compared to equipment lists in the contract documents.
    b. The operation of all system equipment shall be demonstrated by the AVSC.
    c. The operation of the control systems/touch panels will be reviewed for acceptance by the Owner.
    d. Listening and viewing tests, including subjective tests by observers at various positions, under various operating conditions.
    e. A random verification of measurements submitted with the audiovisual systems commissioning checklist.
    f. Final adjustments to signal processors and system gain settings.
7. The Contractor shall provide on-site personnel who performed the installation and testing.
8. Contractor shall make any adjustments, including but not limited to re-wiring of speaker taps, resetting of gain controls, changes in shielding or grounding, and minor changes in wiring and termination, which are deemed necessary by the Engineer. Such work shall be included in the base bid contract amount.
9. Make any adjustments, including but not limited to re-wiring of speaker taps, resetting of gain controls, changes in shielding or grounding, and minor changes in wiring and termination, which are deemed necessary by the Engineer. Such work shall be included in the base bid contract amount.

3.09 CLEANING

A. Leave installations clean and premises free from residue and debris from work of this Section.

B. Waste Management:
    1. AVSC shall continually remove debris, cuttings, crates, cartons, etc., created by his work. Perform clean up daily to eliminate hazard to the public, other workmen, the building, or the Owner's employees. Before acceptance of the installation, AVSC shall carefully clean cabinets, panels, lighting fixtures, wiring devices, cover plates, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.
    2. Remove dirt and debris from the interior of enclosures, outlet boxes, pull and junction boxes, and equipment cabinets.
    3. Clean equipment to remove plaster, taping or patching compound, overspray, paint spills, oil, grease, dust, fingerprints, or other dirt or contaminants to restore equipment to original finish and condition.

3.10 CLOSEOUT ACTIVITIES

A. Demonstration
    1. After substantial completion of the work and after all tests and final inspection of the work by the AV Consultant, the Contractor shall demonstrate the systems and instruct the Owner's designated operating and maintenance personnel in their operation and maintenance. The Contractor shall arrange scheduled instruction periods with the Owner. The Contractor's representatives shall be superintendents or foremen knowledgeable in each system, and suppliers' representatives when so specified.

B. Training

1. At the completion of installation, submit a written request to the Owner to schedule the training sessions, at least two weeks in advance of the requested dates.
2. At a minimum, provide the following sessions of training for systems users, covering operations. Each session shall be for at least the specified number of hours and number of attendees per session.
   a. General Operations: at least one session for operations and management staff.
   b. Technical Operations: at least two sessions for AV technical staff, covering detailed operations and maintenance.
3. At least one of each type of class (as selected by Owner's representative) shall be video-taped by the contractor, with copies of tapes turned over to the Owner's representative as part of the O&M manuals.
4. All maintenance and operational aspects of the systems shall be described and demonstrated to personnel selected by the Owner. The sessions shall be conducted by a representative thoroughly familiar with the characteristics of the system. O&M manual information regarding the system shall be submitted to the Owner prior to scheduling the instruction session. The training session should cover the following areas:
   a. General operation of all systems and functions.
   b. Explanation and orientation of all technical documentation.
   c. Explanation of signal flow including all signal paths through routing switchers and patching.
   d. Basic system troubleshooting and preventive maintenance.
   e. Explanation of system warranty and process for owner to follow during system malfunctions to obtain customer support from the AVSC.

3.11 ATTACHMENTS

A. Schedules
   1. Section 27 41 00.1 – Audiovisual Systems Equipment Schedule
   2. Section 27 41 00.2 – Audiovisual Systems Cable Schedule
   3. Section 27 41 00.3 - Audiovisual Systems Commissioning Checklist

END OF SECTION

SECTION 27 4100.1
AV EQUIPMENT SCHEDULE
CLINICAL ASSESSMENT LAB

Eqpt. ID	Mfg.	Model #	Description	QTY	Notes
DISPLAY/PROJECTION					
MON/3	FBOIC		Exam Room Monitor	6	FBOIC
	FBOIC		Mounting Arm	6	FBOIC
VIDEO					
CAM/1-6	Axis	P3245-LV	H.264 Network Camera	6	FBOIC
SMD/1-6	Extron	SMD 101	H.264 Streaming Media Decoder	6	
	Extron	RSU 126	Rack Shelf	3	
AVS/1	Extron	60-1546-012957	12x8 XTP System	1	
	Extron	XTP II Crosspoint 3200 Frame	32x32 Mounting Frame	1	
	Extron	XTP II CP 4i HD 4K PLUS	4-port HDMI Input Module	2	
	Extron	XTP CP 4i 4K	4-port XTP Input Module	2	
	Extron	XTP II CP 4o HD 4K PLUS	4-port HDMI Output Module	1	
	Extron	XTP CP 4o 4K	4-port XTP Output Module	2	
	Extron	XTP Matrix Blank Plate	Blank Plate	9	
SMP/1,2	Extron	SMP 351	H.264 Streaming Media Processor - 80GB SSD	2	
	Extron	Link License	SMP 300 Panopto Features	2	
PC/1,2			Desktop PC	2	FBOIO
	Matrox	Mura IPX	Video Capture Card	2	FBOIO
			Dual NIC	2	
			Keyboard & Mouse	2	
			Video Monitor	4	
TPX/1,2	Extron	XTP T HD 4K	XTP Transmitter	2	
	Extron	MBU 125	Undertable Mount	2	
TPR/1-6	Extron	XTP R HD 4K	Twisted Pair Receiver	6	
	Extron	PS 1215C	Power Supply	6	
	Extron	ZipClip 400	Mounting Bracket	6	
AUDIO					
HS/1,2	Logitech	H390	Microphone/Headset	2	
DAS/1	Extron	DMP 128 Plus C AT	Digital Audio Server	1	
DASE/1	Extron	DMP 128 FlexPlus C AT	Digital Audio Server Expander	1	
AMP/1	Extron	XPA U 358-70V	8-Ch. Audio Amplifier	1	
S1	Extron	SF 26CT	Ceiling Speaker	6	
	Audinate	DVS-TK-001	Dante Virtual Sound Card	2	
CONTROL/MISC					
CNS/1	Cisco		Clinical Network Switch	1	FBOIO
	Cisco		FO SFP Link Module	1	FBOIO
MC/1	Extron	IPCP Pro 250	Master Control Processor	1	
	Extron	RSU 126	Rack Mount Kit	1	
CP/1	Extron	TLP Pro 1025T	Control Panel	1	
AVP/1	AVSC		Custom AV Interface Panel	2	
AVP/2	AVSC		Custom AV Interface Panel	7	
BASEBUILDING AV					

END OF SECTION

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SECTION 27 4100.2
AV MASTER CABLE SCHEDULE

