# Pullman National Historic Park

11001 S. Cottage Grove Avenue, Chicago, Illinois

FINAL CONSTRUCTION DOCUMENTS
Administration Clock Tower Building: Elevator installation and 2nd & 3rd Floor Build-Out
PMIS 307087

## PROJECT SPECIFICATIONS

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**DIVISION 1 SHORT FORM GENERAL REQUIREMENTS**

## PART 1 – GENERAL

ITEM 1 - DESCRIPTION OF WORK

1.1 Background: Background: Built in 1880, the Administrative Clock Tower Building formed the central mass of a monumental structure seven hundred feet long. As the manufacturing center of Pullman, the Administration and Factory Complex was an unusually ornate industrial building designed to sit in a park-like setting. After standing for 117 years as Pullman landmark, the Administration Clock Tower Building was seriously damaged by a fire set by a arsonist on December 1, 1998. The tower and clock were rebuilt and installed on site in late 2005. The district was named a National Monument (now National Historical Park) on February 19, 2015, making it a component of the National Park System. Now, as of Labor Day 2021, the building hosts the National Park Service's Visitor Center.

1.2 Work Covered by the Contract Documents:

A. Project Location: 610 E 111th Street, Chicago, Illinois 60628

B. Work consists of: The goal of this project is to build-out the second floor to enhance NPS ability to provide education and community outreach programs and support NPS with additional office space. The third floor shall be designed for storage and the potential for partner leasing. Other improvements include: Elevator installation within existing white box shaft to serve all 3 levels; expand HVAC to all 3 levels; restrooms for assembly, storage and business occupancies; Finishes including flooring, acoustical ceilings, painting, doors, audio visual systems, computer network wiring, lighting, electrical, fire alarm, and fire sprinkler modifications.

C. All work will be performed under a single contract.

D. Period of performance: Work shall be completed within 245 calendar days of the start date provided on the Notice to Proceed.

*a.* Clarification: The Notice to Proceed will be issued with a period of performance that is all inclusive of supply lead times, material deliveries, decommissioning, installation, anticipated average weather days for location, final commissioning, and acceptance of completed work. The contractor will be expected to provide a project schedule with adequate critical path details to ensure all work is completed within the stated calendar days from issuance of the Notice to Proceed.

1.3 Existing Condition Protections:

A. Preservation of Historical and Archeological Fabric:

i. The Historic and Archeological Data Preservation Act of 1974 provides for the preservation of historical and archeological data that might otherwise be lost as the result of alterations to the terrain caused by a federal or federally licensed activity or program.

ii. IF, in connection with operations under this contract, the Contractor, subcontractors, or employees of any of them, discovers, encounters or becomes aware of any possible historical or archeological remains or data, objects or sites of cultural value on the project area, such as historical ruins, graves or grave markers, fossils, or artifacts not specifically noted within the contract. The Contractor shall immediately suspend all operations in the vicinity and continue work in other areas outside a 50 foot radius of discovery and notify the Contracting Officer immediately. When safe to do so, follow up in writing with photographs within 2 days, giving the location and nature of the findings. No objects of cultural resource value may be removed. Contracting Officer will contact other entities as required.

iii. Where appropriate by reason of discovery, the Contracting Officer may order delays in the time of performance and/or changes in the work. If such delays and/or changes are ordered, the time of performance and contract price shall be adjusted in accordance with Changes clause.

iv. The Contractor will be responsible for protecting the cultural resources within and adjacent to the project area from damage. In addition, the Contractor will be liable for all damage to the cultural resources caused by their actions or the actions of their agents or representatives. The Contractor shall immediately notify the Contracting Officer or their representative if any damage occurs to any cultural resource and immediately suspend work in the area in which damage has occurred until authorized to proceed.

v. The Contractor agrees to include this language within all subcontracts.

B. The structure involved in the work of this Contract is a designated historic structure listed in the National Register of Historic Places. Every precaution shall be taken by the Contractor to prevent damage to existing historical materials, structural components of the building and to the surrounding area. Should any damage be incurred as a result of the Contractor's operations at the site, it shall be repaired, or the damaged materials replaced in kind by the Contractor to the satisfaction of the Contracting Officer at no additional expense to the Government. There are historic design and construction requirements for the exterior of the building. There are no historical requirements for the interior of the building. The historical design requirements included in this project scope of work include the following: rooftop mechanical equipment location (visibility from street) and window shade color selection.

C. There is no excavation required for this project.

ITEM 2 – PROTECTING EXISTING UTILITIES

2.1 Protecting Existing Utilities: Notify Contracting Officer (CO), Contracting Officer's Representative (COR) and utility companies as required to request location services prior to and to coordinate any excavation/digging operations, and/or for demolition if within Scope of Work.

2.2 Contractor shall be responsible for locating and preventing damage to known utilities on site or indoors. If contractor damage occurs, alert CO and COR as soon as safely possible, and repair utility at no additional expense to the Government. If damage occurs to an unknown utility, contact CO and COR as soon as safely possible.

2.3 Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Government or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated below:

A. Notify CO and COR not less than two business days in advance of proposed utility interruptions.

B. Hours for Utility Shutdowns: Shutdowns shall not exceed 2 hours. Temporary provisions will be needed by the Contractor for periods longer than stated allowance or if required for critical systems as determined by COR.

C. Contractor shall take special care to coordinate any utility shutdowns with COR and to avoid shutdowns during peak visitation times, special events, or any other times identified by the COR.

ITEM 3 - CONTRACTOR'S USE OF PREMISES

3.1 Conduct of Operations: At all times the contractor shall conduct his operations in conformance with the rules and regulations promulgated by the Secretary of the Interior for the National Park Service, and applicable park rules and regulations prescribed by the Park Superintendent. www.nps.gov/pull/learn/management/superintendent-s-compendium.htm

A. Communications: Contractor shall provide the Contracting Officer and COR with methods of communications including land and/or cell phone numbers (note some areas of work have limited service coverage), email and in case of emergency 24-hour contact options for duration of time operations.
B. Contractor must provide job trailer and on-site supervision during the entire period of performance.
   a. Job trailer must have ability to hold regular project review meetings.
   b. Contractor superintendent must be onsite during all construction activities.

C. No signs or advertisements (except those specified herein and as required for safety) shall be displayed on the construction site or within the park unless approved by the Contracting Officer.

D. Smoking is not permitted within any Federal building or within 25 feet of entrances, operable windows, or outdoor air intakes.

E. Public Use of Site: Contractor shall at all times conduct operations to ensure the least inconvenience to the public. Site surrounding project is co-opt with the State of Illinois. The park may have up to 5 events during the construction of this project. The Contractor will have to plan with COR to avoid construction activities impacting these events.

3.2 On-site work hours: Work shall be generally performed during normal business working hours of 6:30 am to 6:30 pm., Monday through Friday, except when otherwise indicated. Work on

Saturdays, Sundays, Federal holidays, early morning, or at night may not be performed without prior consent from the CO and COR. Submit requests for work outside of the stated normal business hours to the CO and COR for approval at least 48 hours in advance of the work.

The following Federal holidays are observed by the National Park Service:
New Year's Day
Inauguration Day
Martin Luther King, Jr's Birthday
Washington's Birthday
Memorial Day
Juneteenth National Independence Day
Independence Day
Labor Day
Columbus Day
Veterans Day
Thanksgiving Day
Christmas Day

- Note: Any of the above holidays falling on a Saturday will be observed on the preceding Friday; holidays falling on Sunday will be observed on the following Monday. The specific day that each holiday is recognized for each year can be found at the following site: Federal Holidays (opm.gov).

3.3 Contractor Use of Site:

A. General: Contractor shall have limited use of the site for construction operations. Limit use of premises to construction area as shown on site plan. Do not disturb portions of Project site beyond areas in which the Work is indicated.

B. Driveways and Entrances: Keep driveways, access roads, and entrances serving premises clear and available to Government, Government's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize use of driveways and entrances.

C. Do Not disturb site outside of noted disturbance area, including earthwork, and clearing of vegetation, to:

1. See site plan for staging and restoring to pre-project conditions.

Contractor shall provide appropriate matts for equipment on turf areas to reduce soil compaction. Contractor shall remediate soil compaction as directed to do so by the CO/COR.

D. Utilities
1. General: Cost or use charges for temporary facilities shall be included in the Contract Sum as required.

2. Water Service: Water from existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations without any additional permit costs. Use resources

wisely and minimize waste of water.

3. Electric Power Service: Electric power from existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations without any additional permit costs. Power may or may not meet your construction power tool requirements, provide generators if questionable. Use power in a resourceful manner and avoid excess power waste.

4. Sanitary Operations:

    a. Toilets: Contractor must provide toilets for contractor personnel, sufficiently lighted and ventilated toilet facilities in weatherproof, sight proof, handicap accessible (if required), sturdy enclosures with privacy locks. Coordinate with COR for approved location if not shown on attached site plan.

    b. Additionally, the following shall be provided as part of the contract:
        a. 2 trailerized restrooms with heating, ventilation, lighting and running water. An example of these trailers can be found from Floods Royal Flush, but many providers are available.
            i. The trailers need to provide 2 separate handicap accessible restrooms and minimum 4 stalls total with separate men's and women's restrooms.
            ii. Provide signage to direct visitors to the restrooms.
        b. Power to be provided with generator by contractor or vendor. Water to be provided by water tanks by contractor or vendor.
        c. A trailer restroom will need to be provided for the duration of time where access to the ground floor restrooms are not available because of construction activities. This trailer restroom shall provide lighting, ventilation, heating/cooling and running water. Handicap accessible fixtures may be a portable unit.
        d. Contractor will be responsible for cleaning and supplying the restrooms. At a minimum the restrooms shall be cleaned daily and product restocking should be checked on regularly. Based on number of visitors, bathrooms may need to be cleaned multiple times of day. COR to notify contractor if there are visitor requests or concerns related to restrooms cleanliness and/or restocking.
        e. Operations to remove waste from the trailers should take place during off hours to prevent disruption to the visitors.
        f. Temporary restrooms are provided for park visitors and staff while the first floor restrooms are unable to be used during construction. Not for contractor use.
        g. Contractor must coordinate work requiring shut down of existing restrooms to minimize the use of temporary facilities for visitors and staff. Shutdown time must be coordinated with and approved by the COR prior to implementation.

E. Security and Protection facilities:

1. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with state and federal environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

2. Cleaning of Equipment: The Contractor shall ensure that prior to moving on to the Project Area, all equipment, is free of soil, seeds, vegetative matter, or other debris that could contain or hold seeds. Ensure that all equipment has been pressure washed and is free of exotic species prior to start-up of operations and moving of equipment to Project Area. Equipment shall be considered free of soil, seeds, and other debris when a visual inspection does not disclose such material. Disassembly of equipment components or specialized inspection tools are not required.

3. Tree and Plant protection is not required for this project.

4. Pest Control: Follow best practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at project completion. Perform control operations lawfully, using environmentally safe materials.

5. Temporary Enclosures: Before construction operations begin, furnish, install and maintain portable six (6) foot tall chain link fencing in a manner that will prevent people and animals from easily entering site and or storage areas except by entrance gates. Chain link fences should have color neutral fabric covering or slatting.

6. Hot Work Permit: Submit HW-1 Hot work permit form and receive approval from COR prior to Hot work activities commencing on site.

3.4 Storage - Staging Areas:

A. Confine Storage of materials and equipment to the project staging area noted on the plans/aerial. Specific storage units shall be provided by the contractor and exact location within staging area shown in appendix A below may be discussed at the preconstruction briefing. All storage units provided by the contractor shall be in a clean and acceptable condition to the COR. Security of the materials and equipment on site is the Contractor's responsibility.

3.5 Preservation of Natural Features: N/A

3.6 Hauling Restrictions: Contractor shall verify and be responsible for the path accessing the site and obtaining / maintaining all local, state and federal permits/licenses associated with hauling/road requirements and dumping of materials associated with the project.

3.7 Waste Removal, Recycling, and General Housekeeping:

A. Keep project site in a neat, orderly, and safe condition at all times.

1. Contractor is responsible for providing dumpsters for waste and recycling and for removing all waste created by the project. Contractor shall recycle to the highest degree possible and empty dumpsters as necessary to avoid debris on site. Coordinate with COR for approved dumpster locations prior to commencing construction.

2. Dispose of waste materials and recycling legally outside the park. The contractor shall not use park dumpsters.

3. Address Recycling: Government goal is to salvage and recycle as much nonhazardous construction waste as possible. Use sustainable methods to the extent possible during this project, recycling material as much as possible within local means. Maintain accurate documentary records for submittal of all recycled materials used including fly ash and slag cement.

4. For all waste and recycling removals offsite, contractors shall provide estimates and/or tickets to quantify material weights and report back to the park, submit to COR for review and record filing.

5. Existing brick that is to be demolished must be carefully removed and stacked for reuse on site. Coordinate storage location with COR.