SIGNAL	DESCRIPTION	MFG.	NON-PLENUM	Rating	Diameter		PLENUM	Rating	Diameter		MATING CONNECTORS		
Audio				NEC	(Inch)	(mm)		NEC	(Inch)	(mm)	Balanced	Unbalanced	BNC	F-Conn
Balanced or Unbalanced	2C#22, STP	BELDEN	9451	CMR	0.135		9451P	CMP	0.127		NC3FX, NC3MX, NP3X-BAG	NP2X-BAG, NF2C-B/2		
Balanced or Unbalanced	2C#22, STP, Stereo Pair	BELDEN	9451D	CMR	0.135		9451DP	CMP	0.127		NC3FX, NC3MX, NP3X-BAG	NP2X-BAG, NF2C-B/2		
Loudspeaker	2C#18	BELDEN	5300UE	CMR	0.158		6300UE	CMP	0.154					
Loudspeaker	2C#16	BELDEN	5200UE	CMR	0.180		6200UE	CMP	0.176					
Loudspeaker	2C#14	BELDEN	5100UE	CL3R	0.218		6100UE	CL2P	0.218					
Loudspeaker	2C#12	BELDEN	5000UE	CL3R	0.260		6000UE	CL2P	0.252					
Loudspeaker	2C#10	BELDEN	5T00UP	CL3	0.356		6T00UP	CL3P	0.308					
Video														
Analog/SDI	Miniature RG/59U	BELDEN	1855A	CM	0.159		1855P	CMP	0.159				1855ABHDL	
Analog/SDI	Miniature 5C RG/59U Snake	BELDEN	7789A	CMR	0.539								1855ABHDL	
Analog/SDI	RG/59U	BELDEN	1505A	CM	0.233		1506A	CMP	0.196				1505ABHDL, 1506ABHDL	
Analog/SDI	5C RG/59U Snake	BELDEN	7796A	CM	0.790								1505ABHDL	
Analog/SDI	RG/6U	BELDEN	1694A	CM	0.274		1695A	CMP	0.235				1694ABHDL, 1695ABHDL	
Analog/SDI	5C RG/6U Snake	BELDEN	7712A	CM	0.970								1694ABHDL	
Analog/SDI	RG/11U	BELDEN	7731A	CMR	0.400		7732A	CMP	0.348				FS11BNC	
CAT 5e	24 AWG, SOLID, 4-PR BONDED UTP	BELDEN	1700A	CMR	0.166		1701A	CMP	0.195		100 011LW			
CAT 6	23 AWG, SOLID, 4-PR BONDED UTP	BELDEN	1872A	CMR	0.365		1874A	CMP	0.365		100 011LW			
Low Skew Cable	23 AWG 4 Pair UTP Low Skew Video Cable	BELDEN	7988R	CMR	0.204		7988P	CMP	0.193		301602			
Low Skew Cable	23 AWG 4 Pair UTP Low Skew Video Cable	EXTRON	22-141-03	CMR	0.280		22-142-03	CMP	0.240		100 011LW			
DBS/Satellite	RG-6 18AWG Solid BC Dual Shield	BELDEN	1829AC	CATV, CM	0.270									DB6U
CATV	RG-6 18AWG Solid Dual Shield	BELDEN	9116	CATV, CM	0.270		9116P	CATVP, CMP	0.235					DB6U, DB6PL2
CATV	RG-6 18AWG Solid CCS Quad Shield, 3.0GHz	BELDEN	1189A	CM	0.294		1189AP	CATVP, CMP	0.248					DB6U, DB6PL2
CATV	RG-11 14AWG Solid CCS Dual Shield	BELDEN	1523A	CATV, CM	0.393		1523AP	CATVP, CMP	0.348					FS11V, FS11PL
HDMI	28 AWG, 4-PR/28 AWG, 1-PR/28 AWG, 5C	COVID	HD-280RD	CMR	0.260		P-HD-28	CMP	0.280	7.00				
Multimedia														
HDBaseT - AMX	23AWG Solid, 4 Pair, F/UTP, Non-bonded	BELDEN	10GX62F	CMR	0.295		10GX63F	CMP	0.295					
	23AWG Solid, 4 Pair, F/UTP	GEPCO	CT104/SDM-07	CMR	0.310		CT104/SDMP-07	CMP	0.295					
HDBaseT - Crestron	24AWG Solid, 4 pair, F/UTP	CRESTRON	DM-CBL-8G-NP	CM	0.244		DM-CBL-8G-P	CMP	0.244					
	23AWG Solid, 4 Pair, F/UTP, Non-bonded	BELDEN	10GX62F	CMR	0.295		10GX63F	CMP	0.295					
	23AWG Solid, 4 Pair, F/UTP	GEPCO	CT104/SDM-07	CMR	0.310		CT104/SDMP-07	CMP	0.295					
HDBaset - Extron	26AWG Solid, 4 Pair, S/FTP	EXTRON	22-214-03	CMR	0.250		22-215-03	CMP	0.235		STP RJ-45			
RF/Wireless														
50-OHM COAX	RG/58U	BELDEN	8240	CMX	0.193		82240	CMP	0.159					
Control														
DMX Control	24 AWG 2 Pair twisted double shielded low capacitance 120Ω	BELDEN	9842	CM	0.340		82842	CMP	0.273		NC5MX, NC5FX			
AXLink/CresNet	Ultralow Capacitance 105Ω twisted shielded pair with 18/2 power	BELDEN	1502R	CMR	0.250		1502P	CMP	0.205					
RS-232/485	22AWG SHIELDED TWISTED PAIR	BELDEN	8723	CM	0.160		88723	CMP	0.148		DB9M, DB9F			
RELAY	4C#20 UNSHIELDED	BELDEN	5402UE	CMR	0.160		6402UE	CMP	0.156					
DATA														
CAT 5e	24 AWG, SOLID, 4-PR UTP	BELDEN	1583A	CMR	0.190		1585A	CMP	0.190					
CAT 6	23 AWG, SOLID, 4-PR U/UTP	BELDEN	2412	CMR	0.225		2413	CMP	0.230					
Fiber														
Riser Single Mode	* = Fiber count, Suffix D = Distribution, BO = Breakout, many styles		***FRIOSM-**	OFNR	Varies		***FRIOSM-**	OFNR	Varies		95-200 series			
Riser 62.5/125 Style	* = Fiber count, Suffix D = Distribution, BO = Breakout, many styles		***FRIOMM6-**	OFNR	Varies		***FRIOMM6-**	OFNR	Varies		95-000 series			
Riser 50/125 Style	* = Fiber count, Suffix D = Distribution, BO = Breakout, many styles		***FRIOMM5-**	OFNR	Varies		***FRIOMM5-**	OFNR	Varies		95-050 series			

SECTION 27 4100.2
AV MASTER CABLE SCHEDULE

SIGNAL	DESCRIPTION	MFG.	NON-PLENUM	Rating	Diameter		PLENUM	Rating	Diameter		MATING CONNECTORS
DC Power											
Remote Power Supply	22 AWG, 2 Conductor twisted unshielded general purpose	LIBERTY	22-2C-GRY	CMR	0.120		22-2C-P-GRY	CMP	0.118		
Remote Power Supply	18 AWG, 2 Conductor twisted unshielded general purpose	LIBERTY	18-2C-GRY	CMR	0.166		18-2C-P-GRY	CMP	0.154		
Specialty											
Projector Application	26 AWG stranded 6 Coaxial plus 2 pair control Jacketed		RGB6C/22-2P	CL2	0.410	10.41	RGB6C/22-2P	CL2	0.410	10.41	
Retrofit Applications	20 AWG Solid 6 Coaxial+ 2 Cat5e UTP Jacketed		RGB6C-20/2L5E	CMR	0.960	24.38	RGB6C-20/2L5E	CMR	0.960	24.38	
Retrofit Applications	23 AWG Solid 6 Coaxial+ 2 Cat5e UTP Jacketed		RGB6C-23-2L5E	CMG	0.627	15.93	RGB6C-23-2L5E	CMG	0.627	15.93	
Retrofit Applications	25 AWG Solid 6 Coaxial+ 2 Cat5e UTP Jacketed		RGB6C-25-2L5E	CM	0.533	13.54	RGB6C-25-2L5E	CM	0.533	13.54	
Rack Interconnection	Mini RG59/U 23 AWG High Definition Serial Digital Coaxial Cable		23-MINI-SD	CM	0.164	4.17	23-MINI-SD	CM	0.164	4.17	
Microphone	24 AWG 2 Pair Star Quad style extra flexible Mic cable		24-2P-STAR-BLK	CM	0.240	6.10	24-2P-STAR-BLK	CM	0.240	6.10	NC3FX, NC3MX

END OF SECTION

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
Audio System Performance Reference Verification Items						
AP-100	Emergency Muting	Verify that any required muting or operational change of the installed sound system(s) has been made in accordance with local regulations in the event of a life safety or similar emergency.	X	X	X	
AP-101	Loudspeaker Zoning	Verify that loudspeaker zones are wired as defined in the project documentation.	X	X		
AP-102	Alignment of Multiple Audio Source Levels	Alignment of calibration of permanent audio system inputs such that the difference between any input signal level after the first common gain adjustment meets the requirements of the project documentation.		X	X	
AP-103	Audio Buzz and Rattles	Verify that no audible noise caused by improper installation of any equipment provided in completed system(s) is present.		X	X	
AP-104	Audio Routes	Verify that all audio routes are tested from endpoint to endpoint via the appropriate midpoint(s) for operation and routing as defined in the project documentation.		X	X	
AP-105	AV Room Reverberation Time	Verify reverberation time meets the requirement defined in the project documentation.			X	
AP-106	DSP Programming	Verify that all DSP-based products have been programmed as defined in the project documentation.		X	X	
AP-107	Loudspeaker Physical Alignment	Verify that loudspeakers are placed and aimed as defined in the project documentation.		X	X	
AP-108	Loudspeaker Polarity	Verify that all loudspeakers have correct polarity as defined in the project documentation.		X	X	
AP-109	Loudspeaker Time Alignment	Verify that loudspeaker time alignment performs as defined in the project documentation.		X	X	
AP-110	Phantom Power	Verify that power is provided at the correct voltage and correct locations as defined in the project documentation.		X	X	
AP-111	Loudspeaker Transformer Tap Setting	Verify the loudspeaker transformer tap setting in constant voltage systems is as defined in the project documentation.		X		

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
AP-112	Acoustical Ambient Noise	Verify that the background acoustic noise levels within audiovisual spaces are within the required limits as detailed in the project documentation. This test is specifically related to ambient noise levels and not audio system electronic quiescent noise, which is tested separately.			X	
AP-113	Assistive Listening Devices	Verify that all devices that are part of the assistive listening system have been tested as a complete end-to-end personal listening system. Verify that the assistive listening system complies with regulatory requirements and adheres to project documentation.			X	
AP-114	Audio Coverage in Listener Area	Verify that the coverage of the audio systems in listener areas meets the performance requirements as defined in the project documentation. ANSI/INFOCOMM A102.01.2017, Audio Coverage Uniformity in Listener Areas should be used. Perform separate tests for all independent systems within the project, including but not limited to program sound, speech reinforcement, and show relay.			X	
AP-115	Audio Dynamics	Verify use of audio dynamics, including but not limited to noise compensation, automatic gain control, gating, feedback suppression, compression, limiting, delays, and levelers, meets the requirements defined in the project documentation.			X	
AP-116	Audio Level Exceeds Background Noise Level	Verify that the audio level provided by the installed audio system exceeds the background noise level as defined in the project documentation.			X	
AP-117	System Electronic Frequency Response	Verify that the electronic frequency response of the audio system is as defined in the project documentation.			X	
AP-118	Audio System Equalization for Spectral Balance	Verify that the audio system equalization is in accordance with the acoustic response curves as defined in the project documentation.			X	
AP-119	Audio System Latency	Verify that audio system latency meets requirements defined in the project documentation.			X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
AP-120	Audio System Speech Reproduction at Listener Positions	Verify that the audio system provides speech reproduction (intelligibility) as defined in the project documentation.			X	
AP-121	Audio System Total Harmonic Distortion	Verify that the total harmonic distortion of the installed audio system is as defined in the project documentation.			X	
AP-122	Conferencing Audio Far-Side Level Adjust	Verify that in a conferencing audio application, the incoming and outgoing audio levels are checked and adjusted in the system as defined in the project documentation.			X	
AP-123	Conferencing Echo Suppression Performance	Verify that a system with conferencing capability performs at nominal operating levels in a full duplex mode with echo and latency performance as defined in the project documentation.			X	
AP-124	Loudspeaker Impedance	Verify that all loudspeaker circuits have the correct impedance as defined in the project documentation.			X	
AP-125	Microphone Physical Alignment and Placement	Verify proper alignment and placement of microphones in the system as defined in the project documentation.			X	
AP-126	Microphone Gain Before Feedback	Verify that the speech reinforcement system is operating without feedback and at audio levels as defined in the project documentation.			X	
AP-127	Microphone Level Alignment	Verify calibration of microphone inputs so that the difference between any input signal level after the first common gain adjustment meets the requirements of the project documentation.			X	
AP-128	Multi-Channel Loudspeaker System Output	Verify that the audio outputs of a multi-channel loudspeaker system are assigned correctly to designated outputs as defined in the project documentation.			X	
AP-129	Sound Masking	Verify that audio system sound-pressure levels and equalization are adjusted to the level of sound masking as defined in the project documentation.			X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
AP-130	Audio Reinforcement System Headroom	Verify that the audio system is capable of performing above nominal operating levels without distortion as defined in the project documentation.			X	
AP-131	Audio System Signal-to-Noise Ratio	Verify audio system electrical signal-to-noise ratio meets the minimum levels defined in the project documentation.			X	
Video System Performance Verification Items						
VP-100	EDID Management Plan	Verify that the EDID (Extended Display Identification Data) management plan has been implemented as defined in the project documentation.	X	X		
VP-101	HDCP Management Plan	Verify that the HDCP (High-bandwidth Digital Content Protection) management plan has been implemented as defined in the project documentation.	X	X		
VP-102	Projected Display Physical Alignment	Verify that the combined installation of projector and screen provides a displayed image that is correctly aligned to the active projection screen surface without misalignment unless an alternative condition is specified in the project documentation.		X	X	
VP-103	Video System Pixel Failure Tolerance	Verify that all display images do not have pixel failures (bright or dead pixels) that exceed the requirements of the project documentation or the manufacturer's specifications.		X	X	
VP-104	Image Geometry	Verify that all displayed images are correctly focused, have the correct image geometry and are free from distortion (e.g., stretching, keystone, barrel/pincushion). Any requirements for projection mapping or image shaping to unusual surfaces should be validated in accordance with the requirements of the project documentation.		X		
VP-105	Displayed Image Performance	Verify that the components of the displayed image system(s) (projection or direct- view) perform(s) as required with relation to image size, viewing angles, sight lines, viewer locations, and/or any other requirements as defined in the project documentation.	X	X	X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
VP-106	Colorimetry	Verify calibration of all video displays to ensure they display colors uniformly to a common reference standard as defined in the project documentation.			X	
VP-107	Multiple Resolution Performance of Video Displays	Verify that the system(s) accurately display(s) all resolutions required by project documentation on all displays within the system (i.e., no pixel shift, no geometric distortion, no artifacts from scaling, letterboxing, pill-boxing, or window-boxing).			X	
VP-108	Projected Display Brightness Uniformity	Verify that the combined installation of projector and screen provides a display to the viewer that meets the requirements of the project documentation.			X	
VP-109	Projected Image Contrast Ratio	Verify that the system conforms to the appropriate viewing category as defined in the project documentation. The testing methodology in ANSI/INFOCOMM 3M-2011 shall be used. The projected image contrast ratio shall be measured for all projected images within the system.			X	
VP-110	Test Video Routes	Verify that all video routes are tested from endpoint to endpoint via the appropriate midpoint(s) for operation and routing required by the project documentation.			X	
VP-111	Video Camera Image and Operation	Verify that cameras, lenses, and pan/tilt systems operate as defined in the project documentation. Inspect the camera image through the full lens operation.			X	
Audio/Video System Performance Verification Items						
AVP-100	Emergency Communications	Verify that emergency communications systems properly receive inputs and information from other systems (including but not limited to life safety systems, security systems, and weather notifications) and deliver appropriate notifications to target audiences, comply with regulatory requirements, and adhere to requirements defined in the project documentation.		X	X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
AVP-101	Genlocking (Video Synchronization)	Verify that the video synchronization of the system is performing as defined in the project documentation.		X	X	
AVP-102	Audio and Video Recording	Verify that audio and video signals are being routed to the recording device(s) and that the recording device(s) is or are operating correctly, as defined in the project documentation.			X	
AVP-103	Audio/Video Recording	Verify that audio/video synchronization is maintained to ensure the proper time alignment of signals during playback at the point of user experience or transmission as defined in the project documentation.			X	
AVP-104	Radio Frequency Television Distribution	Verify that the radio frequency and satellite intermediate frequency distribution systems provide all services to all endpoints as defined in the project documentation.			X	
AVP-105	Source Testing	Verify that the signal produced by a source typical of what will be used in normal operation of the system is routed through the system to applicable endpoints and produces the performance as defined in the project documentation.			X	
Cable Management, Termination, and Labeling Reference Verification Items						
CABL-100	Cable Bend Radius	Verify that cables are not bent beyond their minimum bend radius as specified in cable data sheet in order to maintain signal integrity as defined in the project documentation. Project documentation may state a larger radius to allow for a safety margin.	X	X		
CABL-101	AV Connector Plate Input and Output Labeling	Verify that all AV connector plate inputs and outputs are labeled as defined in the project documentation.		X		
CABL-102	AV Connector Seating	Verify that all AV connectors are correctly keyed, seated, and latched to respective connection points as defined in the project documentation. Conditions where physical parameters exceed the connector's ability to maintain full seating should be resolved as defined in the project documentation.		X		

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
CABL-103	AV Connector Verification	Verify that all AV cable terminations are made securely and meet the recommendations of the connector and cable manufacturer(s), published standards, and requirements defined in the project documentation.		X		
CABL-104	AV Equipment Power Cable Management	Verify that all AV equipment power cables are managed as defined in the project documentation. Verify that cables are managed in a uniform and acceptable manner so as not to compromise safety/OEM warranty, AV signal quality, and/or future field service.		X		
CABL-105	AV System Cable Labeling	Verify that all AV system cables are identified by a unique ID as defined in the project documentation. Verify that this unique ID is displayed permanently at both ends of the cable, is legible, and is positioned where it can be seen without undue disturbance.		X		
CABL-106	Cable Separation	Verify that both site and rack cables have appropriate separation according to signal type and level as defined in the project documentation.		X		
CABL-107	Cable Supports	Verify that all cables are supported throughout their lengths as defined in the project documentation.		X		
CABL-108	Cable Ties	Verify that, where appropriate, cable ties are used to secure the cables, are correctly tensioned, and that the correct type of cable tie(s) is used as defined in the project documentation.		X		
CABL-109	Cables Bundled by Type	Verify that cables are only bundled together when their construction, signal type, and signal level are compatible and will not cause measurable crosstalk or interference between cables.		X		
CABL-110	Cables Dressed	Verify that cables are dressed to ensure that all rack and site cables are installed to provide serviceability, safety, and aesthetics as defined in the project documentation.		X		