3.8 Occupancy Requirements for Buildings:

A. Existing Buildings:

1. Full Government Occupancy: Government will occupy buildings that will be under construction during the entire contract period. Cooperate with Government during construction operations to minimize conflicts and facilitate Government usage. Perform the Work so as not to interfere with Government's day-to-day operations. Maintain existing exits, unless otherwise indicated. Contractor will maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from the CO or COR. Contractor will maintain existing building in a weather tight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

B. New /Existing Buildings Unoccupied:

1. N/A

3.9 Photo Documentation:

A. Contractor must provide existing condition, progress, and completion photos. All photos shall be in focus, show maximum range of depth of field general photo and then close up detail photo as needed. Shall be in JPEG digital form and submitted preferably electronically by email or optional via CD-R Archival Gold or DVD-R Archival Gold media with printed labels and 8 mega pixels minimum within 7 days from time of taken or as approved by COR.

B. Existing Condition Images:

1. Before starting construction, take color, dated, digital images of project site and adjacent property/roads/etc. that may be impacted by construction activity/traffic. Include existing items to remain or be salvaged from different vantage points and with context for location identification.

C. Construction Progress Images:

1. Document all sub-surface work/ trenches etc. prior to backfill with photos covering enough overall field view to show location and then zoom in for details. (Locations and dimensions shall also be noted on as built drawing set.)
2. Maintain organized index for photos with date, description, etc.
3. Additional images as needed when questions or emergency situations occur. Submit within 24 hours.

D. Completion Images:

1. Document all completed work within scope of work.
2. Maintain organized index for photos with date, description, etc..
3. Additional images as needed when questions or emergency situations occur. Submit within 24 hours.

3.10 Fire and Life Safety:

A. As a minimum, conduct one weekly 15 minute "toolbox" safety meetings. These meetings shall be conducted by a foreman or supervisor and attended by all construction personnel at the worksite. Topics need to coincide with work scheduled for the following week. Document and submit meeting minutes to the CO and COR within one day after the meeting and document the meetings on the daily reports.

B. Comply with the requirements of NFPA 241 (Standard for Safeguarding Construction, Alteration, and Demolition Operations). Take all necessary precautions to prevent fire during construction. Provide adequate ventilation during use of volatile or noxious substances.

C. Store and handle hazardous materials in accordance with manufacturers and OSHA 29CFR1926 Subpart D requirements 1926 | Occupational Safety and Health Administration (osha.gov). Maintain readily available, on site, MSDS/Safety Data Sheets (SDS) for each chemical.

1. Immediately report all spills of hazardous materials to the CO, COR, and park.
2. Maintain a spill emergency response kit.
3. Train employees how to respond to a spill and use the emergency response kit.

3.11 Noise and Acoustics Management

A. Contractor shall not have personal radios or other media sources and they shall not be broadcast within NPS property.

B. Noise Control: Perform operations to minimize noise. Perform noise-producing work in less sensitive hours of the day or week as directed by the Contracting Officer or COR.

C. Repetitive and/or intermittent, high-level noise: Permitted only during Daytime.
a) Coordinate with COR prior to execution.

ITEM 4 - COMMENCEMENT, PROSECUTION, AND COMPLETION

4.1 The Contractor shall commence work in accordance with the terms and conditions of the contract. Contractor shall coordinate and incorporate long lead and delivery time items within the schedule.

4.2 Products included in specifications or approved equals need to comply with the Buy American Act.

ITEM 5 - EXAMINATION OF THE SITE

5.1 All bidders are urged to visit the job site and examine existing conditions before submitting bids. Contractors will be accountable for understanding existing conditions. No cost changes for items visible during site visit will be allowed.

ITEM 6 - ABBREVIATIONS

6.1 The list of abbreviations, standards and organizations which may be used in/referred within the Construction Specifications or Special Provisions, may be found linked from the listed page below. On the home page, follow the link under **"Contracting and Procurement"** labeled **"NPS Reference Standards."** https://www.nps.gov/orgs/1671/do-business-with-us.htm

ITEM 7 - ACCIDENT PREVENTION

7.1 Description: The work of this section consists of establishing and implementing an effective accident prevention program (APP) and providing a safe environment for all personnel and visitors.

7.2 Submittals:

A. Accident Prevention (Safety) Plan (APP): Submit a **site-specific** accident prevention (safety) plan. The Plan shall be written to comply with OSHA and project requirements (a generic plan is not acceptable) including but not limited to the following:

1. Name and qualifications of responsible supervisor to carry out the program.
2. First aid and rescue procedures.
3. Training, both initial and continuing.
4. Outline of each phase of the work, the hazards associated with each major phase, and the methods proposed to provide for property protection and safety of the public, National Park Service personnel, and Contractor's employees. Identify the work included under each phase, with a Job Hazard Analysis (JHA)/Job Safety Analysis (JSA), etc. A sample JHA template may be provided upon request.
5. Planning for possible emergency situations, such as cave-ins, earthquake, explosions, fires, floods, power outages, slides, and windstorms. Such planning shall take into consideration the nature of construction, site conditions, and degree of exposure of persons and property.
6. Contractor to identify nearest location of medical facility for emergencies
7. Recognition that works will be performed in remote areas with limited communication or cell phone coverage if applicable.
8. Supplemental hazard specific plans may be required IAW 29 CFR 1926 or 1910.

B. Meeting and Inspection Reports: Safety Meetings: As a minimum, conduct 15 minute "toolbox" safety meetings. These meetings shall be conducted by a foreman and attended by all construction personnel at the worksite. Submit a report of safety meetings and inspections

to CO and COR within one day after the meeting and document the meetings on the daily reports.

7.3 Qualification of Employees:

A. Ensure that employees are physically qualified to perform their assigned duties in a safe manner to include operators of vehicles and equipment. Provide operating instructions for all equipment.

B. Do not allow employees to work whose ability or alertness is impaired because of drugs, fatigue, illness, intoxication, or other conditions that may expose themselves or others to injury.

7.4 Accident Reporting: The Contractor shall report all accidents to the CO and COR as soon as safely possible and assist the CO and COR and other officials as required in the investigation of the accident.

7.5 First Aid Facilities: Provide access to facilities for the number of employees and appropriate to the hazards associated with the types of ongoing construction work at the site.

7.6 Emergency Instructions: Post telephone numbers and reporting instructions for ambulance, physician, hospital, fire department, and police in conspicuous locations at the work site.

7.7 Personal Protective Equipment (PPE): It is the Contractor's responsibility to require all those working on or visiting the site to wear necessary protective equipment at all times.

A. PPE must meet requirements of applicable ANSI standards. Selection shall conform to OSHA 29CFR 1926 Subpart E.

B. A hard hat use area shall be designated by the Contractor. The hard hat area shall be posted by the Contractor in a manner satisfactory to the Contracting Officer.

C. All PPE will be serviceable at all times. At a minimum, maintain 2 sets of PPE including hard hats and all other Accident Prevention Plan required equipment.

7.8 Hazardous Materials: It shall be the responsibility of all operators and contractors, functioning within the park to properly cleanup, mitigate and remediate if necessary, all unauthorized discharges of hazardous materials or non-hazardous chemical and biological products released from fleet and/or other support vehicles or stationary sources. Response shall be consistent with guidelines established by federal, state, and local regulations, and as outlined within the operator's Safety or Hazardous Materials Business Plan.

A. If a spill, leak, or other release occurs, the operator shall as soon as possible, without impeding cleanup, notify the local 911 Emergency Response, COR and or the National Park Service Emergency Dispatch.

ITEM 8 - PRECONSTRUCTION CONFERENCE

8.1 If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed. See Item 9.1C below.

ITEM 9 - SUBMITTALS

9.1 General Contracting Submittal Procedures:

A. General: Prepare and submit submittals required by individual Technical Specification Sections. Types of submittals are indicated in individual specific sections.

1. CM-16 Transmittal Form: All submittals shall be transmitted via electronic email using National Park Service form CM-16 form. The form will be provided by the Contracting Officer. No action will be taken on a submittal item unless accompanied by the CM-16 transmittal form. Submit completed CM-16 forms to the CO and the COR

B. Submittal List: administrative required submittals are listed below in 9.1.C and does not include technical section submittal requirements included in each technical section.

C. Preconstruction Conference Submittal: Satisfactory evidence of liability insurance coverage and workman's compensation, and any applicable bonds, must be submitted within 10 calendar days of Notice of Award. The following items are to be submitted prior to the Preconstruction Conference or as specified at the CO's discretion. The timeline for the documents to be submitted will be addressed at the pre-construction conference for those items that were not received and approved prior. Notice to Proceed may not be issued, and the Contracting Officer will consider other contractual remedies if not resolved as directed. Work shall not commence until written Notice to Proceed has been issued. Contracting Officer will notify Contractor of tentative date for the Pre-Construction Conference:

1. Letter designating Project Superintendent.
2. Construction Schedule. (Must include shop drawings, procurement time including long lead time items, mobilization, trade work progression and completion at minimum.)
3. A comprehensive breakdown of the Schedule of Values.
4. Accident Prevention (Safety) Plan (see section 7 of this document).
5. A list of Subcontractors for this project.
6. Written statements from subcontractors certifying compliance with applicable labor standard clauses (SF1413).
7. Quality Control Plan.
8. Waste Management Plan. **["N/A"]**
9. Temporary Storm Water Pollution Prevention Plan (SWPPP or UPPP) Submitted to AHJ (Authority Having Jurisdiction). **["N/A"]**
10. Indoor Air Quality (IAQ) Management Plan. **["N/A"]**
11. Contractors Commissioning Plan. **["N/A"]**
12. Historic Preservation Treatment Plan Submitted to AHJ (Authority Having Jurisdiction). **["REQUIRED for this project."]**
13. List of Construction Permits. Include the following information for each permit: **["REQUIRED for this project."]**
    a. IDNR: Illinois Special Activity Permit.

i. https://dnr.illinois.gov/content/dam/soi/en/web/dnr/parks/camp/documents/activitypermit.pdf.

9.2 Project Submittal Process (Shop Drawings, Product Data, and Samples): Contracting Officer will provide sample cover sheet and a list of required submittals is included in each technical specification or attached at the end of this document.

A. Shop Drawings: Contractor must review all shop drawings for compliance with construction documents prior to submittal. Uncoordinated, unclear, or unreviewed shop drawings will be rejected without review or comment.
B. Shop Drawings: Indicate all coordinating materials and work impacting the installation coordination, connection details, anchorage requirements, hardware locations, and installation details and locations.

1. Submit Shop Drawings according to Part 9.1 of this section to include one digital file (.PDF or .TIF) and two full size hardcopy documents to COR.

C. Product Data: Provide component construction and specification data sheets, anchorage requirements and any other product specific data.

1. Submit Product Data according to Part 9.1 of this section to include one digital file (.PDF or .TIF) to COR.

D. Samples: Submit 2 color samples 4” x 6” minimum in size for all product color selections. Paint samples shall be actual paint finish drawdown for all project colors.

1. Submit Samples CM-16 Transmittal Form according to Part 9.1 of this section to include one digital file (.PDF or .TIF) and physical samples of actual material to COR.

E. For submittals specified above, forward submittals to Contracting Officer and COR at least 15 days before need for approval (depends on length of project).

F. After reviewing submittals, Contracting Officer and/or COR will return one copy to the Contractor. If submittals are rejected, Contracting Officer will return all copies to Contractor with reasons for rejection. Resubmit, identifying changes. Any work done before approval shall be at Contractor's own risk.

G. Shop drawing review is provided as a courtesy. Shop drawing submittals, whether approved or not, are not contract documents and do not modify the requirements of the contract.

9.3 Approved Equals: All brand names noted are subject to ‘or equal’ products. If an item in this solicitation is identified as “brand name or equal” or lists more than 1 manufacturer, the description of the proposed item must reflect the characteristics and level of quality that will satisfy the Government’s needs as demonstrated by the salient physical, functional, or performance characteristics that “equal” products must meet and/or exceed that as specified in the solicitation or relevant specification. Contractor shall incorporate and be responsible for all collateral costs due to the or equal proposed as required to provide a complete project.

A. For each item proposed as an “approved equal,” submit supporting data, including:

1. Drawings and samples as appropriate.
2. Comparison of the characteristics of the proposed item with that specified and with the salient characteristics provided.
3. Changes required in other elements of the work because of the substitution.
4. Name, address, and telephone number of vendor.
5. Manufacturer's literature regarding installation, operation, and maintenance, including schematics for electrical and hydraulic systems, lubrication requirements, and parts lists. Describe availability of maintenance service, and state source of replacement materials.

B. A request for approval constitutes a representation that General Contractor:

1. Has investigated and shall provide documentation in request showing that the proposed item is equal or superior in all respects to the salient characteristics specified.
2. Will meet or exceed warranties for the proposed item specified.
3. Has determined that the proposed item is compatible with interfacing items.
4. Will coordinate the installation of an approved item and make all changes required in other elements of the work because of the substitution.
5. Waives all claims for additional expenses that may be incurred as a result of the substitution.

C. Approved Equals will be evaluated and approved/disapproved during the submittal process.

9.4 Schedule of Values: Submit the Schedule of Values a minimum of one week prior to the Preconstruction Conference for COR review. Schedule of Values shall include defined work line items with cost break downs including labor, material, and equipment for COR approval.