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
CABL-111	Patch Panel Configuration	Verify that all patch panels have been correctly wired and configured as defined in the project documentation		X		
CABL-112	Patch Panel Labeling	Verify that all patch panels have been labeled as defined in the project documentation. Verify that all labeling is machine-printed, consistent, durable, accurate, and legible.		X		
CABL-113	Termination Stress	Verify that all cable terminations have been completed and adequately supported to minimize stress on the termination point and/or connector.		X		
CABL-114	AV Connector Plate Consistent Labeling	Verify that AV connector plates have consistent labeling throughout the project as defined in the project documentation.			X	
CABL-115	AV System Cabling Verification	Verify that all cabling is the correct type and routed correctly from point to point as defined in the project documentation.			X	
CABL-116	Cable Length Required for Serviceability	Verify that sufficient cabling is available so the device can be placed in a serviceable location as defined in the project documentation.			X	
Control Reference Verification Items						
CON-100	Control System Communications	Verify that all control communications are tested from endpoint to endpoint via the appropriate midpoint(s) for operation and functionality as defined in the project documentation.		X	X	
CON-101	Interfacing and Control of External Devices and Systems	Verify that AV control system interfaces to and from control systems provided by others conform to requirements as defined in the project documentation.		X	X	
CON-102	Mobile Device Integration	Verify that mobile devices that are to be supported are integrated and operating as defined in the project documentation.		X	X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
CON-103	System Response to Emergency Condition	Verify that any required response of the installed audiovisual system(s) in the event of a life safety or similar emergency operates in accordance with local regulations and as defined in the project documentation. This item specifically excludes sound system response to an emergency condition, which is covered under item AP-100, Emergency Muting.		X	X	
CON-104	Control System Automated Functions	Verify that all time-dependent or automated functions executed by the control system conform to requirements as defined in project documentation.			X	
CON-105	Control System User Interface Performance	Verify that the control system is implemented in a manner consistent with the requirements as defined in the project documentation.			X	
CON-106	Control System Response Time	Verify that the control system provides the user response time and maximum latency defined in the project documentation.			X	
System and Record Documentation Reference Verification Items						
DOC-100	Final Inventory of AV Equipment	Verify that all equipment has been delivered as defined in the project documentation.	X	X	X	
DOC-101	Approval of Samples	Verify that samples of all equipment to be used as defined in the project documentation have been submitted for approval.	X			
DOC-102	Delivered Product Against Samples	Where samples of products have been required for approval, verify that the products that are delivered are the same and of the same quality.		X		
DOC-103	Wireless Frequency Licensing	Verify that the correct and valid wireless frequency licensing permits have been obtained for legal operation of the system.		X		
DOC-104	Consultant's Testing	Verify that any consultant’s testing requirements defined in the project documentation have been performed and approved.			X	
DOC-105	General Contractor's Testing	Verify that any general contractor’s testing requirements defined in the project documentation have been performed and approved.			X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
DOC-106	Integrator's Testing	Verify that any integrator's testing requirements have been performed and approved as defined in the project documentation.			X	
DOC-107	Manufacturer's Testing	Verify that any manufacturer's testing requirements defined in the project documentation have been performed and approved.			X	
DOC-108	Owner's Testing	Verify that any owner's testing requirements defined in the project documentation have been performed and approved.			X	
DOC-109	Third-Party Testing	Verify that any third-party testing requirements have been performed and approved as defined in the project documentation.			X	
DOC-110	Substantial/Practical Completion	Verify that a conditional acceptance of the project has been issued by the owner or owner's representative, acknowledging that the project or a designated portion is substantially/practically complete and ready for use by the owner, however some requirements and/or deliverables defined in the project documentation may not be complete.			X	
DOC-111	As-Built Drawings Complete	Verify that a complete set of accurate as-built drawings indicating all AV devices, AV device locations, mounting details, system wiring and cabling interconnects, and all other details has been provided as defined in the project documentation.				X
DOC-112	Audio System Test Reporting	Verify that the audio system test report has been completed and issued as defined in the project documentation.				X
DOC-113	Control System Test Reporting	Verify that the control system test report has been completed and issued as defined in the project documentation.				X
DOC-114	Final Commissioning Report and System Turnover	Verify that the final commissioning report has been completed, issued to the proper entity, and accepted as defined in the project documentation.				X

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
DOC-115	Required Closeout Documentation	Verify that a complete set of as-built system documentation has been provided as defined in the project documentation.				X
DOC-116	Software Licensing	Verify that the usage and ownership rights have been assigned as defined in the project documentation.				X
DOC-117	User Manuals	Verify that manufacturer's user manuals are delivered to the owner in a format defined in the project documentation (e.g., binders, PDFs), or dispose of the manuals in a responsible manner (recycling) if the owner specifies that they do not wish to receive the manuals. Integrator- or programmer-created manuals and documentation shall be delivered to the owner in a format defined in the project documentation.				X
DOC-118	Video System Test Reporting	Verify that the video system test report has been completed and issued as defined in the project documentation.				X
DOC-119	Warranties	Verify that all warranties are activated and that all warranty details have been passed to the owner as defined in the project documentation.				X
DOC-120	Final Acceptance	Verify that a final acceptance of the project has been issued by the owner or owner's representative, acknowledging that the project is 100% complete, that all required deliverables, services, project-specific verification lists, testing, verification and signoffs have been received, and that all requirements defined in the project documentation have been satisfied and completed.				X
Electrical Reference Verification Items						
ELEC-100	AV Equipment Connected to Proper Circuit	Verify that all AV equipment is powered from the designated power circuit and outlet as defined in the project documentation. No additional (non-AV) equipment should be connected unless permitted in the project documentation.	X	X	X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
ELEC-101	Grounding/Earthing	Verify that all elements of the AV system are correctly bonded to an electrical ground/earth in accordance with the requirements of the regulatory authority and as defined in the project documentation.	X	X		
ELEC-102	Mains Voltage Sub-Distribution Integrity	Verify that all electrical sub-distribution systems provided by the AV contractor in equipment racks, furniture, and similar structures meet local regulatory requirements for electrical integrity.	X			
ELEC-103	Power Sources	Verify that the sources of mains voltage AC power to be used for the supply of AV equipment are correct as defined in the project documentation and have been tested to the outlet in accordance with local electrical standards.	X			
ELEC-104	Power Sequencing	Verify that the power sequencing of devices is correct as defined in the project documentation.		X	X	
ELEC-105	UPS Operation	Verify that the uninterruptible power supply (UPS) is performing to the specifications as defined in the project documentation.		X	X	
ELEC-106	DC Power Distribution	Verify that all DC powered devices are receiving the proper voltage and current for normal operation.		X		
ELEC-107	Power Loss Recovery	Verify that the AV systems resume normal operation on the restoration of power following a hard electrical power outage. Power loss recovery shall include verification of the resumption state on power recovery. Resumption state shall be the control system start-up condition/start page (where applicable) and resetting all devices to a known state as defined in the project documentation.			X	
ELEC-108	Power Monitoring	Verify power-monitoring equipment is working and reporting as defined in the project documentation. Power-monitoring equipment should be verified with a known electrical load where possible. If power-monitoring data is being collected for an energy management system, connectivity with the system should be verified.			X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
Information Technology Verification Items						
IT-100	Content Delivery Network	Verify that the content delivery network (e.g., digital signage) is in place and provides the required connectivity for the required audio, video, and control systems. Verify that all required content licensing has been acquired.	X	X	X	
IT-101	IEEE 802 Wireless Security	Verify that the wireless network is protected in accordance with the client/owner's information security policies from unauthorized access and provides the required connectivity for the audio, video, and control systems.	X	X	X	
IT-102	Network Bandwidth	Verify that the required network bandwidth is available for control, audio, video, and data as part of either a shared or a dedicated audiovisual network.	X	X	X	
IT-103	Network QoS (Quality of Service)	Verify that the required Quality of Service (QoS) is in place for audio, video, and data as part of either a shared network or a dedicated audiovisual network.	X	X	X	
IT-104	Network Security	Verify that the shared or dedicated network is secure as defined in the project documentation and accessible to suit the required audio, video, and control systems.	X	X	X	
IT-105	Telephony	Verify that any required telephony connections to the AV system are in place and connectivity is verified.	X	X	X	
IT-106	Unified Communications	Verify that any connections to IT-based unified communication applications that will interface with the AV system have been planned for and integrated.	X	X	X	
IT-107	AV IP Address Scheme	Verify and document that all network-connected equipment has the correct IP address, subnet mask, hostname, and gateway configuration as defined in the project documentation.	X	X		

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
IT-108	IEEE 802 Wireless Networks	Verify that the wireless network configuration is correct and valid (e.g., channel no., SSID, TX power) in defined areas of use as defined in the project documentation. Verify that there is adequate channel separation between any client wireless networks that are required to co-exist in the same area.	X	X		
IT-109	PoE (Power over Ethernet)	Verify that PoE (Power over Ethernet) devices are supplied with correct power required for normal device operation. Verify under normal operations that the switch providing PoE has the capacity to power all of the devices that are connected to it.	X	X		
IT-110	Network Topology	Verify that the network for audio, video, and control is of a suitable topology to support the services to be delivered as defined in the project documentation.	X			
IT-111	Application Integration	Verify that the audiovisual and control systems have been integrated and have been fully configured with headend software, including monitoring and asset management; databases; web-based front ends; digital signage software and systems; content generation and distribution platforms; and appliances as defined in the project documentation.		X	X	
IT-112	Enterprise Management Tools	Verify that enterprise management tools such as central monitoring client/server or web-based applications have been installed and connected to all systems they are required to monitor or control as specified in the project documentation.			X	

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
IT-113	Identity Management	Verify that all systems-authentication credentials are configured correctly. Any temporary credential used during system installation and commissioning should be removed. User and group authentication and authorization are verified based on the requirements from the project documentation. Connectivity with the central directory, database, or other identity authority should be verified.			X	
IT-114	Network Performance Under Full Functional Load	Verify that the network can provide the required operational performance to carry control, audio, video, and data under production load and at times of peak production load (refer to IT-102 Network Bandwidth).			X	
IT-115	Remote Access	Verify that remote access to AV and IT systems are configured as defined in the project documentation.			X	
IT-116	Remote Management	Verify that remote management tools such as virtual touch panels, internal web applications, or manufacturer's applications are configured and functional as required by the project documentation and/or manufacturer's specification.			X	
Operations and Support Verification Items						
OP-100	Software	Verify that all control programming code, DSP configuration files, and any other associated software have been provided as defined in the project documentation.	X	X	X	
OP-101	Battery Management Plan	Verify that a battery management plan has been completed and supplied to the owner in the project documentation package.	X			
OP-102	Content Management Plan	Verify there is a plan for managing the content to be delivered by the audiovisual systems, including the means to create content and update content when new information needs to be conveyed.	X			

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
OP-103	System Content Provided	Verify that any owner, vendor, or third-party-produced system content that is required for operations as defined in the project documentation has been supplied, loaded, and tested in the completed AV system.		X	X	
Physical Environment Reference Verification Items						
PHYSE-100	Divisible Spaces	Verify that the divisible spaces provide the functionality defined in the project documentation.	X	X	X	
PHYSE-101	Human Factors, Usability, and Ergonomics	Verify that ergonomics and usability elements for audience and system users are installed and configured as defined in the project documentation.	X	X	X	
PHYSE-102	Lighting	Verify that the lighting systems are suitable for each type of application (e.g., video conferencing, presentation, broadcast, performance) as defined in the project documentation.	X	X	X	
PHYSE-103	Vibration	Verify that the physical environment is suitable for the intended audiovisual systems in relation to all sources of vibration affecting stability of equipment such as videoconferencing cameras, document cameras, and fixed screen and projector locations.	X	X	X	
PHYSE-104	Backing/Blocking/Framing	Verify that installed backing, blocking, and framing meets project documentation requirements and industry standards for installation means and methods.	X			
PHYSE-105	Clean Building Handover	Verify that the area is clean, free of dust, and suitable for equipment installation and that no further work is planned that will release contaminants into any AV equipment area. Verify that the area released is isolated from any areas not yet released.	X			

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
PHYSE-106	Coordinated Construction Elements	Verify that the elements (including but not limited to spatial requirements and building services) required by the AV system and that are coordinated with other disciplines have been provided as defined in the project documentation.	X			
PHYSE-107	Device Enclosures	Verify that device enclosures accommodate the intended device and that all necessary environmental controls (e.g., heating, cooling, humidity) are incorporated into the enclosure as defined in the project documentation.	X			
PHYSE-108	Finishes	Verify AV equipment, furniture, fixtures, and accessories against the project documentation.	X			
PHYSE-109	Floor Boxes/Wall Boxes/Ceiling Boxes	Verify that installed floor, wall, and ceiling boxes meet project documentation and regulatory authority requirements.	X			
PHYSE-110	HVAC Commissioned	Verify the HVAC system has been tested and balanced prior to completing verification items AP-112 and AP-116.	X			
PHYSE-111	HVAC Operations	Verify the HVAC system has begun continuous operations in advance of equipment operations.	X			
PHYSE-112	Structural Mounting	Verify configuration and compatibility of structural accommodations and all mounting hardware based on the intended application. All equipment mounting hardware shall be installed in the manner specified by the hardware manufacturer.	X			
PHYSE-113	Protection of Installed Equipment	Verify that all elements of the AV system are free of damage.		X		
PHYSE-114	Accessibility	Verify that all systems are accessible in accordance with regulatory requirements.			X	

Physical Installation Reference Verification Items

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
PHYSI-100	Cable Containment/Conduit	Verify that installed containment/conduit capacity and routes meet project documentation requirements, industry standards, and regulatory requirements for installation means and methods. Verify that installed containment/conduit is serviceable and free of contaminants.	X			
PHYSI-101	AV Rack Air Flow and Temperature Performance	Verify that the AV rack(s) provides the air flow as required in the project documentation. Verify that the temperature in the AV rack has been measured and is within tolerances defined by manufacturers' guidelines and the project documentation. This verification item shall require a metric to be verified.		X	X	
PHYSI-102	Equipment Security	Verify that equipment is secured as defined in the project documentation. Verify that all security systems, devices, and manufacturer security accessories are installed and verified to be operating as defined in project documentation. Verify that keyed devices have been keyed as defined in the project documentation and devices requiring configuration have been configured as defined in the project documentation and are verified to be operating within specification.		X	X	
PHYSI-103	AV Equipment Labeling	Verify that all AV equipment has been labeled in accordance with the requirements of the project documentation. All labeling must be consistent, durable, accurate, and visible without dismantling of sub-assemblies.		X		
PHYSI-104	Plumb and Level/Square	Verify that all AV equipment has been installed, aligned, or angled correctly as defined in the project documentation. Level and plumb are the default requirement unless particular angles or other alignments are defined in the project documentation.		X		
PHYSI-105	Site Security	Verify that all elements of the AV system are free from loss, damage, or tampering.		X		

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
PHYSI-106	AV Equipment Located Per Project Documentation	Verify that AV equipment is installed at the location and/or in the rack or enclosure as defined in the project documentation. Equipment is installed per the elevation or other specification provided by the project documentation or the manufacturer's specification.			X	
PHYSI-107	AV Rack Cleanliness	Verify that all components installed in AV equipment racks are free from dirt, dust, water, or any other element that would compromise the performance and/or longevity of the AV system.			X	
PHYSI-108	Non-End User Controls Protection	Verify that installed items with user-facing controls that are not intended for end- user access have been covered, disabled, or otherwise secured to prevent end- user operation.			X	
PHYSI-109	Optical Components Cleanliness	Verify that all optical components, such as lenses and mirrors, are free from dirt, dust, damage, or markings that would compromise the optical performance of those system components.			X	
PHYSI-110	Handing of Accessories Otherwise Undefined	Verify that all items that are pre-packaged with primary system equipment but have no documented/planned use in the AV system(s) are managed in accordance with the project documentation.				X
PHYSI-111	Turnover of Accessory System Elements	Verify that any equipment that may be considered portable and/or otherwise not specifically incorporated into the installed AV system(s) has been set up, configured, and tested.				X
Serviceability Reference Verification Items						
SERV-100	Access Panels	Verify that any access panels that have been installed to provide access to any type of AV equipment are properly sized and positioned as detailed in the project documentation.	X	X		

SECTION 27 4100.3
AV SYSTEMS PERFORMANCE VERIFICATION CHECKLIST

Item Number	Test	Description	Pre-Integration	Systems Integration	Post-Integration	Closeout
SERV-101	Ability to Maintain and Service Equipment	Verify that all equipment is accessible and capable of being maintained, serviced, cleaned, or adjusted as necessary. Verify that all equipment requiring regular cleaning or maintenance is accessible without requirement for special equipment or tools that would disrupt the normal use of the facility and systems therein.			X	
SERV-102	Input and Output Panel Accessibility	Verify that all input and output panels are accessible and meet all requirements for user access and placement.			X	
SERV-103	Rack Clearance	Verify rack placement and use for physical stability in accordance with the project documentation and regulatory authority.			X	
Wireless Reference Verification Items						
WL-100	Wireless Audio Systems Operation	Verify that the operation of wireless audio systems (RF and IR) is as defined in the project documentation.	X	X	X	
WL-101	Wireless Controls System Operation	Verify that the operation of wireless control systems (RF and IR) is as defined in the project documentation.	X	X	X	
WL-102	Wireless Coordination	Verify that the environment is suitable for the required wireless services (RF and IR) to provide audio, video, and control, and can be implemented for the required number of channels as defined in the project documentation.	X	X	X	
WL-103	Wireless Video Systems Operation	Verify that the operation of wireless video systems (RF and IR) is as defined in the project documentation.	X	X	X	

END OF SECTION

SECTION 27 5223
NURSE CALL SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section details product and execution requirements for a complete Caregiver/Patient Communication system for [Project].

B. Provide complete caregiver/patient communication system as shown on drawings

1.02 RELATED WORK

A. Section 26 0593 - Electrical Systems Firestopping

B. Section 27 0000 - General Communications Requirements

C. Section 27 0528.33 - Raceway and Boxes for Communications Systems

D. Section 27 0553 - Communications Systems Identification

E. Section 27 1500 - Communications Horizontal Cabling

1.03 REFERENCES AND STANDARDS

A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

B. Refer to Section 27 0000 - General Communications Requirements which identify pertinent References and Standards.

C. Other applicable references and standards include:
   1. NEMA SB 10 - Audio Standards for Nurse Call Systems
   2. UL 1069 - Hospital Signaling and Nurse Call Equipment
   3. AIA – American Institute of Architects

1.04 WORK BY OWNER

A. Refer to Section 27 0000 - General Communications Requirements which identifies Work by Owner affecting sub-system(s) covered by this Section.
   1. All system components (i.e. Master Station, Patient Station, Code Blue Station, etc.) shall be Owner Furnished Contractor Installed (OFCI).

1.05 SUBMITTALS

A. Shop drawings for all equipment and devices provided under this Section.

B. Provide system wiring diagram showing all devices on system.

1.06 QUALITY ASSURANCE

A. Refer to Section 27 0000 - General Communications Requirements which identify general quality assurance requirements for the Project.

B. All materials and products shall be of the highest professional quality and in proper operating condition performing to the manufacturer’s published specifications. Discontinued materials and products are not allowed.

C. Contractor shall:
   1. Have been in the nurse call/paging/intercom business for minimum of 5 yrs. and shall have successfully completed two (2) projects equal to magnitude specified in the following sections within the previous two (2) yrs.
   2. Be a certified/authorized installer of the equipment type(s) proposed.
      a. This authorization/certification shall be in place at time of bidding and remain so throughout project.
      b. System basis of design shall be ASCOM/GE Telligence.

1.07 GUARANTEE

A. Refer to Division 01, General Conditions, and General Requirements - Guarantee Documents for general warranty requirements.

B. Provide a written one (1) year warranty covering the installed system.

C. During the warranty period, the products shall be free from defects in material or factory workmanship.

D. The product and materials warranty shall cover the full replacement or repair of defective products.
   1. Coverage shall include all parts, labor, travel, and expenses.

PART 2 PRODUCTS

2.01 SYSTEM

A. System shall be a network based Caregiver/Patient signal system which allows both data and voice to be distributed over a common network infrastructure. System shall be solid state, of modular construction and provide simultaneous audible and visible annunciation of all calls made from all stations on the network.