9.5 Progress Reporting: The initial Construction Schedule and Schedule of Values are required a minimum of one week prior to the Preconstruction Conference. After the Notice to Proceed is issued and after on-site work begins, progress will be documented via daily logs and by providing an updated Construction Schedule and Schedule of Values when requested, but minimally with each pay application. Submit digital copy electronically (PDF preferred) of all required documents. Construction Schedules are normally in bar chart form and indicate estimated starting and completion dates for each part of the work. For a pay application to be reviewed and processed in a timely manner, the following information must either be submitted prior to or accompany submission of the pay application:

A. Daily/weekly progress reports during construction as part of the administration process.

B. Updated Schedule of Values: Breakdown each lump-sum item into component work activities used in the schedule, for which progress payments may be requested. The Schedule of Values will form the basis for payment. The work activities broken out within the schedule of values shall be integrated into and made a logical part of the construction baseline schedule submitted under this specification. The total costs for the component work activities shall equal the contract price for that lump-sum item. The Contracting Officer may request data to verify accuracy of dollar values. A sample Schedule of Values format may be provided upon request.

10.1 It is the Contractor's responsibility to provide temporary services, equipment, tools, and skilled labor as required for the chosen means and methods to perform the work in accomplishing this Contract.

ITEM 11 - PROJECT CLOSEOUT

11.1 Description: The work of this section consists of final cleanup, closeout submittals, final inspection procedures working toward Final Acceptance.

11.2 Cleaning: Remove all tools, equipment, surplus materials, and rubbish. Move attic stock to location coordinated with COR. At time of final inspection, project shall be thoroughly clean and ready for intended use. Inspector holds the right to reschedule if project is not ready for inspection.

11.3 Completion and Final Inspection: Contractor shall submit written certification of project completion and request a final inspection to the Contracting Officer and COR. The Contracting Officer or designee will make an inspection within 10 days of receipt of request or at a mutually agreeable time.

A. If the work is determined to be complete following the final inspection with minor comments, the COR will prepare and provide the Contractor a Punch List noting outstanding items to be addressed.
B. If the work is not determined to be complete following the final inspection, the Contracting Officer will notify Contractor in writing, stating reasons. Contractor, after completing the work according to the Contract Documents, shall resubmit completion and request a new final inspection. Re-inspection costs may be charged against the Contractor in accordance with the Inspection of Construction contract clause.

C. Contractor shall complete the Punch List within 30 calendar days, or a time directed by the CO.

D. Once Contractor completes all items of work on the Punch List and all contractually required items are accepted, Contracting Officer will issue Letter of Final Acceptance of Work and request the final pay application.

E. If the Contractor fails to complete the work within the time frame, the Contracting Officer may correct the work with an appropriate reduction in contract price or charge for re-inspection costs in accordance with the Inspection of Construction contract clause.

F. Disposition of any permits and warranties required by the specifications in this section.

11.4 Final Acceptance of the Work: After all punch list deficiencies have been corrected, a Letter of Final Acceptance will be issued. A Release of Claims document must be executed and submitted to the Contracting Officer before final payment can occur.

11.5 Warranties

A. Construction Warranty shall be based on date of final acceptance of the work and remain in effect for one year.

B. Provide all manufacturer warranty information of products installed organized by Division. All contact information, extent of coverage and conditions shall be clearly noted as well as date of overall final acceptance.

11.6 Operation and Maintenance

a. Provide operation and maintenance manuals for each warranted product organized by division.
b. Provide operation and maintenance training to building staff (as identified by COR) for each warranted product.
    i. Training must be provided in person.
    ii. Provide a recording of all trainings to COR for use in ongoing staff training. Recording must be of a high quality.
c. Absent, unorganized, or low quality operation and maintenance documentation and training is cause to withhold final acceptance.

ITEM 12 - DEFINITION OF CONTRACT LINE ITEMS

12.1 Summary

A. The intent of this section is to explain, in general, what is and what is not included in a contract line item, and the limits or cut off points where one item ends, and another begins.

B. If no contract line item exists for a portion of the work, include the costs in a related item.

12.2 List of Contract Line Items

A. Contract Line-Item No. CLIN (Schemmer to provide)

1. This item consists of CLIN (Schemmer to provide).
2. Payment will be made per the contract and percentage of completion level.

**END OF SECTION**

## SECTION 03-35-11 - CONCRETE FLOOR FINISHES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Clear coatings.

#### 1.02 SUBMITTALS

A. See Section 01 10 00 Short Form General Requirements, for submittal procedures.

B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.

C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

#### 1.03 MOCK-UP

A. Mock-Up Size: 10 feet square.

B. Locate where directed.

C. Mock-up may remain as part of the work.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

#### 1.05 FIELD CONDITIONS

A. Maintain ambient temperature of 60 degrees F minimum and [90] degrees F maximum.

#### 1.06 WARRANTY

A. See Section Section 01 10 00 Short Form General Requirements for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 CONCRETE FLOOR FINISH APPLICATIONS

A. Clear Coating:

1. Use at following locations: See drawings for locations. This product to be used under Option 2..

#### 2.02 COATINGS

A. High Gloss Clear Coating: Transparent, nonyellowing, acrylic polymer-based coating.

1. Composition: Water-based.
    a. Nonvolatile Content: 20 percent, minimum, when measured by volume.
    b. Abrasion Resistance ASTM D4060 CS-17 1000 Cycles: 25mg loss.
    c. VOC ASTM D3960: <50 g/l
    d. Tensile Strenght ASTM D638: 4400 psi
    e. Products: Basis of Design
        1) Concrete Sealers USA; TS210: www.concretesealersusa.com/#sle.
        2) Substitutions: See Section 01 10 00 Short Form General Requirements.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

A. Verify that floor surfaces are acceptable to receive the work of this section.

B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

**3.02 GENERAL**

A. Apply materials in accordance with manufacturer's instructions.

**3.03 COATING APPLICATION**

A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.

B. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

C. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

**END OF SECTION**

## SECTION 04-20-00 - UNIT MASONRY

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Common brick.

B. Mortar and grout.

C. Reinforcement and anchorage.

### PART 2 PRODUCTS

#### 2.01 BRICK UNITS

A. Building (Common) Brick: Re-use existing brick. See sheet demolition sheets. If there are not enough salvaged bricks then contractor to find similar brick from a local brick yard. Salvaged brick need to be full bricks and cleared of mortar prior to reuse. Bricks to be evaluated for suitability prior to reuse.

1. Nominal size: As indicated on drawings.

#### 2.02 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type N.

1. Colored Mortar: Premixed cement as required to match Architect's color sample.

B. Grout Aggregate: ASTM C404.

C. Water: Clean and potable.

#### 2.03 REINFORCEMENT AND ANCHORAGE

A. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

B. Single Wythe Joint Reinforcement: ASTM A951/A951M.

1. Type: Truss or ladder.
2. Material: ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M Class 3.
3. Size: 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not less than 5/8 inch of mortar coverage on each exposure.

#### 2.04 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.

1. Interior, non-loadbearing masonry: Type N.

B. Colored Mortar: Proportion selected pigments and other ingredients to match adjacent masonry mortar, without exceeding manufacturer's recommended pigment-to-cement ratio.

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

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

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

**3.02 COURSING**

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Brick Units:

1. Bond: Running.
2. Coursing: Three units and three mortar joints to equal 8 inches.
3. Mortar Joints: Concave.

**3.03 PLACING AND BONDING**

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Remove excess mortar and mortar smears as work progresses.

C. Interlock intersections and external corners.

**3.04 GROUTED COMPONENTS**

A. Lap splices minimum 24 bar diameters unless noted on drawings.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

**3.05 BUILT-IN WORK**

A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout.

D. Do not build into masonry construction organic materials that are subject to deterioration.

**3.06 TOLERANCES**

A. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 3/8 inch in 20 ft, 1/2 maximum. or more.

B. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

**3.07 CLEANING**

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

**END OF SECTION**

## SECTION 06-10-00 - ROUGH CARPENTRY

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Communications and electrical room mounting boards.

B. Concealed wood blocking, nailers, and supports.

#### 1.02 DELIVERY, STORAGE, AND HANDLING

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

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. Species: Spruce-Pine-Fir (South) Spruce Pine Fir, unless otherwise indicated.
2. 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.
3. 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. Sizes: Nominal sizes as indicated on drawings, S4S.

B. Moisture Content: S-dry or MC19.

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring: as indicated on drawings.

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.

### 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.

**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. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

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. Grab bars.
4. Plumbing accessories.

**END OF SECTION**

## SECTION 06-41-00 - ARCHITECTURAL WOOD CASEWORK

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Specially fabricated cabinet units.

B. Countertops.

C. Hardware.

#### 1.02 SUBMITTALS

A. See Division 1 for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

C. Product Data: Provide data for hardware accessories.

D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet and shelf unit substrate and finish.

E. Samples: Submit actual sample items of proposed Drawer Slides, demonstrating hardware design, quality, and finish.

#### 1.03 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.

B. Quality Certification:

1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
2. 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.
3. Provide designated labels on shop drawings as required by certification program.
4. Provide designated labels on installed products as required by certification program.
5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
6. Replace, repair, or rework all work for which certification is refused.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect units from moisture damage.

#### 1.05 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), unless noted otherwise.

B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:

1. Finish - Exposed Exterior Surfaces: Decorative laminate.
2. Finish - Exposed Interior Surfaces: Solid phenolic.
3. Finish - Semi-Exposed Surfaces: Decorative laminate
4. Finish - Concealed Surfaces: Manufacturer's option.
5. Door and Drawer Front Edge Profiles: Square edge with thick applied band.
6. Casework Construction Type: Type A - Frameless.
7. Interface Style for Cabinet and Door: Style 1 - Overlay; flush overlay.
8. Adjustable Shelf Loading: 50 psf.
    a. Deflection: L/144.
9. Cabinet Style: Flush overlay.
10. Cabinet Doors and Drawer Fronts: Flush style.
11. Drawer Side Construction: Multiple-dovetailed.
12. Drawer Construction Technique: Dovetail joints.

## 2.02 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

## 2.03 LAMINATE MATERIALS

A. Manufacturers:

1. Arborite: www.arborite.com
2. Formica Corporation: www.formica.com
3. Panolam Industries International, Inc: www.panolam.com
4. Wilsonart LLC: www.wilsonart.com
5. Substitutions: See Division 1.

B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as follows:

1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness.
2. Vertical Surfaces: VGS, 0.028 inch nominal thickness.
3. Cabinet Liner: CLS, 0.020 inch nominal thickness.
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 COUNTERTOPS

A. Countertops: See Section 12-36-00.

## 2.05 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.
   1. Color: As selected by Architect from manufacturer's standard range.
B. Plastic Edge Banding: Extruded 3mm PVC, flat shape; smooth surface finish; of width to match component thickness.
   1. As selected by Architect from manufacturer's standard range.
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.
E. Concealed Joint Fasteners: Threaded steel.
F. Grommets: Standard Stainless steel grommets for cut-outs, in color to match adjacent surface.

**2.06 HARDWARE**

A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
C. Drawer and Door Pulls: "U" shaped wire pull, steel with satin finish, 4 inch centers.
D. Drawer Slides:
   1. Type: Standard extension.
   2. Static Load Capacity: Heavy Duty grade.
   3. Mounting: Side mounted.
   4. Stops: Integral type.
   5. Features: Provide non-self closing type.
   6. Manufacturers:
      a. Hettich America, LP: www.hettich.com
      b. Knape & Vogt Manufacturing Company; Heavy-Duty Drawer Slides: www.knapeandvogt.com/#sle.
      c. Substitutions: See Division 1.
E. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
   1. Manufacturers:
      a. Grass America Inc: www.grassusa.com
      b. Hardware Resources: www.hardwareresources.com
      c. Hettich America, LP: www.hettich.com
      d. Substitutions: See Section 01 10 00 Short Form General Requirements.
F. Double Door Lock: Brass plated steel. 2" square mounting plate. 1/2" throw on each locking tongue. Keyed alike.
   1. Manufacturers:
      a. Rockler: BK0017 w/screws.
      b. Substitutions: See Section 01 10 00 Short Form General Requirements.

**2.07 FABRICATION**

A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

D. 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.

## 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.

E. Carefully scribe casework, countertops, and filler panels abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

F. 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.

### 3.04 CLEANING

A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

**END OF SECTION**

## SECTION 06-83-16 - FIBERGLASS REINFORCED PANELING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

#### 1.02 SUBMITTALS

A. See Section 01 00 00 Short for General 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.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:

1. Crane Composites, Inc: www.cranecomposites.com
2. Specialized Building Systems, Inc; : www.sbs-frp.com.
3. Nudo Products, Inc: www.nudo.com
4. Panolam Industries International, Inc: www.panolam.com
5. Substitutions: See Section 01 00 00 Short Form General Requirements.

#### 2.02 PANEL SYSTEMS

A. Wall Panels:

1. Panel Size: 4 by 8 feet.
2. Panel Thickness: 0.10 inch.
3. Surface Design: Embossed.
4. Color: White.
5. Attachment Method: Adhesive only, with trim and sealant in joints.

#### 2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.

1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
2. Sanitation and Cleanability: Comply with 9 CFR 416.2.
3. Chemical Cleanability: Excellent chemical resistance to common cleaners and detergents when tested in accordance with ISO 2812-1.

B. Trim: Vinyl; color coordinating with panel.

C. Adhesive: Type recommended by panel manufacturer.

D. Sealant: Type recommended by panel manufacturer; color matching panel.

### PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

## 3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut panels with carbide tipped saw blades or snips.

C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturer's recommended gap for panel field and corner joints.