B. General Requirements
   1. Duplex audible and visible annunciation of all calls shall be viewed at master stations and visible annunciation at corridor lights and zone lights associated with each call.
   2. System shall consist of master stations, patient stations, corridor lights, zone lights, code blue stations, centralized control equipment with power supply and system cabling.
   3. Alerting tones shall be electronically generated and be amplified at each master station.
   4. Central equipment (network switch) and termination panels shall be rack mounted.
      a. Central equipment (network switch) is existing in serving IDF.
   5. Power supply shall operate from 120 V, 60 Hz.
   6. Shall be capable of controlling a minimum of 100 patient stations, corridor lights, zone lights, staff stations, and code blue stations.
   7. Calls on system shall function as follows:
      a. Normal Call:
         1). Shall have a steady illumination at corridor light and any zone light associated with station.
         2). Shall have a steady illumination and a slow rate tone at master station.
         3). Shall have a steady illumination and a slow rate tone at duty station.
      b. Emergency Call:
         1). Shall flash at a slow rate of illumination at corridor light and any zone lights associated with station.
         2). Shall have a slow rate flash of illumination and a rapid rate tone at master station.
         3). Shall have a slow rate flash of illumination and a rapid rate tone at duty station.
      c. Code Blue Call:
         1). Shall flash at a rapid rate of illumination at corridor light and any zone lights associated with station.
         2). Shall have a rapid rate flash of illumination and a steady tone at master station.
         3). Shall have a rapid rate flash of illumination and a steady tone at duty station.

C. Master Station
   1. Shall be of modular construction and contain solid-state networks for operation.
   2. Shall have full duplex audio communication.
   3. Shall provide visual identification of all incoming calls by room designation and call type.
   4. Shall have volume adjuster for incoming tones.
   5. Shall have the capability to monitor adjacent nursing zones.
   6. Shall have integral phone for caregiver/patient privacy.
   7. Shall have the capability to communicate with other master stations on the system.

D. Patient Stations:

1. Shall originate normal call.
2. Shall have a minimum of (1) cancel button, (1) receptacle for pillow speaker, (1) auxiliary input receptacle and an optional receptacle for bed interface.
3. Shall have a status LED to indicate communication status.
4. An alarm shall sound at master station when a device is removed from patient station.
    a. To cancel device alarm, device must be reinserted into station and depress cancel button.

E. Pillow Speaker
1. Shall include a minimum of (1) patients call button, and integral moisture-resistant speaker.
2. Shall have jack to plug into patient station that can withstand accidental removal from patient station receptacle without damage to pillow speaker or patient station.
3. Cord shall be a minimum of 6 ft with an integrated sheet clip.
4. Shall have a light to indicate communication status.
5. Shall be full duplex audio communication.
6. Electronic components shall be isolated from surface controls.

F. Call Cord
1. Pushbutton
    a. Pushbutton switch shall be mounted in a high impact plastic housing that is permanently molded to cord.
    b. Shall have a plug that is molded to cord for insertion to station receptacle.
    c. Cord shall be 6’ in length, have a non-removable bed sheet clamp, and be highly flexible polyvinyl chloride cable.
    d. Entire assembly shall be shock proof and be able to withstand gas sterilization without discoloration or deterioration.

G. Corridor and Zone Light
1. Lamps shall be incandescent or LED.
2. Shall be programmable.
3. Lamp colors shall be easily interchangeable if required.
4. Shall indicate level of call by the flashing rate.
5. Lens shall be shatter-proof, heat resistant plastic and shall snap on or off for easy lamp replacement.
6. Supervised light at master station locations shall emit an audible annunciation.

H. Cabling:
1. Shall use RJ-45 type connectors.
2. Connections shall use a minimum of 4-pair unshielded twisted pair Category 6 cable.
    a. Refer to specifications section 27 1500 for cable criteria.
3. Use manufacturer’s recommendations.
4. Shall be plenum rated.

PART 3 EXECUTION

3.01 INSTALLATION

A. System installation shall be in accordance with manufacturer's recommendations and requirements.

B. Equipment and wiring shall not be installed until building is enclosed, weather tight, and temperature and humidity conditions are approximately same as final conditions expected.

C. Install all cabling in conduit, cable tray and free-air. Terminate cabling per manufacturers recommendations.
1. Support cable not in conduit or cable tray using J-hooks.

D. Coordinate all pathway routing and back box locations with electrical contractor and architect.

E. Coordinate all back box sizes with electrical contractor and architect.

F. Provide supervised corridor light at each master station location for tone and light announcement in case of power outage.

G. At completion of installation, contractor shall provide personnel to check and test the system, subsequently certify to Owner that system is complete, operational, and meet all requirements.

H. Contractor shall be responsible for set up of system features with Owner. Coordination includes, but is not limited to, the following:
   1. Identifying call priority levels on master station.
   2. Setting up caregiver call groups.
   3. Configuring incoming calls to ensure call is directed to correct caregiver device.
   4. Assist owner with setting up or configuring any other available option on system.
      a. Contractor shall provide two (2) copies of step-by-step manual to Owner for system set up or configurations for future use.

I. All system components shall be cataloged products of a single supplier.

J. Label cabling and system components.
   1. Labeling shall be by mechanical means.
   2. Hand lettered designations are not allowed.
   3. Tags shall be non-removable.
   4. Characters shall be black ink and printed on background of contrasting color.
   5. Labels shall be as large as practicable while fitting properly.
   6. No lettering shall be smaller than 10-point.
   7. Label cables at each end with tag which is wrapped around cable sheath.

K. Test and adjust system to Owner’s satisfaction.
   1. Provide test results to owner.

3.02 SYSTEM DOCUMENTATION

A. Refer to Section 27 0000 - General Communications Requirements for general guidelines regarding documentation requirements.

B. Provide two (2) sets of complete instruction manuals which include:
   1. Service manuals
   2. Updated schematics (as built)
   3. Record drawings which depict all station location(s)
   4. Parts lists
   5. Recommended spare parts lists
   6. Current list of local manufacturer approved service centers
   7. Troubleshooting

3.03 OWNER TRAINING

A. Provide training for owner's personnel on operation and maintenance of total system and each component.

B. Training shall be complete to enable owner personnel to operate system, configure at user level and to perform maintenance and troubleshooting functions.

C. Conduct training during normal business hours after system start-up and owner acceptance.

D. Training shall include hands-on exposure to the installed system.

E. Shall be one (1) session; duration two (2) hours minimum for the session.

F. Up to ten (10) members of the owners’ staff may attend each session.

END OF SECTION

SECTION 28 3116
MULTIPLEXED FIRE DETECTION AND ALARM SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Section 21 1314 - Automatic Fire Sprinkler System
B. Section 26 0000 - General Electrical Requirements
C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables
D. Section 26 0526 - Grounding and Bonding for Electrical Systems
E. Section 26 0533 - Raceway and Boxes for Electrical Systems
F. Section 26 0553 - Electrical Systems Identification

1.02 REFERENCE

A. Work under this section is subject to requirements of Contract Documents including General Conditions, Supplementary Conditions, and sections under Division 01 General Requirements.

1.03 DESCRIPTION

A. In general, work consists of:
   1. Furnish and install complete Multiplexed Fire Alarm System as shown on plans.
   2. System shall:
      a. Connect into existing building Honeywell fire alarm system.
      b. Allow for loading and editing special instructions and operating sequences as required
      c. Be capable of on-site programming to accommodate system expansion and facilitate changes in operation
      d. Be wired, connected, and left in operating condition
   3. System includes:
      a. Manual Stations
      b. Heat Detectors
      c. Smoke Detectors
      d. Alarm Indicating Devices
      e. Terminations
      f. Other necessary material for complete operating systems
   4. Software operations shall be stored in non-volatile programmable memory within fire alarm control panel. Loss of primary and secondary power shall not erase instructions stored in memory.

1.04 REFERENCE STANDARDS

A. IBC - 2015 - International Building Code
B. IFC - 2015 - International Fire Code
C. NECA 305 - Standard for Fire Alarm System Job Practices
D. NFPA 72 - National Fire Alarm and Signaling Code
E. NFPA 101 - Life Safety Code
F. UL 268 - Smoke Detectors for Fire Protective Signaling Systems
G. UL 497B - Protectors for Communications and Fire Alarm Circuits
H. UL 521 - Heat Detectors for Fire Protective Signaling Systems
I. UL 864 - Control Units for Fire Protective Signaling Systems
J. UL 1480 - Speakers for Fire Protective Signaling Systems

K. UL 1481 - Power Supplies for Fire Protective Signaling Systems

L. UL 1711 - Amplifiers for Fire Protective Signaling Systems

1.05 QUALIFICATIONS

A. Equipment shall be supplied by company specializing in fire alarm and smoke detection systems with 5 yrs. documented experience

B. Work shall be performed by licensed contractor, regularly engaged in installation and servicing of fire alarm systems.

C. Furnish proof of 5 yrs. documented experience and factory authorization to furnish and install equipment proposed.

D. Contractor shall be located within 100 miles of Project site.

1.06 SUBMITTALS

A. Submit bill of materials listing part number and quantity of components and devices.

B. Submit general catalog cutsheets of all devices that are to be provided as part of system. Mark cutsheets with items specific to the project when multiple items are identified.

C. Submit block diagrams showing layout and operation of entire system.

D. Submit schematic diagrams, of circuits from field devices to terminal strip(s) associated with control panel.

E. Diagrams shall show schematic wiring of equipment; and connections to be made to devices.
1. Terminal connections in equipment shall be numbered to correspond to diagrams.
2. Wiring diagrams shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are same on drawings.

F. Submit standby battery power calculations.

G. Submit sound amplifier and strobe power supply calculations showing current draws for every device and module during standby, alarm and trouble conditions.