F. Place trim on panel before fastening edges, as required.

G. Fill channels in trim with sealant before attaching to panel.

H. Install trim with adhesive as required.

I. Seal gaps at floor, and between panels with applicable sealant to prevent moisture intrusion.

J. Remove excess sealant after paneling is installed and prior to curing.

**END OF SECTION**

## SECTION 07-84-00 - 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 SUBMITTALS

A. Product Data: Provide data on product characteristics, performance ratings, and limitations.

B. Installer's qualification statement.

#### 1.03 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.

B. Installer Qualifications: Company specializing in performing the work of this section and:

1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
2. Verification of minimum three years documented experience installing work of this type.
3. Verification of at least five satisfactorily completed projects of comparable size and type.
4. Licensed by local authorities having jurisdiction (AHJ).

#### 1.04 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/#sle.
2. Hilti, Inc: www.us.hilti.com/#sle.
3. Specified Technologies Inc: www.stifirestop.com/#sle.
4. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
5. Substitutions: See Section 01 10 00 Short Form General Requirements.

#### 2.02 MATERIALS

A. Firestopping Materials: Any materials meeting requirements.

B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.

C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

D. Fire Ratings: Refer to drawings for required systems and ratings.

**2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS**

A. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.

**2.04 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS**

**2.05 FIRESTOPPING SYSTEMS**

A. Firestopping: Any material meeting requirements.

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. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

C. Install labeling required by code.

**3.04 CLEANING**

A. Clean adjacent surfaces of firestopping materials.

**3.05 PROTECTION**

A. Protect adjacent surfaces from damage by material installation.

**END OF SECTION**

## SECTION 07-92-00 - JOINT SEALANTS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Joint backings and accessories.

#### 1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical datasheets for each product to be used; include 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.

#### 1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Nonsag Sealants:

1. Bostik Inc: www.bostik-us.com
2. Dow Chemical Company: www.consumer.dow.com
3. Hilti, Inc: www.us.hilti.com
4. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us
5. Sika Corporation: www.usa-sika.com
6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com
7. W.R. Meadows, Inc: www.wrmeadows.com
8. Substitutions: See Section 01 10 00 Short Form General Requirements.

#### 2.02 JOINT SEALANT APPLICATIONS

A. Scope:

1. Interior Joints: 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. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
        1) Exception: Such gaps and openings in gypsum board finished stud walls and suspended ceilings. See Section 09-21-16 for additional information.
    c. Other joints indicated below.

B. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

1. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear.
2. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
3. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

**2.03 JOINT SEALANTS - GENERAL**

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

**2.04 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.

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, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

**3.02 PREPARATION**

A. 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.

**3.03 INSTALLATION**

A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Provide joint sealant installations complying with ASTM C1193.

C. Install acoustical sealant application work in accordance with ASTM C919.

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.

**END OF SECTION**

## SECTION 08-11-13 - HOLLOW METAL DOORS AND FRAMES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames.

D. Accessories, including glazing.

#### 1.02 SUBMITTALS

A. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

#### 1.03 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:

1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com
2. Curries, an Assa Abloy Group company: www.assaabloydss.com
3. Fleming Door Products, an Assa Abloy Group company: www.assaabloydss.com/#sle.
4. Republic Doors, an Allegion brand: www.republicdoor.com
5. Steelcraft, an Allegion brand: www.allegion.com
6. Substitutions: See Section 01 10 00 Short Form General Requirements.

#### 2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. 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.

2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Door Edge Profile: Manufacturers standard for application indicated.
4. Typical Door Face Sheets: Flush.
5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
6. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

**2.03 HOLLOW METAL DOORS**

A. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire-Rated:
   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. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
   2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
   3. Door Thickness: 1-3/4 inches, nominal.
   4. Door Face Sheets: Flush.
   5. Door Finish: Factory primed and field finished.

C. Fire-Rated Doors:
   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. Model 1 - Full Flush.
      d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
   2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
      a. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
      b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
      c. Attach fire rating label to each fire rated unit.
      d. Smoke and Draft Control Doors (Indicated with letter "S" on Drawings and/or Door Schedule): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;

1) Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
2) Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
3) Label: Include the "S" label on fire-rating label of door.

3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
4. Door Thickness: 1-3/4 inches, nominal.

**2.04 HOLLOW METAL FRAMES**

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
2. Frame Finish: Factory primed and field finished.

C. Door Frames, Fire-Rated: Full profile/continuously welded type.
1. Fire Rating: Same as door, labeled.
2. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
3. Frame Finish: Factory primed and field finished.

D. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

E. Transom Bars: Fixed, of profile same as jamb and head.

F. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

**2.05 FINISHES**

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

**2.06 ACCESSORIES**

A. Door Window Frames: Door window frames with glazing securely fastened within door opening.
1. Size: As indicated on drawings.
2. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
3. Metal Finish: Beige polyester powder coating.
4. Glazing: 1/4 inch thick, tempered glass, in compliance with requirements of authorities having jurisdiction.

B. Glazing: As specified in Section 08-80-00.

C. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.

D. Transom infill panels: Same construction and finish as door; same performance rating

E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.

F. 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.

G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

## 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 PREPARATION

### 3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and 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. Install door hardware as specified in Section 08-71-00.

E. Comply with glazing installation requirements of Section 08-80-00.

### 3.04 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 edge, corner to corner.

### 3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

B. Adjust sound control doors so that seals are fully engaged when door is closed.

C. Test sound control doors for force to close, latch, and unlatch; adjust as necessary in compliance with requirements.

**END OF SECTION**

## SECTION 08-14-16 - FLUSH WOOD DOORS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Flush wood doors; flush configuration; non-rated.

#### 1.02 SUBMITTALS

A. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

B. 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.

C. Warranty, executed in Owner's name.

#### 1.03 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 sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

#### 1.04 WARRANTY

A. Interior Doors: Provide manufacturer's warranty for the life of the installation.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:

1. Haley Brothers: www.haleybros.com/#sle.
2. Masonite Architectural: www.architectural.masonite.com/#sle.
3. Oregon Door: www.oregondoor.com/#sle.
4. VT Industries, Inc: www.vtindustries.com/#sle.
5. Graham Wood Doors<>: www.grahamdoors.com/#sle..
6. Marshfield DoorSystems, Inc[<>]: www.marshfielddoors.com/#sle.
7. Substitutions: See Division 1.

#### 2.02 DOORS AND PANELS

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 unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.

1. Provide solid core doors at each location.

C. Transom Panels: Same construction and finish as door; same performance rating as door.

## 2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

## 2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

## 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. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.

D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

F. Provide edge clearances in accordance with the quality standard specified.

## 2.06 FINISHES - WOOD VENEER DOORS

A. 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 - 9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
    b. Color: As selected by Architect. To match existing doors on first floor.
    c. Sheen: Satin.

B. Factory finish doors in accordance with approved sample.

C. Seal door top edge with color sealer to match door facing.

## 2.07 ACCESSORIES

A. Hollow Metal Door Frames: See Section 08-11-13.

B. Glazed Openings:

1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
2. Glazing: Single vision units, 1/4 inch thick glass.
3. Tint: Clear.

C. Door Window Frames: Door window frames with glazing securely fastened within door opening.

1. Size: As indicated on drawings.
2. Frame Material: 18 gauge, 0.0478 inch, galvanized steel.
3. Metal Finish: Factory primed and field finished.

4. Glazing: 1/4 inch thick, tempered glass, in compliance with requirements of authorities having jurisdiction.

D. Glazing Stops: _____, butted corners; prepared for countersink style tamper proof screws.

E. Door Hardware: See Section 08-71-00.

## 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.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. 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

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

**END OF SECTION**

# SECTION 08 71 00 – DOOR HARDWARE

## PART 1 - GENERAL

### 1.01 SUMMARY

A. Section includes:
   1. Mechanical and electrified door hardware.
   2. Electronic access control system components.
   3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.
   4. 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. Cabinets (casework), including locks in cabinets
   2. Signage
   3. Toilet accessories
   4. Gates

C. Related Sections:
   1. Section 01 23 00 "Alternates" for alternates affecting this section.
   2. Section 06 10 00 "Rough Carpentry" for reinforcement walls for surface applied hardware.
   3. Section 06 20 00 "Finish Carpentry" for installation of door hardware.
   4. Section 07 92 00 "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
   5. Section 08 11 00 "Metal Doors and Frames" for required reinforcements applicable to material specified in this section.
   6. Section 08 14 00 "Wood Doors" for applicable preparations for material specified in this section.
   7. Section 09 90 00 "Painting and Coating" for touchup, finishing or refinishing of existing openings modified by this section.

### 1.02 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. Keying Systems and Nomenclature
   4. Installation Guide for Doors and Hardware

C. ANSI - American National Standards Institute
   1. ANSI A117.1 (2017) – Accessible and Usable Buildings and Facilities
   2. ANSI/BHMA A156.1 through A156.17; A156.19 through A156.26; and A156.29 through A156.37 – Standards for Commercial Hardware and Specialties
   3. ANSI/BHMA A156.18 – Materials and Finishes
   4. ANSI/BHMA A156.28 – Recommended Practices for Keying Systems
   5. ANSI/WDMA I.S. 1A – Interior Architectural Wood Flush Doors
   6. ANSI/SDI A250.8 – Standard Steel Doors and Frames

D. NFPA – National Fire Protection Association
   1. NFPA 80 (2016) – Standard for Fire Doors and Other Opening Protectives
   2. NFPA 101 – Life Safety Code
   3. NFPA 105 – Standard for Smoke Door Assemblies and Other Opening Protectives
   4. NFPA 252 – Fire Tests of Door Assemblies

## 1.03 SUBMITTALS

A. General:
   1. Submit in accordance with Conditions of Contract and requirements of Section 01 33 00 “Submittal Procedures”.
   2. Prior to forwarding submittal for architectural review:
      a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
      b. Review drawings and submittals from other trades to verify compatibility with specified hardware.
      c. Highlight, encircle, or otherwise specifically identify on submittals, deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:
   1. Product Data: Submit technical product data for each item of door hardware clearly marked and identified, illustrating, and describing each product in the Hardware Schedule.
      a. Include construction and material descriptions showing finish and other information necessary to show compliance with specification requirements.
   2. Door Hardware Schedule: Prepared by or under the supervision of a Door & Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC).
      a. Submit concurrent with submission of Product Data and Door and Frame Shop Drawings.
      b. Submit schedule with hardware sets in vertical format as illustrated by Sequence and Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each opening, including:
         1) Door Index, door number, heading number, and Architects hardware set number.
         2) Quantity, type, style, function, size, and finish of each hardware item.
         3) Handing of Pivots, Mortise Locks, Exit Devices and other items requiring special handing.
         4) Product name and manufacturer of each item.
         5) Fastenings and other pertinent information required for proper installation.
         6) Location of each hardware set cross-referenced to indications on Drawings.
         7) Explanation of all abbreviations, symbols, and codes contained in schedule.
         8) Mounting locations for hardware.
         9) Door and frame sizes and materials.
         10) Degree of Swing and Handing.
         11) List of related door devices specified in other Sections for each opening.

c. Submittal Sequence: Coordinate submission of door hardware schedule with construction scheduling requirements, to facilitate fabrication of other work that is critical to the Project Construction Schedule.

3. 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. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.
4. 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. Furnish 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. 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. Parts list for each mechanical product.
   d. Final approved hardware schedule, edited to reflect conditions as installed.
   e. Final keying schedule
   f. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

E. Inspection and Testing:
1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
   a. Required Egress Door Assemblies, in compliance with NFPA 101.

## 1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:
1. Supplier Qualifications and Responsibilities:
   a. Recognized architectural hardware supplier with a minimum of 5 years documented experience and a record of successful in-service performance for supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project.
   b. Supplier to have on staff a DHI certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to the Owner, Architect and Contractor at reasonable times during the Work for consultation on product or installation.
   c. Warehousing Facilities: In Project’s vicinity.

d. A factory direct supplier of the specified material.

2. Hardware Consultant: Person who is experienced in providing consulting services for door hardware installation that are comparable in material, design, and extent to that indicated for this Project and meet these requirements:
   a. For Door Hardware: DHI certified AHC or DHC:
   b. Furnish technical data and installation guidance to Architect, and other related sub-contractors.
   c. Capable of inspecting and verifying mechanical and electromechanical component s are properly installed and in working condition upon completion of installation.
   d. Scheduling Responsibilities:
      1) Preparation of door hardware and keying schedules
3. Installer Qualifications:
   a. A skilled tradesperson who is experienced in the application of commercial grade door hardware in projects of similar scope, type, size and quality with a record of successful in-service performance. Knowledgeable in reading and understanding a Door Hardware Schedule.
      1) Lead Installer minimum 5 years.
      2) Assistant Installers minimum 2 years.
      3) Maximum apprentice installers: 1.

B. Certifications:
   1. Fire-Rated Openings:
      a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
      b. 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 type and sized of doors indicated.
      c. Hardware 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.
   2. Smoke and Draft Control Door Assemblies:
      a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 80.
      b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu m per minute/sq m) at tested pressure differential of 0.3-in wg. (75 Pa) of water.
   3. Accessibility Requirements:
      a. For door hardware on doors in an accessible route, comply with ANSI A117.1 – Accessible and Useable Buildings and Facilities governing accessibility regulations.
      b. This project to comply with all Federal Regulation for the American with Disabilities Act (ADA) and all local accessibility regulations.

C. Pre-Installation Meetings
   1. Keying Conference:
      a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
         1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
         2) Preliminary key system schematic diagram.
         3) Requirements for key control system.
         4) Requirements for access control.
         5) Address for delivery of keys.
   2. Pre-installation Conference
      a. Participants to include: Contractor, Installation Supervisor, Lead Installer, Hardware Supplier.

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 frames and discuss preparatory work performed by other trades.
3) Review any special product installation requirements or installation sequences.
4) Review required testing, inspecting, and certifying procedures.
5) Review questions or concerns related to proper installation and adjustment of door hardware.

D. Buy American Compliance: Materials provided under work of this section shall comply with the following requirements:
1. Buy American Act of 1933 BAA-41 U.S.C., 10a - 10d.
2. Buy American Act provision of section 1605 of the American Recovery and Reinvestment Act of 2009 (ARRA)

E. Inspection and Testing:
1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
a. Fire Door Assemblies in compliance with NFPA 80.
b. Required Egress Door Assemblies, in compliance with NFPA 101

F. 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.
4. Deliver keys to Owner by registered mail or overnight package service. Furnish one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
5. Forward bitting list, key cuts and key system schematic from factory directly to Owner, by means as directed by Owner.

## 1.05 DELIVERY, STORAGE, AND HANDLING

A. Tag each item or package separately with opening number 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.
2. Furnish complete packing list with each delivery showing quantity and type of product delivered and opening number(s).

B. Jointly inventory door hardware with hardware supplier upon receipt.

C. Project Conditions:
1. 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.
a. Organize and store products on shelving.
b. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

1.06 COORDINATION

A. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Installation Templates: Distribute to relevant subcontractors for doors, frames and other work specified to be factory or shop prepared for door hardware.

C. Security: Coordinate installation of door hardware and keying with Owner's security consultant.

D. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions, and preparations. Coordinate existing opening conditions with newly specified hardware to suit opening conditions and for proper door operation.
   1. Inform architect of potential major conflict with proper door operation.

1.07 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 does not cover damage or faulty operation due to improper installation, improper use or abuse.
   2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.
      a. Mechanical Warranty:
         1) Locks: 10 years
         2) Closers: 30 years

      b. Key Blanks: Lifetime

1.08 MAINTENANCE

A. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 HINGES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product:
      a. Ives 5BB series
   2. Acceptable Manufacturers and Products:
      a. Hager BB series.
      b. McKinney TA/T4A series
      c. Best (Stanley) FBB series

B. Requirements:
   1. Provide hinges conforming to ANSI/BHMA A156.1.
   2. Provide five knuckle, ball bearing hinges.

3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
    a. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) up to and including 42 inches (1067 mm) wide:
    a. Interior: Heavy weight, steel, 4-1/2 inches (114 mm) high
5. 1-3/4 inch (44 mm) and 2 inch (51 mm) thick doors over 42 inches (1067 mm) wide
    a. Provide 1 additional hinge of the specified type per door leaf, in addition to specified quantity specified in this article.
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. 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.
8. 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.
9. 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

## 2.02 FLUSH BOLTS

A. Manufacturers:
    1. Scheduled Manufacturer:
        a. Ives
    2. Acceptable Manufacturers:
        a. Burns
        b. Rockwood
        c. Trimco
        d. Hager

B. Requirements:
    1. Provide manual flush bolts with forged bronze 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.

## 2.03 COORDINATORS

A. Manufacturers:
    1. Scheduled Manufacturer and Product: Ives COR Series
    2. Acceptable Manufacturers and Products: Burns 7600 Series; Rockwood 2600 Series

B. Requirements:
    1. Where pairs of doors are equipped with automatic flushbolts, 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 prepare coordinators for vertical rod exit device strikes as specified.

## 2.04 MORTISE LOCKS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Yale 8800FL Series (Facility Standard)
   2. Acceptable Manufacturers and Products: No Substitute

B. Requirements:
   1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
   2. Indicators: Where specified, provide indicator window color-coded with full text and/or symbols, as scheduled, for easy visibility.
   3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
   4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to “KEYING” article, herein.
   5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
   6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
   7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified. Provide thru-bolted escutcheons.
      a. Lever Design: Yale PBCN

## 2.05 EXIT DEVICES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Yale 7100 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. Provide only manufacturer’s approved strikes.
   3. Cylinders: Refer to “KEYING” article, herein.
   4. Provide exit devices with dead-latching feature for security.
   5. Provide exit devices cut to door width and height.
   6. Provide exit devices with touchpad that extends a minimum one half the width of the door.
   7. Provide glass bead kits or fillers to fill space behind exit device for flush mounting to face of door.
   8. Provide exit devices with trim designs to match other lever designs used on the project.

## 2.06 CYLINDERS

A. Manufacturers: Yale
   **1.** Scheduled Manufacturer and Product:
      **a. <Insert existing key system>**
   **2.** Acceptable Manufacturers and Products:
      a. No Substitute

B. Requirements:

1. Provide permanent cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

C. Construction Keying:
   1. Provide temporary construction cylinders for each lockable door.
      a. Furnish in accordance with the following requirements:
         1) 12 construction change (day) keys.
      b. Replace temporary construction cores with permanent cores at time of substantial completion.

## 2.07 KEYING

A. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Contact:
   1. Firm Name:
   2. Contact Person:
   3. Telephone:

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. Identification:
      a. Mark permanent cylinders/cores and keys with applicable blind code 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.
   4. Quantity: Furnish in the following quantities.
      a. Change (Day) Keys: 3 per cylinder/core.
      b. Master Keys: 6 per master key group.

## 2.08 DOOR CLOSERS

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: LCN 4040XP series (Facility Standard)
   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 piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
   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. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
   6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
   7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
   8. 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).
   9. 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.

## 2.09 PROTECTION PLATES

A. Manufacturers:
   1. Scheduled Manufacturer and Product: Ives 8400 series.
   2. Acceptable Manufacturers and Products: Burns Manufacturing 50 series; Rockwood Manufacturing K1050 series; Trimco Products K0050 series.

B. Requirements:
   1. Provide protection plates with a 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 plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a Sound Seal or edge guards.
   3. At fire rated doors, provide protection plates mounted over 16 inches high from the bottom of the door with UL label.

## 2.10 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:
   a. Scheduled Manufacturer and product: Glynn-Johnson 100 series as shown in the hardware groups.
   2. Acceptable Manufacturers and Products: ABH Manufacturing 1000 series; Rixson 9-series; Rockwood Manufacturing OH100 series.

B. Requirements:
   1. Provide overhead stop at any door where conditions do not allow for a wall stop or, where floor stop presents tripping hazard.
   2. Provide friction type at doors without closer and positive type at doors with closer.

## 2.11 DOOR STOPS AND HOLDERS

A. Manufacturers:
   1. Scheduled Manufacturer and Product: Ives WS401/402 series.
   2. Acceptable Manufacturers and Products: Burns Manufacturing 560 series; Rockwood Manufacturing 400 series; Trimco Products 1270C series.

B. Provide door stops at each door leaf:
   1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
   2. Where a wall stop cannot be used, provide Ives FS439 universal floor stops or equal product from acceptable manufacturers.
   3. Where wall or floor stop cannot be used, inform architect of change to provide an overhead stop.

## 2.12 SOUND SEALS

A. Manufacturers:
   1. Scheduled Manufacturer and Product: Zero International #188
   2. Acceptable Manufacturers and Products: National Guard Products #5050, Pemko Manufacturing #S44, Reese Enterprises #638

B. Requirements:
   1. Provide Self-Adhesive Silicone Sound Seal for hinge jamb, lock jamb and frame head.
   2. Furnish with pressure sensitive adhesive protected by a release liner that has high initial adhesion and long-term holding power from -30 to 150 degrees Fahrenheit.

## 2.13 SECURITY ASTRAGALS

A. Manufacturers:
   1. Scheduled Manufacturer and Product: Zero International #43
   2. Acceptable Manufacturers and Products: National Guard Products #139; Pemko Manufacturing #345; Reese Enterprises #183

B. Requirements:
   1. Provide fixed overlapping security astragal without holes for strike plate lip at pairs of doors where scheduled in the hardware groups.
   2. Security astragal to extend the full height of the secure side of the door.
   3. Provide through-bolts for mounting astragal at top and bottom of door.
   4. Provide TEK or self-drilling sheet metal screws for intermediate fastening between through-bolts centered not more than 8 inches (203 mm) apart.

## 2.14 SILENCERS

A. Manufacturers:
   1. Scheduled Manufacturer and Product: Ives #SR64/SR65
   2. Acceptable Manufacturers: Burns #500/501, Rockwood #608-RKW/609.

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 double door frame.

3. Omit where gasketing is specified.

2.15 FINISHES

A. Finish: BHMA 626/652 (US26D) – Satin Chrome on Brass or Bronze / Steel.; except:
   1. Automatic Flushbolts: BHMA 630 (US32D) – Satin Stainless Steel
   2. Protection Plates: BHMA 630 (US32D) – Stain Stainless Steel
   3. Coordinators: BHMA 628 (US28) – Clear Anodized Aluminum
   4. Overhead Stops and Holders: BHMA 630 (US32D) – Satin Stainless Steel
   5. Door Closers: BHMA 689 (ALUM)– Aluminum Powder Coat Paint
   6. Protection Plates: BHMA 630 (US32D) – Satin Stainless Steel
   7. Security Astragals: BHMA 600 (USP) – Prime Paint
   8. Smoke & Sound Seal: Black (BLK)
   9. Silencers: Gray (GRY)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, to ensure frames are installed Plumb, Level, Square and True, and the floor is level throughout the swing of the door.

B. Inspect labeled openings for proper fire-rating label, door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames and wall have been properly reinforced for hardware installation.

C. Confirm finishing of all frames and doors, and wash-down of concrete has been completed before beginning hardware installation.

D. Report unsatisfactory conditions to Architect. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Hollow Metal Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6

B. Wood Doors: Comply with door and hardware manufacturers' written instructions

3.03 INSTALLATION

A. Mount door hardware units at heights to comply with one of 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. Reinforce drywall partitions for surface applied door stops or holders.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. 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 or every 30 inches (750 mm) o for height, whichever is more stringent.

I. Exit Devices: Install level with floor at height recommended by exit device manufacturer, allowable by governing building codes and approved by Architect.

J. Lock Cylinders: Install temporary construction cylinders to secure project perimeter and lock-up areas during construction period.
   1. Replace construction cylinders with permanent cylinders as indicated in keying section.

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.
   1. Install self-limiting closers for maximum degree of swing
   2. Adjust closers immediately upon installation to conform with manufacturer's printed instructions and set latch speed to assure unassisted positive latching.

L. Protection Plates: Install each protection plate with a thinly spread layer of mastic in its center to assure even contact before fastening with screws. Set bottom edge of plate flush with door bottom.

M. Stops: Provide wall stops for all doors unless floor or other type stops are indicated in door hardware schedule.
   1. Do not mount floor stops where they may impede traffic or present tripping hazard.

N. Perimeter Gasketing: Cut and fit all gasketing applied to head and jamb forming a complete seal between door and frame.
   1. Do not notch perimeter gasketing for surface applied hardware.

O. Overlapping Security Astragal: Attach to secure side of door.

## 3.04 FIELD QUALITY CONTROL

A. Inspection and Testing:
   1. Provide functional testing and inspection of each Fire Door Assembly by a qualified person in accordance with NFPA 80.
      a. Schedule fire door assembly inspection within 90 days of Substantial Completion of the Project.
      b. Submit a signed, written final report as specified in Paragraph 1.04.E1.a
      c. Correct all deficiencies and schedule a reinspection of each fire door assembly noted as deficient on the initial inspection report.
      d. Inspector to re-inspect fire door assemblies after repairs are made.
      e. No deficiencies of fire door assemblies are to be present at time of final completion.
   2. Provide inspection of required egress door assemblies by a qualified person in accordance with NFPA 101
      a. Schedule egress door assembly inspection within 90 days of Substantial Completion of the Project for the required openings.
      b. Submit a signed, written final report as specified in Paragraph 1.04.E.1.b
      c. Correct all deficiencies and schedule a reinspection of egress door assemblies noted as deficient on the inspection report.
      d. Inspector to reinspect required egress door assemblies after repairs are made.

B. 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 hardware schedule, manufacturer's installation requirements and include whether door hardware is properly adjusted.

## 3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware at each door to ensure proper operation and smooth function of every unit. Replace units that cannot be adjusted to operate as intended.
   1. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three months after date of Substantial Completion, Installer must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure proper function of doors and door hardware.

## 3.06 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 until time of Substantial Completion.

## 3.07 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance and, removal and replacement of door hardware.

## 3.08 DOOR HARDWARE SCHEDULE

A. Hardware items are referenced in the following hardware groups. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. The hardware sets listed below represent the design intent and direction of the Owner and Architect for interior and exterior doors. These hardware sets are used to establish a type, continuity and standard of quality. They are a guideline only and should not be considered a detailed hardware schedule. It is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability and proper functioning of the hardware items specified herein.