H. Submit voltage drop calculations for both initiating and alarming circuits.

I. Submit list of device addresses with location labeling as they will appear in 2 line, 40 character display of fire alarm panel .

J. Submit to Authority Having Jurisdiction (AHJ):
1. Copy of shop drawings as required to show component locations.
2. Upon receipt of comments from AHJ, make resubmissions if required to make clarifications or revisions to obtain approval.
3. All fees associated with this shall be included in the bid.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Honeywell

2.02 SYSTEM OPERATIONS

A. Alarm Initiation
1) Shall Match existing building standard programming.

B. Power Requirements
1. Provide 120 VAC power via dedicated branch circuit.
2. Branch circuit shall have "breaker lock" to prevent accidentally de-energizing of power to fire alarm panel.
3. Circuit breaker shall be painted red and labeled "FIRE ALARM.”
4. Provide disconnect switch for AC power near panel or within Fire Alarm Control Panel itself. Switch shall be labeled “Fire Alarm Power Disconnect.”
5. Where new Control Panel is to remain at same location as existing panel, contractor may use existing branch circuit, if it meets requirements stated above.

6. Provide power surge and transient protection.
7. Provide back-up battery capacity to operate entire system in normal supervisory mode for period of 24 h with 10 minutes of alarm operation at end of period.
8. System shall automatically transfer to standby batteries upon power failure.
    a. Battery charging and recharging operations shall be automatic.
9. Provide power limited, filtered, and regulated battery charger.
    a. Charger shall:
        1) Be combination high rate/float maintenance type
        2) Charge fully discharged battery to 70% in 12 h
        3) Monitor for AC fail/disconnect, low/no battery, and high battery level
        4) Include switches and associated LEDs for high rate and AC disconnect
        5) Provide 5 amps of regulated 24 VDC for peripheral devices requiring ± 5% regulation and 8 amps at 24 VDC for standard peripheral devices.
        6) Be compatible with lead acid batteries
10. External circuits requiring system operating power shall be 24 VDC and shall be individually supervised and fused at Control Panel.

C. Smoke Detection Operation
1. Smoke detector alarms shall be processed and reported immediately.
2. Upon building completion, alarm verification shall be added to detector(s) as directed by project engineer.
3. Control Panel shall:
    a. Be capable of displaying number of times (tally) detector has gone into verification mode from the system history
    b. Download alarm set point to detector
    c. Determine condition of each detector by comparing detector's value to stored values.
    d. Maintain moving average of detectors' smoke chamber value to automatically compensate for dust and dirty conditions
    e. Continuously perform an automatic self-test routine on each detector
    f. Have capability of being programmed for pre-alarm or two-stage function
    g. Clear "detector dirty" trouble after detector has been removed from its base cleaned and replaced
4. System shall maintain constant smoke obscuration sensitivity for each detector by compensating for environmental factors.
5. Photoelectric detector's smoke obscuration sensitivity shall be adjustable to within 0.3% of either limit of UL window (0.5% to 4.0%) to compensate for any environment.
6. System shall indicate when individual detector needs cleaning. When detector's average value reaches predetermined level, trouble MESSAGE shall be audible and visibly indicated at Control Panel. LED on detector base shall glow steady giving visible indication.
7. For scheduling of maintenance, Control Panel shall generate MESSAGE indication for any detector approaching trouble condition due to dirt or contamination.
8. Operator shall have capability to manually access the following information for each detector:
    a. Primary status
    b. Device type
    c. Present average value
    d. Present sensitivity value selected
    e. Detector range (normal, dirty, etc.)
9. Values at Control Panel shall be in "percent of smoke obscuration" format, so that no interpretation is required by operator.

10. Operator shall be able to manually control following for each detector:
    a. Enable or disable detector
    b. Establish alarm sensitivity
    c. Control detector's relay driver output
11. It shall be possible to program Control Panel to automatically change sensitivity settings of each detector based on time-of-day and day-of-week. There shall be 3 sensitivity settings available for each detector.

2.03 ENCLOSURE

A. Provide cabinets of sufficient size to accommodate equipment.

B. Cabinet shall be equipped with door, with lock and transparent door panel, providing tamper proof enclosure and allowing full view of various lights and controls.

2.04 FIELD PROGRAMMING

A. System shall be fully programmable, configurable, and expandable in field and shall not require replacement of memory IC's.

B. Programming may be accomplished through Control Panel keyboard or keyboard at printer or use of PC.

C. Programs shall be stored in non-volatile memory.

D. Programming or reprogramming shall be done by supplier at no charge until system is accepted by Owner.

2.05 INTELLIGENT NETWORK

A. System shall provide communications with intelligent initiating and control devices individually.

B. Devices shall be individually annunciated at control panel.

C. Annunciation shall include the following conditions for each point:
    1. Alarm
    2. Trouble
    3. Open
    4. Short
    5. Device missing/failed

D. Devices shall have capability of being disabled or enabled individually.

E. There shall be no limit to number of detectors, stations, or addressable modules, which may be activated or "in alarm" simultaneously.

F. Multiple intelligent devices shall be connected to a single pair of wires.

G. Communication format must be completely digital poll/response protocol to allow t-tapping of circuit wiring.

2.06 MULTIPLEXED PERIPHERAL DEVICES

A. Devices shall be supervised for trouble conditions.

B. Failure of device shall not hinder operation of other system devices.

C. Device Identification
    1. Each intelligent device shall be identified by an address code.
    2. Location of end-of-line device shall be indicated on device that containing same.
    3. System must verify that proper type device is in place and matches software configuration.

D. Intelligent Detector Bases
    1. Either base or head shall contain electronic circuits that communicate detector's status (normal, alarm, sensitivity status, trouble) to Control Panel over two wires. Same two wires shall also provide power to base and detector.

2. Contacts between base and head shall be of bifurcated type using spring-type, self-wiping contacts.
3. Base shall have locking capability. Locking feature must be field removable when not required.
4. Upon removal of detector's head, trouble signal shall be transmitted to Control Panel.
5. Detector base or head shall contain LED(s) that flash when detector is being scanned by Control Panel.
6. LED(s) shall turn on steady when detector is in alarm condition.

E. Intelligent Detector Heads - General
1. Intelligent detector heads shall be low-profile type.
2. Heads shall be plug-in units, which mount to common base.
3. Heads shall be 24 VDC type.
4. Heads may be reset by actuating Control Panel reset switch.
5. To minimize false alarms, voltage and RF transient suppression techniques shall be employed.
6. Smoke detectors:
   a. Listed for sensitivity testing from Control Panel. Sensitivity test results shall be logged and downloaded to printer.
   b. Include an insect screen.
   c. Communicate actual smoke chamber values to Control Panel.
   d. Covered with plastic bags after installation to maintain cleanliness. Bags shall be red for quick visual identification for removal at time of occupancy.

F. Intelligent Photoelectric Smoke Detectors
1. Detectors:
   a. Contain no radioactive material
   b. Be of solid state photoelectric type and shall operate on light scattering photodiode principle using pulsed infrared LED light.

G. Intelligent Heat Detectors
1. Detectors:
   a. Be a combination rate-of-rise and fixed temperature (135°F unless noted).
   b. Sense within temperature range of 32° to 158°F. The control panel shall be capable of sensing either a set point of 135°F, or a rate-of-rise of **[**15°F**] [**20°F**]** per minute for fire sensing.

H. Interface Modules - General
1. Interface Modules:
   a. Receive 24 VDC power from separate two wire circuit
   b. Available in either Class B or Class A supervision version
   c. Supervised and identified by Control Panel
   d. Capable of being programmed for its "address" location
   e. Compatible with addressable manual stations and intelligent detectors on same intelligent initiating circuit
2. Class A wiring shall be looped back and connected to module.
3. Class B wiring shall be supervised by an end-of-line device.
4. Should interface module become non-operational or removed, trouble signal shall be transmitted to Control Panel.
5. Interface module LED's shall be clearly visible on the face of the trim plate.

I. Interface Modules - Supervised Control
1. Interface Modules shall be used for control of indicating appliances, door holders, and AHU systems.

2. For signals, speakers, fire fighter phone jacks and other device control interface module shall provide double-pole/double-throw relay switching that can connect any of the following through 2 amp fuses:
    a. Zone of signals to power source
    b. Speakers to audio source
    c. Fire fighter phone jacks to communications channel
    d. Variety of controlled devices to appropriate controlling circuits.
3. Interface modules:
    a. Communicate supervised wiring status (normal, trouble) to fire alarm control panel.
    b. Receive from fire alarm control panel command to transfer relay.

J. Interface Modules - Supervised Monitoring
1. Interface Modules:
    a. Suited for monitoring of water-flow, valve tamper, and non-intelligent detectors.
    b. Addressable interface module shall be provided for interfacing normally open direct-contact devices to an intelligent initiating circuit.
    c. Provide power to and monitor status of zone consisting of conventional 2-wire smoke or heat detectors and N/O contact devices.
    d. Communicate zone's status (normal, alarm, trouble) to Control Panel.
2. Supervision of zone wiring shall be Class B or Class A.

K. Interface Modules - Non-Supervised Control
1. Interface module shall provide double-pole/double-throw relay switching for loads up to 120VAC. It shall contain 2 amp fuses, one on each common leg of relay.