C. Discrepancies, conflicting hardware and missing items should be brought to the attention of the Architect with proposed solutions. Omitted items critical to opening operation or function should be scheduled with the appropriate additional hardware for the proper application and brought to the attention of the architect.

D. Manufacturer's Abbreviation List:

1. (GLY) - Glynn-Johnson
2. (IVE) - Ives
3. (LCN) - LCN Closers
4. (YAL) - Accentra (Yale)
5. (ZER) - Zero International

E. Hardware Sets:

**Hardware Group No. 01**

For use on Door #(s):

| | | | | | |
|---|---|---|---|---|---|
| 203 | 212 | 213 | 214 | 215 | 305 |
| 306 | 307 | 308 | | | |

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE PRIVACY LOCK w/IND. | PBCN 8802FL V20 | 626 | YAL |
| 1 | EA | SURFACE CLOSER | 4040XP REG OR PA AS REQ | 689 | LCN |
| 1 | EA | ARMOR PLATE | 8400 18" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | WALL STOP | WS401/402CVX | 626 | IVE |
| 1 | EA | SOUND SEAL | 188SBK PSA | BLK | ZER |

**Hardware Group No. 02**

For use on Door #(s):

| | | |
|---|---|---|
| 209 | 219 | 220 |

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE OFFICE LOCK | PBCN 8807FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | WALL STOP | WS401/402CVX | 626 | IVE |
| 1 | EA | SOUND SEAL | 188SBK PSA | BLK | ZER |

**Hardware Group No. 03**

For use on Door #(s):

| | |
|---|---|
| 204 | 313 |

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE STOREROOM LOCK | PBCN 8805FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | WALL STOP | WS401/402CVX | 626 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

**Hardware Group No. 04**

For use on Door #(s):
221 222 312

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE STOREROOM LOCK | PBCN 8805FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | OH STOP & HOLDER | 100F | 630 | GLY |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

**Hardware Group No. 05**

For use on Door #(s):
207

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE OFFICE LOCK | PBCN 8807FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | OH STOP & HOLDER | 100F | 630 | GLY |
| 1 | EA | SOUND SEAL | 188SBK PSA | BLK | ZER |

**Hardware Group No. 06**

For use on Door #(s):
210

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE PASSAGE SET | PBCN 8801FL | 626 | YAL |
| 1 | EA | WALL STOP | WS401/402CVX | 626 | IVE |
| 1 | EA | SOUND SEAL | 188SBK PSA | BLK | ZER |

**Hardware Group No. 07**

For use on Door #(s):
211 311-B 311 315-B 315-A

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE CLASSROOM LOCK | PBCN 8808FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | OH STOP | 100S | 630 | GLY |
| 1 | EA | SURFACE CLOSER | 4040XP REG OR PA AS REQ | 689 | LCN |
| 1 | EA | SILENCER | SR64 | GRY | IVE |

**Hardware Group No. 08**

For use on Door #(s):
217

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE CLASSROOM LOCK | PBCN 8808FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | SURFACE CLOSER | 4040XP REG OR PA AS REQ | 689 | LCN |
| 1 | EA | WALL STOP | WS401/402CVX | 626 | IVE |
| 3 | EA | SILENCER | SR64 | GRY | IVE |

**Hardware Group No. 09**

For use on Door #(s):
202

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 6 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 2 | EA | MANUAL FLUSH BOLT | FB458 | 626 | IVE |
| 1 | EA | DUST PROOF STRIKE | DP2 | 626 | IVE |
| 1 | EA | MORTISE STOREROOM LOCK | PBCN 8805FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 2 | EA | WALL STOP | WS401/402CVX | 626 | IVE |
| 1 | EA | SECURITY ASTRAGAL | 43SP | 600 | ZER |
| 2 | EA | SILENCER | SR64 | GRY | IVE |

NOTE 1: 180 DEGREE SWING

**Hardware Group No. 10**

For use on Door #(s):
317

Provide each PR door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 6 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 2 | EA | CONST LATCHING BOLT | FB51P | 630 | IVE |
| 1 | EA | DUST PROOF STRIKE | DP2 | 626 | IVE |
| 1 | EA | MORTISE STOREROOM LOCK | PBCN 8805FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | COORDINATOR | COR X FL X MB | 628 | IVE |
| 1 | EA | OH STOP | 100S (RHR LEAF ONLY) | 630 | GLY |
| 2 | EA | SURFACE CLOSER | 4040XP REG OR PA AS REQ | 689 | LCN |
| 1 | EA | WALL STOP | WS401/402CVX (LHR LEAF ONLY) | 626 | IVE |
| 2 | EA | SMOKE SEAL | 488SBK PSA | BLK | ZER |
| 1 | EA | SECURITY ASTRAGAL | 43SP | 600 | ZER |

**Hardware Group No. 11**

For use on Door #(s):
303

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | MORTISE STOREROOM LOCK | PBCN 8805FL LC | 626 | YAL |
| 1 | EA | MORTISE CYLINDER | 2153 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | SURFACE CLOSER | 4040XP REG OR PA AS REQ | 689 | LCN |
| 1 | EA | WALL STOP | WS401/402CVX | 626 | IVE |
| 1 | EA | SMOKE SEAL | 488SBK PSA | BLK | ZER |

**Hardware Group No. 12**

For use on Door #(s):
NOT USED

Provide each SGL door(s) with the following:

| QTY | | DESCRIPTION | CATALOG NUMBER | FINISH | MFR |
|---|---|---|---|---|---|
| 3 | EA | HINGE | 5BB1 4.5 X 4.5 | 652 | IVE |
| 1 | EA | FIRE EXIT DEVICE | 7100F x PB627F | 630 | YAL |
| 1 | EA | RIM CYLINDER | 1109 x BLDG STD KEYWAY | 626 | YAL |
| 1 | EA | SURFACE CLOSER | 4040XP REG OR PA AS REQ | 689 | LCN |
| 1 | EA | KICK PLATE | 8400 10" X 2" LDW B-CS | 630 | IVE |
| 1 | EA | WALL STOP | WS401/402CVX | 626 | IVE |
| 1 | EA | SMOKE SEAL | 488SBK PSA | BK | ZER |

**END OF SECTION**

| Door No. | Hdw Set No. |
|---|---|
| 202 | 09 |
| 203 | 01 |
| 204 | 03 |
| 207 | 05 |
| 209 | 02 |
| 210 | 06 |
| 211 | 07 |
| 212 | 01 |
| 213 | 01 |
| 214 | 01 |
| 215 | 01 |
| 217 | 08 |
| 219 | 02 |
| 220 | 02 |
| 221, 222 | 04 |
| 303 | 11 |
| 305 | 01 |
| 306 | 01 |
| 307 | 01 |
| 308 | 01 |
| 311 | 07 |
| 311-B | 07 |
| 312 | 04 |
| 313 | 03 |
| 315-A | 07 |
| 315-B | 07 |
| 317 | 10 |
| N2, M02 | Existing |
| S2 | Existing |

## SECTION 08-80-00 - GLAZING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Insulating glass units in doors and sidelights.

B. Glazing units.

C. Glazing compounds.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data on 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. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

#### 1.04 WARRANTY

A. See Section 01 10 00 Short Form General Requirements for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Float Glass Manufacturers:

1. Cardinal Glass Industries: www.cardinalcorp.com
2. Guardian Glass, LLC: www.guardianglass.com
3. Pilkington North America Inc: www.pilkington.com
4. Vitro Architectural Glass : www.vitroglazings.com
5. Substitutions: See Section 01 10 00 Short Form General Requirements.

B. Obscure - Patterned Glass Manufacturers:

1. GGI - General Glass International; Patterned Glass: www.generalglass.com/#sle.

#### 2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.

1. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
2. Patterned Glass Type: ASTM C1036, Type II - Patterned Flat Glass, Quality - Q5, Form 3 - Patterned glass, with color and performance characteristics as indicated.

#### 2.03 INSULATING GLASS UNITS

A. Manufacturers:

1. Glass: Any of the manufacturers specified for float glass.
2. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
3. Guardian Glass, LLC: www.guardianglass.com/#sle.
4. Pilkington North America Inc: www.pilkington.com/na/#sle.Pilkington North America Inc: www.pilkington.com/na/#sle.
5. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.
6. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.

B. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Metal-Edge Spacers: Aluminum, bent and soldered corners.
3. Spacer Color: Black.
4. Color: Black.
5. Purge interpane space with dry air, hermetically sealed.

C. Type IG-2 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
2. Space between lites filled with air.
3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
4. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
   a. Tint: Clear.
5. Total Thickness: 1 inch.

**2.04 GLAZING UNITS**

A. Type G-2 - Monolithic Interior Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
2. Glass Type: Fully tempered float glass.
3. Tint: Clear.
4. Thickness: 1/4 inch, nominal.

B. Type G-4 - Obscure - Patterned Glazing: Textured or rolled glass; translucent, showing shadows but not form.
1. Applications: Locations as indicated on drawings.
2. Finish: F1 - Patterned one side; ASTM C1036.
3. Style: As selected by Architect from manufacturers standard line.
4. Tint: Clear.
5. Glass Type: Fully tempered.
6. Thickness: 1/4 inch, nominal.
7. Thickness: As required for application.
8. Glazing Method: Glazing compounds and accessories per manufacturer recommendations..

9. Manufacturers:
    a. GGI - General Glass International; Thin Ribbed: www.generalglass.com/#sle.

**2.05 ACCESSORIES**

A. Glazing Tape: Provide at glass located in hollow metal frames as indicated on drawings. Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal.

**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. 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.

**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. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

C. 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 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.

**3.05 CLEANING**

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent 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.

**3.06 PROTECTION**

A. After installation, mark pane with an 'X' by using removable plastic tape or paste.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

**END OF SECTION**

## SECTION 09-21-16 - GYPSUM BOARD ASSEMBLIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Acoustic insulation.

D. Gypsum wallboard.

E. Joint treatment and accessories.

#### 1.02 SUBMITTALS

A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

#### 1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum three years of experience.

### PART 2 PRODUCTS

#### 2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Interior Partitions: Provide completed assemblies with the following characteristics:

1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code.

1. ICC IBC Item Numbers: Comply with applicable requirements of ICC IBC for the particular assembly.
2. Gypsum Association File Numbers: Comply with requirements of GA-600 for the particular assembly.
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. Manufacturers - Metal Framing, Connectors, and Accessories:

1. ClarkDietrich: www.clarkdietrich.com
2. Jaimes Industries: www.jaimesind.com/#sle.
3. Marino: www.marinoware.com
4. Substitutions: See Section 01 10 00 Short Form General Requirements.

B. Non-structural 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 flat faces.
   2. Runners: U shaped, sized to match studs.
   3. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch.
   4. Furring Members: Zee-shaped sections, minimum depth of 1 inch.
   5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.

C. 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 screwed to secondary deflection channel set inside but unattached to top track.

D. Non-structural Framing Accessories:
   1. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

**2.03 BOARD MATERIALS**

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company: www.americangypsum.com
   2. CertainTeed Corporation: www.certainteed.com
   3. Georgia-Pacific Gypsum: www.gpgypsum.com
   4. National Gypsum Company: www.nationalgypsum.com
   5. USG Corporation: www.usg.com
   6. Substitutions: See Section 01 10 00 Short Form General Requirements.

B. 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, unless otherwise indicated.
   2. 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.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch.

C. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Edges: Tapered.

**2.04 GYPSUM BOARD ACCESSORIES**

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: Fit to cavity.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
   1. Products:

a. Franklin International, Inc; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: www.titebond.com/#sle.
b. Liquid Nails, a brand of PPG Architectural Coatings; _____: www.liquidnails.com/#sle.
c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.

C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rolled zinc, unless noted otherwise.
1. Corner Beads: Low profile, for 90 degree outside corners.
a. Products:
1) CertainTeed Corporation; No-Coat Drywall Corner: www.certainteed.com/#sle.
2) ClarkDietrich; Strait-Flex Big-Stick: www.clarkdietrich.com/#sle.
3) Phillips Manufacturing Co; Everlast Corner Bead: www.phillipsmfg.com/#sle.
4) Trim-Tex, Inc; _____: www.trim-tex.com/#sle.
2. L-Trim with Tear-Away Strip: Sized to fit 5/8 inch thick gypsum wallboard.
3. Expansion Joints:
a. Type: V-shaped PVC with tear away fins.

D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
2. Joint Compound: Drying type, vinyl-based, ready-mixed.

E. Finishing Compound: Surface coat and primer, takes the place of skim coating.
1. Products:
a. CertainTeed Corporation; Quick Prep Plus Interior Prep Coat: www.certainteed.com/#sle.
b. Substitutions: See Section 01 10 00 Short Form General Requirments.

F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

### 3.02 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 in all locations.
2. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.

C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

D. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.

E. Blocking: Install wood blocking for support of:

1. Framed openings.
2. Wall-mounted cabinets.
3. Plumbing fixtures.
4. Toilet partitions.
5. Toilet accessories.
6. Wall-mounted door hardware.

**3.03 ACOUSTIC ACCESSORIES INSTALLATION**

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

1. Place continuous bead at perimeter of each layer of gypsum board.
2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

**3.04 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.

C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

D. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

**3.05 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.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

**3.06 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. ***Use High Build Drywall Surfacer: Vinyl acrylic latex-based coating for spray application in achieving a smooth finish similar to Level 5.***

2. Level 2: In utility areas, 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.

D. ***Spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.***

**3.07 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 09-30-00 - TILING

## PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Extruded polystyrene foam panel backer board as tile substrate.

D. Ceramic accessories.

E. Ceramic trim.

F. Non-ceramic trim.

### 1.02 ADMINISTRATIVE REQUIREMENTS

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

### 1.03 SUBMITTALS

A. See Section 01 10 00 Short Form General Requirements for submittal procedures.

B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

C. Shop Drawings: Indicate tile layout, patterns, perimeter conditions, junctions with dissimilar materials, control and expansion joints, ceramic accessories, and setting details.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Se, for additional provisions.
2. Extra Tile: 5 percent of each size, color, and surface finish combination.

### 1.04 QUALITY ASSURANCE

A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.

B. Installer Qualifications:

1. Company specializing in performing tile installation, with minimum of five years of documented experience.

### 1.05 DELIVERY, STORAGE, AND HANDLING

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

### 1.06 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

## PART 2 PRODUCTS

### 2.01 TILE

A. Manufacturers: Basis of Design .

1. Dal-Tile Corporation; Articulo: www.daltile.com/#sle.
2. Substitutions: See Section 01 10 00 Short Form General Requirements.

B. Porcelain Tile: ANSI A137.1 standard grade.

1. Size: 12 by 24 inch, nominal.
2. Thickness: 5/16 inch.
3. Edges: Square.
4. Surface Finish: Matte glazed.
5. Color(s): As indicated on drawings.
6. Pattern: Articulo.

**2.02 TRIM AND ACCESSORIES**

A. Ceramic Accessories: Glazed finish, same color and finish as adjacent field tile; same manufacturer as tile.

B. Ceramic Trim: Matching bullnose and cove ceramic shapes in sizes coordinated with field tile.
   1. Applications:
      a. Inside Corners: Jointed.
      b. Floor to Wall Joints: Straight base.
   2. Manufacturers: Same as for tile.

C. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
   1. Applications:
      a. Open edges of wall tile.
      b. Wall corners, outside and inside.
      c. Transition between floor finishes of different heights.
      d. Thresholds at door openings.
      e. Expansion and control joints, floor and wall.
      f. Floor to wall joints.
   2. Manufacturers:
      a. Schluter-Systems: www.schluter.com/#sle.
      b. Substitutions: See Section 01 10 00 Short Form General Requirements.

**2.03 SETTING MATERIALS**

A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.

B. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.

C. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.

D. Water Based Adhesive: Multi-purpose type mastic.

E. Adhesive for Bonding Fleece-Backed Underlayments to Non-Cementitious Substrates: Water-based rubber resin.

F. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.

**2.04 GROUTS**

A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
   1. Applications: Bathrooms.
   2. Color(s): As selected by Architect from manufacturer's full line.

## 2.05 ACCESSORY MATERIALS

A. Waterproofing Membrane at floor in RR 214 only: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
   1. Membrane Type:
      a. Material: Synthetic rubber or Acrylic.
      b. Thickness: 25 mils, minimum, dry film thickness.
      c. Products:
         1) Schluter-KERDI and KERDI-DS.
         2) Substitutions: See Section 01 10 00 Short Form General Requirements.

B. Backer Board: High density polystyrene with reinforcement layer on both sides; with compatible alkaline resistant joint tape; to be covered with waterproofing prior to installation of tile.
   1. Thickness: 5/8 inches.
   2. Products:
      a. Schluter-KERDI-BOARD.
      b. Substitutions: See Section 01 10 00 Short Form General Requirements.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.

C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.

D. Verify that required floor-mounted utilities are in correct location.

## 3.02 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

## 3.03 INSTALLATION - GENERAL

A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install ceramic accessories rigidly in prepared openings.

G. Install non-ceramic trim in accordance with manufacturer's instructions.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

K. Grout tile joints unless otherwise indicated. _____ .

L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

**3.04 INSTALLATION - FLOORS - MORTAR BED METHODS**

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated.

B. Cleavage Membrane: Lap edges and ends.

C. Waterproofing Membrane: Install as recommended by manufacturer and as specified in the section in which the product is specified.

D. Mortar Bed Thickness: 1-1/4 inch, unless otherwise indicated.

**3.05 INSTALLATION - WALL TILE**

A. Rigid extruded polystyrene foam building element panel, with reinforcement material and polypropylene fleece webbing laminated on both sides for thin-set ceramic tile and dimension stone installations.

**3.06 CLEANING**

A. Clean tile and grout surfaces.

**3.07 PROTECTION**

A. Do not permit traffic over finished floor surface for 4 days after installation.

**END OF SECTION**

## SECTION 09-51-00 - ACOUSTICAL CEILINGS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

#### 1.03 SUBMITTALS

A. Product Data: Provide data on suspension system components and acoustical units.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

#### 1.04 QUALITY ASSURANCE

A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### 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 MANUFACTURERS

A. Acoustic Tiles/Panels:

1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
2. USG Corporation: www.usg.com/ceilings/#sle.
3. Substitutions: See Section 01 10 00 Short Form General Requirements.

B. Suspension Systems:

1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   Rockfon, LLC: www.rockfon.com/#sle.
2. USG Corporation: www.usg.com/ceilings/#sle.
3. Substitutions: See Section 01 10 00 Short Form General Requirements.

#### 2.02 ACOUSTICAL UNITS

A. Acoustical Units - General: ASTM E1264, Class A.

B. Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:

1. Classification: ASTM E1264 Type IV.

a. Form: 2, water felted.
b. Pattern: "E" - lightly textured.

2. Size: 24 by 24 inches.
3. Thickness: 1" inches.
4. Panel Edge: Square Tegular.
5. Color: White.
6. Suspension System: Exposed grid.
7. Products:
   a. Armstrong World Industries, Inc; Optima: www.armstrongceilings.com/#sle.
   b. Substitutions: See Section 01 10 00 Short Form General Requirements.

**2.03 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: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   2. Profile: Tee; 15/16 inch face width.
   3. Finish: Baked enamel.
   4. Products:
      a. USG Corporation; Donn Brand DX/DXL 15/16 inch Acoustical Suspension System: www.usg.com/ceilings/#sle.
      b. Substitutions: See Section 01 10 00 Short Form General Requirements.

**2.04 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. Hold-Down Clips: Manufacturer's standard clips to suit application.

D. Perimeter Moldings: Same metal and finish as grid.
   1. Size: As required for installation conditions.
   2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
   3. Inside/Outside Corner Ceiling Grid Covers

E. Metal Edge Trim for "Cloud" Suspension Systems: Steel or extruded aluminum; provide attachment clips, splice plates, and preformed corner pieces for complete trim system.
   1. Trim Height: 4 inch.
   2. Finish: Baked enamel.
   3. Color: White.

F. 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 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

### 3.03 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, and ASTM E580/E580M 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 on room axis according to reflected plan.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.

1. Use longest practical lengths.
2. Inside/Outside Corner Ceiling Grid Covers

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.

### 3.04 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. Lay directional patterned units with pattern parallel to longest room axis.

D. Fit border trim neatly against abutting surfaces.

E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

F. Cutting Acoustical Units:

1. Make field cut edges of same profile as factory edges.

G. Where round obstructions occur, provide preformed closures to match perimeter molding.

### 3.05 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**

## SECTION 09-54-26 - SUSPENDED WOOD CEILINGS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Linear wood planks.

B. Metal suspension system.

#### 1.02 RELATED REQUIREMENTS

A. Section 09-51-00 - ACOUSTICAL CEILINGS: Metal suspension systems.

#### 1.03 SUBMITTALS

A. Shop Drawings: Indicate grid layout and related dimensioning, attachment of wood ceiling components to grid, accessory attachments, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

B. Product Data: Provide data on wood ceiling components and suspension system components.

C. Samples: Submit two full size samples illustrating material and finish of wood ceiling components.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 10 00 Short Form General Requirements for additional provisions.
2. Wood Ceiling Components: Provide a quantity equal to 5 percent of total product installed.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood ceiling components to project site in original, unopened packages.

B. Store in fully enclosed space, flat, level and off the floor.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Suspended Wood Ceilings: Match existing system on ground floor.

1. Armstrong World Industries, Inc; Woodworks: www.armstrongceilings.com/#sle.

#### 2.02 SUSPENDED WOOD CEILING SYSTEM

A. Performance Requirements:

1. Design for maximum deflection of 1/360 of span.

B. Linear Wood Planks: Composite wood core with wood veneer finish.

1. Type: Pre-assembled module of linear planks with battens attached perpendicularly to back of planks.
   a. Module Size: 5.553" x 96" by 3/4" inches, nominal.
   b. Veneer Perforations: W9
2. Veneer Species: Light Cherry.
   a. Factory Finish: Clear sealer.

C. Metal Suspension System:

1. General: Comply with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   a. Materials:

1) Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.

2. Concealed Ceiling Suspension System: Aluminum grid.
   a. Description: Engineered grid, with slotted faces in main tees, cross tees, hangers, trim molding, load resisting struts, hinge assemblies, and other suspension components required to support ceiling and other ceiling supported construction. Panels installed from below by inserting torsion springs into slots in faces of main tees of ceiling grid.
   b. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
   c. Profile: Flat.
   d. Finish: Powder coat.
   e. Color: Black.
   f. Products:
3. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement.
4. Edge Trim: Woodworks Solid Wood Trim - 4".

D. Accessories: Manufacturer's standard accessories for installation method indicated, seismic requirements and above-ceiling accessibility.

**2.03 FABRICATION**

A. Shop fabricate wood ceiling components to the greatest extent possible.

B. Fabricate components to allow access to ceiling plenum as required.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify existing conditions before starting work.

B. Do not install ceiling until after interior wet work is dry.

**3.02 PREPARATION**

A. Coordinate the location of hangers with other work.

B. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

C. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.

D. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

**3.03 INSTALLATION**

A. General: Install suspended wood ceiling system in accordance with CISCA (WC).

B. Wood Ceiling:
   1. Install wood ceilings in accordance with manufacturer's instructions.
   2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.

3. Install components in uniform plane, and free from twist, warp, and dents.
4. Cut to fit irregular grid and perimeter edge trim.
5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.

**3.04 TOLERANCES**

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

**3.05 CLEANING**

A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

**END OF SECTION**

## SECTION 09-65-00 - RESILIENT FLOORING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

#### 1.02 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

B. Verification Samples: Submit two samples, ___ by ___ inch in size illustrating color and pattern for each resilient flooring product specified.

C. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Flooring Material: 20 square feet of each type and color.
2. Extra Wall Base: 20 linear feet of each type and color.

#### 1.03 QUALITY ASSURANCE

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

#### 1.04 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. Do not double stack pallets.

#### 1.05 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 TILE FLOORING

A. Luxury Vinyl Tile: Surface-decorated, with wear layer.

1. Manufacturers:
   a. Mohawk Group; Luxury Vinyl Tile; Boulder 5.0: www.mohawkflooring.com.
   b. Substitutions: See Section 01 10 00 Short Form General Requirements.
2. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.

3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648, NFPA 253, ASTM E 648, or NFPA 253.
4. Plank Tile Size: 18 by 36 inch.
5. Wear Layer Thickness: 20 mil (0.5 mm)
6. Total Thickness: 5 mm (.12")
7. Pattern: Bolder 5.0 C2108.
8. Color: 859 Aura.

**2.02 RESILIENT BASE**

A. Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic.
   1. Manufacturers:
      a. **Basis of Design:** Johnsonite, a Tarkett Company: www.johnsonite.com
      b. Mannington Commercial: www.manningtoncommercial.com#sle.
      c. Roppe Corporation: www.roppe.com
      d. Substitutions: See Section 01 10 00 Short Form General Requirements.
   2. Height: 4 inch.
   3. Thickness: 0.080 inch.
   4. Finish: Satin.
   5. Length: Roll.
   6. Color: Charcoal

**2.03 ACCESSORIES**

A. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
B. Moldings, Transition and Edge Strips: Same material as flooring.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

**3.02 INSTALLATION - GENERAL**

A. Starting installation constitutes acceptance of conditions.
B. Install in accordance with manufacturer's written instructions.
C. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
   2. Resilient Strips: Attach to substrate using adhesive.

**3.03 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 plank tile with a random offset of at least 6 inches from adjacent rows.

**3.04 INSTALLATION - RESILIENT BASE**

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.

B. Miter corners.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

**3.05 CLEANING**

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

**3.06 PROTECTION**

A. Prohibit traffic on resilient flooring for 48 hours after installation.

**END OF SECTION**

## SECTION 09-68-13 - TILE CARPETING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

#### 1.02 SUBMITTALS

A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

B. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

C. Installer's Qualification Statement.

D. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

#### 1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

#### 1.04 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Tile Carpeting: Basis of Design

1. Mohawk Group; ____: www.mohawkgroup.com/#sle.
2. Substitutions: See Section 01 10 00 Short Form General Requirements.

#### 2.02 MATERIALS

A. Tile Carpeting: Tufted, mulit-level pattern loop, manufactured in one color dye lot.

1. Tile Size: 12 by 36 inch, nominal.
2. Thickness: .239 inch.
3. Color: Sediment 856.
4. Pattern: Digital Terrain GT341.
5. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
6. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
7. Gauge: 1/12 inch.
8. Stitches: 10.5 per inch.