2.07 SPEAKER/STROBE DEVICES

A. Combination Speaker/Strobe Devices
1. Speakers:
    a. Operate on 24 V DC circuit
    b. Include separate wire leads for in/out wiring for each leg of associated signal circuit. T tappings of signal device conductors shall not be acceptable.
    c. Be suitable for rear mounting behind audio-visual assemblies, which shall be flush or semi-flush mounted, with manufacturer back boxes and flush trim ring.
    d. Have field adjustable output taps, 3 taps minimum.
    e. Provide minimum sound pressure level of 85.7 dBA at 10’ using 1-watt tap.
    f. Provide a minimum sound pressure level of 90 dBA at 10’ using the 2-watt tap.
    g. Include a blocking capacitor for line supervision and screw terminal for in-out wiring.
2. Strobes shall be:
    a. Multi-tap units with taps at 15, 30, 75, and 110 cd.
    b. Tapped at 15-candela peak power or as noted on drawings.
    c. Have flash synchronization module on circuit when more than one strobe is visible at a time.
    d. On separate supervised circuit from speaker circuit.
3. White Lexan lens shall have "FIRE" in red lettering visible from a 180° field of view.
4. Have off-white semi flush housing.
5. Strobe circuit loading shall be calculated at 75 cd tap for all devices, except in mechanical, interstitial spaces where circuit loading shall be calculated at 110 cd tap

B. Speaker Devices
1. Speakers without strobe units:
2. Include above-listed features

3. Flush ceiling mounted white baffle and recessed back box for installation in suspended ceiling system.
4. Red baffle with surface mounted back box, furnished by speaker manufacturer, where installed in areas with exposed structure.
5. Cast metal grille and back box where installed in mechanical/interstitial spaces.

PART 3 EXECUTION

3.01 GENERAL

A. Class B circuiting shall be used.

B. Installation shall be done in neat, workmanlike manner in accordance with manufacturer's recommendations.

C. Smoke detectors shall not be mounted until construction is completed.

3.02 RACEWAYS

A. Fire Alarm Panel risers shall be in conduit system separate from other building wiring.

B. Wiring shall be in conduit system separate from other building wiring. See Section 26 0533 - Raceway and Boxes for Electrical Systems.

C. Minimum 3/4” steel raceway.

D. Contractor shall size conduit and boxes by circular mil size of cable in conduit or box.

E. Surface access to existing alarm initiating circuits in public areas shall be via surface metal raceways (minimum equivalent to 3/4” conduit) and box extensions.

F. Existing conduit and surface metal raceway that are not 3/4” size may be reused if found to have adequate space for existing and new conductors.

3.03 CONDUCTORS

A. Cables and wires shall be provided per manufacturer shop drawings.

B. Conductors shall be color-coded. Coding shall be consistent throughout facility.

C. Green wire shall be used only for equipment ground.

D. Control Panel power wiring shall be #12 AWG.

E. Control Panel shall have #12 AWG equipment ground wire.

F. Cable Detector Loops shall be twisted pair with shield jacket. Shield shall be connected to earth ground only at control panel.

G. Detector wiring shall not be in same conduit with 120/240 VAC wiring or other high current circuits.

H. T-taps or branch circuit connections allowed for class B intelligent loop circuits.

I. Leave 8” wire tails at each device box and 36” wire tails at Control Panel

J. Wiring of initiating device circuits, alarm horn circuits, and alarm strobe circuits shall be #14 AWG minimum.

K. Fire alarm cable shall be held in place at device box by means of 2-screw connector, (do not use squeeze or crimp type connectors).

L. Splices or connections shall be made within approved junction boxes and with approved fittings.

M. Boxes shall be red and labeled "FIRE ALARM SYSTEM" by decal or other approved markings.

N. Horn and strobe circuits shall have separate conductors and shall operate independently of each other.

3.04 DEVICE MOUNTING

A. Recommended mounting heights, and requirements are as follows:
   1. Audio-Visual Devices

a. Install flush, semi-flush 6” below finished ceiling or 80” from bottom of device to finished floor.
b. No devices protruding 4” or more shall be installed lower than 80”.
c. Audio/visual devices may be installed on the ceilings in accordance with NFPA 72 - Table 2-A.
d. For surface mounting, use manufacture-supplied backboxes and trim plates.
e. Mark each device with its circuit number.

2. Heat and Smoke Detectors

f. Location of detectors shown on plans is schematic only. Detectors must be located according to code requirements.
g. Surface mounted detectors shall be installed using back boxes equal to base size. Standard octagon and square boxes are not acceptable.
h. Detectors shall be located on the highest part of smooth ceiling so that edge of detector is no closer than 4” from sidewall.
i. Ceilings with beams, joists or soffits that exceed 8” in depth require special planning and closer spacing.
j. Mount detectors on sidewalls with top of detector no closer than 4” from ceiling and no further away than 12”.
k. Smoke detectors shall not be installed closer than 3’ from air supply diffusers.
l. No detectors shall be installed in direct airflow.
m. Heat and smoke detectors should be located near center of open area, which they protect.
n. Mark zone number and ranking of each detector on its base.
o. For intelligent systems, mark address and loop number on each detector's base.

3.05 DEMOLITION

A. Existing equipment that is removed shall be inventoried and turned over to Owner
B. Upon inspection by Owner, Contractor shall dispose of equipment that is deemed useless to Owner.
C. Contractor shall remove abandoned devices and conduit not being reused.

3.06 IDENTIFICATION LABELS

A. Junction boxes shall be painted red and labeled "Fire Alarm.”
B. Circuits must be labeled with name of circuit and area being served by circuit.
C. Labels shall be permanent, and be machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS SHALL BE ALLOWED.
D. Labels shall be self-laminating, white/transparent vinyl and be wrapped around cable
E. Flag type labels are not allowed.
F. Labels shall be of adequate size to accommodate circumference of cable being labeled and properly self-laminate over full extent of printed area of label.
G. Adhesive type labels not permitted except for phase and wire identification.
H. Wiring color code shall be maintained throughout installation.
I. Green wire shall be used only for equipment ground.

3.07 MANUFACTURER'S SERVICES

A. Supervision of installation shall be provided by trained service technician from manufacturer of fire alarm equipment.
B. Technician shall be US certified and have had minimum of 2 yrs. of service experience in fire alarm industry.

C. Technician's name shall appear on equipment submittals, and letter of certification from fire alarm manufacturer shall be sent to project engineer.

D. Manufacturer's service technician shall be responsible for following items:
   1. Pre-installation visit to job site to review equipment submittals and verify method by which system shall be wired.
   2. Make periodic job site visits to verify installation and wiring of system.
   3. Upon completion of wiring, final connections shall be made under supervision of technician.
   4. At time of final checkout, technician shall give operational instructions to Owner and/or his representative.
   5. Job site visits shall be dated and documented in writing and signed by Electrical contractor.
   6. Discrepancy shall be noted on document and copy kept in system job folder, which shall be available to project Engineer any time during project.

3.08 TESTING

A. Manufacturer's authorized representative shall perform complete functional test of each system and submit written report to Contractor attesting to proper operation of completed system prior to final inspection.

B. Contractor shall test each device in system before system is considered substantially complete.

C. Completed fire alarm system shall be fully tested by Contractor in presence of Owner's representative and local Fire Marshal.

D. Upon completion of successful test, Contractor shall:
   a. Certify system to Owner in writing
   b. Complete NFPA 1-7.2.1 record of completion form
   c. Provide as-builts and O&M manuals

3.09 WARRANTY

A. Warrant completed fire alarm system wiring and equipment to be free from inherent mechanical and electrical defects for a period of 2 yrs. from the date of substantial completion of project.

B. Post warranty period along with company’s name and telephone number inside fire alarm panel.

C. Warranty service for equipment shall be provided by system supplier's factory trained representative.

D. Warranty shall include parts, labor, and necessary travel.

E. Occupied facility shall not be without UL and NFPA approved and fully operational fire alarm system for period longer than 2 h. Emergency response shall be provided within 2 h of notification, to contractor, of failure of system to perform operationally per UL and NFPA standards.

F. Non-emergency service calls shall be responded to within 24 h of notification to contractor.

G. Repairs and/or replacement shall be completed within 72 h of time of notification. Other than emergency, actual repairs and/or replacement shall be provided during normal working hours, Monday through Friday, excluding holidays.

H. If repair and/or replacement cannot be made within prescribed time, other means and methods of protection shall be provided to insure safety of building occupants during which time system is not in compliance with standards. This may involve up to and include hiring Owner approved qualified personnel to stand fire watch, at contractor's expense.

3.10 TRAINING

A. Contractor shall provide minimum of 4 h system operation training for Owner, Architect/Engineer, and fire department personnel.

B. Training session shall be at a time to be stipulated by Owner.

C. Training shall be completed prior to final inspection.

3.11 MAINTENANCE CONTRACT

A. Equipment manufacturer shall make available to Owner, maintenance contract proposal to provide minimum of 2 inspections and tests per year in compliance with NFPA-72 Codes.

3.12 SPECIAL CONSIDERATIONS

A. Contractor shall notify Owner's security officer 24 h in advance of any zones inoperative for a period of time exceeding 2 h.

B. Existing fire alarm systems must be returned to full operation at end of each working day, or notification to campus security of what zones are inoperative on a daily basis in writing, hand delivered.

3.13 SPARE PARTS

A. Contractor shall provide the following spare parts in quantities shown, with a minimum of 1/item:

Quantity	Type of Device Present
10%	Photoelectric smoke detectors
10%	Heat detectors
10%	Smoke and heat detector bases
10%	Monitor Modules
10%	Control Modules
1%	Horn/strobe Units
1%	Strobes
1%	Manual Stations

END OF SECTION