9. Total Weight: 20 oz/sq yd.

**2.03 ACCESSORIES**

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: Rubber, color as selected by Architect.

C. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.

**3.02 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 square pattern, with pile direction parallel to next unit, set parallel to building lines.

F. Locate change of color or pattern between rooms under door centerline.

G. Fully adhere carpet tile to substrate.

H. Trim carpet tile neatly at walls and around interruptions.

I. Complete installation of edge strips, concealing exposed edges.

**3.03 CLEANING**

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

**END OF SECTION**

## SECTION 09-91-23 - 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. Elevator pit ladders.
3. Mechanical and Electrical:
    a. In finished areas, paint insulated and exposed ducts and hangers, brackets, collars and supports, unless otherwise indicated.

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. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
6. Floors, unless specifically indicated.
7. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
8. Glass.
9. Acoustical materials, unless specifically indicated.
10. Concealed pipes, ducts, and conduits.

#### 1.02 SUBMITTALS

A. 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.

B. 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.

C. Maintenance Data: Submit data including product technical data sheets, care and cleaning instructions, touch-up procedures, and repair of painted and finished surfaces.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
2. Label each container with color in addition to the manufacturer's label.

**1.03 QUALITY ASSURANCE**

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

**1.04 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.

**1.05 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 from the same manufacturer to the greatest extent possible.

1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions in Section 01 10 00 Short Form General Requirements.
2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.

B. Paints:

1. Behr Process Corporation: www.behr.com
2. Diamond Vogel Paints: www.diamondvogel.com
3. PPG Paints: www.ppgpaints.com
4. Rodda Paint Co: www.roddapaint.com/#sle.

5. Sherwin-Williams Company: www.sherwin-williams.com

C. Primer Sealers: Same manufacturer as top coats.

**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. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
   4. Supply each paint material in quantity required to complete entire project's work from a single production run.
   5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

C. Colors: As indicated on drawings.
   1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
   2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

**2.03 PAINT SYSTEMS - INTERIOR**

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board and shop primed steel.
   1. Two top coats and one coat primer.
   2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
   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 locations.
      c. Satin: MPI gloss level 4; use this sheen for items subject to frequent touching by occupants, including door frames and railings.
   4. Primer: As recommended by top coat manufacturer for specific substrate. ***Refer to section 09 2116 - Gypsum Board Assembilies for high build drywall surfacer requirements***

B. Paint I-OP-MD-DT - Medium Duty Door Frames: 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; MPI #47, 48, 81, or 96.
4. Top Coat Sheen:
    a. Satin: MPI gloss level 4; use this sheen at all locations.
5. Primer: As recommended by top coat manufacturer for specific substrate.

C. Paint I-OP-DF - Dry Fall: Metals; exposed structure, spray on fire proofing, and overhead-mounted services, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, galvanized piping, and _____.
1. Shop primer by others.
2. One top coat _____.
3. Top Coat: Latex Dry Fall; MPI #118, 155, or 226.
4. Top Coat Sheen:
    a. Flat: MPI gloss level 1; use this sheen at all locations.
5. Primer: As recommended by top coat manufacturer for specific substrate.

**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 adequately 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 affect proper application.
D. **If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.**

**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 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. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
G. Galvanized Surfaces:
H. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

**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. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
G. 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 10-14-19 - DIMENSIONAL LETTER SIGNAGE

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Dimensional letter signage.

#### 1.02 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.

B. ADA Standards - 2010 ADA Standards for Accessible Design.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities.

#### 1.03 SUBMITTALS

A. See Section 01 10 00 Short Form General Requirements for submittal procedures.

B. Shop Drawings:

1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.

#### 1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Package dimensional letter signs as required to prevent damage before installation.

B. Store under cover and elevated above grade.

C. Store tape adhesive at a normal room temperature of 68 to 72 degrees F.

#### 1.06 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Dimensional Letter Signs:

1. FASTSIGNS International, Inc: www.fastsigns.com/#sle.
2. Inpro Corporation: www.inprocorp.com/#sle.
3. Substitutions: See Section 01 10 00 Short Form General Re.

#### 2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

#### 2.03 DIMENSIONAL LETTERS

A. Plastic Letters: Match existing signage. See drawings for signage locations and selections.

1. Material: Injection molded plastic.

2. Thickness: 1/8 inch minimum.
3. Letter Height: As indicated on drawings. Match existing.
4. Text and Typeface:
    a. Character Font: Helvetica, Arial, or other sans serif font. Match existing.
5. Finish: Semi-gloss.
6. Color: Match existing..
7. Mounting: Tape adhesive.

**2.04 ACCESSORIES**

A. Tape Adhesive: Double-sided tape, permanent adhesive.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Locate dimensional letter signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

**END OF SECTION**

## SECTION 10-28-00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Electric hand/hair dryers.

C. Diaper changing stations.

D. Utility room accessories.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

#### 1.03 SUBMITTALS

A. See Section 01 10 00 Short Form General Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:

1. AJW Architectural Products: www.ajw.com
2. American Specialties, Inc: www.americanspecialties.com
3. Bradley Corporation: www.bradleycorp.com
4. Georgia-Pacific Professional: www.blue-connect.com
5. Substitutions: Approved equals..

B. Diaper Changing Stations:

1. American Specialties, Inc: www.americanspecialties.com
2. Bradley Corporation: www.bradleycorp.com
3. Diaper Deck & Company: www.diaperdeck.com
4. Koala Kare Products: www.koalabear.com
5. Safe-Strap Company, Inc: www.diaperdepot.com
6. Substitutions: Approved equals.

#### 2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.

1. Grind welded joints smooth.

B. Stainless Steel Sheet: ASTM A666, Type 304.

C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.

D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

E. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

## 2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

## 2.04 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser (TA-10): Double roll, stainless steel, surface mounted, for coreless type rolls. Basis of Design: Bobrick B-2892. DispencABILITY ONE Skilcraft Jumbo Core Toilet Paper Roll - 22P483|8540-01-590-9073 Grainger

B. Paper Towel Dispenser (TA-42): Electric, roll paper type. Basis of Design: Bobrick B-2974
   1. Cover: Stainless steel. Paper Discharge: Touchless automatic.
   2. Capacity: 8 inch diameter roll.
   3. Mounting: Surface.
   4. Paper Discharge: Touchless automatic.
   5. Power: Battery operated.
   6. Refill Indicator: Illuminated refill indicator.

C. Automated Soap Dispenser (TA-61): Liquid soap dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, tumbler lock. Basis of Design: Bobrick B-2013 Provide Rubbermaid 4013131 Grean Seal Certified Lotion Soap Honeysuckle Scent 800ml Refill 4/Carton. Power: Battery operated.

## 2.05 COMMERCIAL TOILET ACCESSORIES CONT.

A. Mirrors (TA-30): Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: As indicated on drawings..
   3. Frame: 0.05 inchangle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.

B. Seat Cover Dispenser (TA-4): Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
   1. Minimum capacity: 250 seat covers.
   2. Products: Bobrick B-4221

C. Grab Bars (TA-1, 2, &3): Stainless steel, textured surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Finish: Satin.
      d. Length and Configuration: As indicated on drawings.

D. Sanitary Napkin Disposal Unit (TA-50): Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

1. Products: Bobrick B-270

E. Clothes hook (TA-62): Surface-mounted coat hook with satin finish steel.

1. Products: Bobrick B-9542.

**2.06 ELECTRIC HAND/HAIR DRYERS**

A. Electric Hand Dryers (TA-21): Traditional fan-in-case type, with downward fixed nozzle.

1. Operation: Automatic, sensor-operated on and off.
2. Mounting: Surface mounted.
3. Cover: Stainless steel with brushed finish.
   a. Tamper-resistant screw attachment of cover to mounting plate.
4. Air Velocity: 18,000 linear feet per minute, minimum, at full power.
5. Heater: 500 W, minimum, at full power.
6. Runtime: Field adjustable, from approximately 10 seconds to approximately 35 seconds.
7. Electric Hand Dryer Products:
   a. Bobrick B-7128.

**2.07 DIAPER CHANGING STATIONS**

A. Diaper Changing Station (TA-6): Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.

1. Material: Stainless steel.
2. Mounting: Surface, vertical
3. Color: Stainless steel
4. Minimum Rated Load: 250 pounds.
5. Products: Koala Kare KB111-SSWM

**2.08 UTILITY ROOM ACCESSORIES**

A. Combination Utility Shelf/Mop and Broom Holder (TA-63): 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.

1. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
2. Length: Manufacturer's standard length for number of holders/hooks.
3. Products: Bobrick B-239

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

D. Verify that field measurements are as indicated on drawings.

**3.02 PREPARATION**

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

## 3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

1. Other Accessories: As indicated on drawings.

## 3.04 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

**END OF SECTION**

## SECTION 12-24-00 - WINDOW SHADES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Interior manual roller shades.

B. Interior motorized roller shades.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.

B. 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.

#### 1.03 SUBMITTALS

A. See Section 01 10 00 Short Form General 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. Selection Samples: Include fabric samples in full range of available colors and patterns.

1. Motorized Shades: Include finish selections for controls.

#### 1.04 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of this type with minimum 3 years of documented experience with shading systems of similar size and type.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

#### 1.06 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### 1.07 WARRANTY

A. See Section 01 10 00 Short Form General Requirements, for additional warranty requirements.

B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
   1. Shade Hardware: One year.
   2. Electric Motors: One year.
   3. Electronic Control Equipment: One year.
   4. Fabric: One year.
   5. Aluminum and Steel Coatings: One year.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Interior Manually Operated Roller Shades:
   1. Inpro WT; Manual clutch shades: https://inpro-shades.com/
   2. Hunter Douglas Architectural; RB500 Manual Roller Shades: www.hunterdouglasarchitectural.com/#sle.
   3. Levolor; _____: www.levolor.com/commercial/#sle.
   4. Lutron Electronics Co., Inc; Contract Roller Manual Roller Shades: www.lutron.com/#sle.
   5. MechoShade Systems LLC; Mecho/7 System: www.mechoshade.com/#sle.
   6. SWFcontract, a division of Springs Window Fashions, LLC.; Pro Series Manual Solar Shade System: www.swfcontract.com/#sle.
   7. Substitutions: SeeSection 01 10 00 Short Form General Requirements.

B. Interior Motorized Roller Shades, Motors and Motor Controls:
   1. Inpro WT: Motorized shade: https://inpro-shades.com/
   2. Hunter Douglas Architectural; RB500 Motorized Roller Shades: www.hunterdouglasarchitectural.com/#sle.
   3. Levolor: www.levolor.com/commercial/#sle.
   4. Lutron Electronics Co., Inc; Contract Roller Motorized Roller Shades: www.lutron.com/#sle.
   5. MechoShade Systems LLC; UrbanShade Single Roller - Motorized: www.mechoshade.com/#sle.
   6. Substitutions: See Section 01 10 00 Short Form General Requirements.

C. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

### 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.
   3. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
      a. Comply with NFPA 70.

b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.

c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.

B. Roller Shades:

1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Drop Position: Regular roll.
   b. Roll Direction: Roll down, closed position is at window sill.
   c. Roll Direction: Bottom-up, closed position is at top of window opening.
   d. Mounting: Wall mounted.
   e. Size: As indicated on drawings.
   f. Fabric: As indicated on shade schedule
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   a. Material: Stamped steel.
   b. Multiple Shade Operation: Provide hardware as necessary to operate more than one shade using a single clutch operator.
3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum, clear anodized finish.
   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.
   d. Take-Up Roller: Manufacturer's standard roller tube pretensioned for winding lift cable in bottom-up type shades.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Exposed aluminum bottom bar, flat profile with closed ends; clear anodized finish.
   b. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Manual Operation for Interior Shades:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
   b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.

c. Shade Lift Assistance: Manufacturer's standard spring device contained in the idler end of roller tube to reduce force required to lift shades; as required based on shade weight.

d. Chain Retainer:

1) Chain tensioning device complying with WCMA A100.1.

2) Manufacturer's standard clip.

6. Accessories:

a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.

1) Color: White.

2) Profile: Square.

b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.

c. Interior Side Channels: As required for light sealing room-darkening shade applications.

d. Lifting Cables: Nylon coated cable for lifting bottom-up type shades.

C. Interior Roller Shades - Basis of Design: Inpro WT: https://inpro-shades.com/product-category/shading-systems/manual-clutch-shade-systems/manual-clutch-shades/

1. Description: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and other components necessary for complete installation.

a. Drop Position: Regular roll.

b. Mounting: Wall mounted.

2. Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.

3. Roller Tubes: As required for type of shade operation; designed for removal without removing mounting hardware.

a. Material: Extruded aluminum or steel, with wall thickness and material selected by manufacturer.

b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.

4. Hembars: Designed to maintain bottom of shade straight and flat, selected from manufacturer's standard options.

5. Manual Operation:

a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.

b. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.

D. Interior Roller Shades - Basis of Design: Inpro WT: https://inpro-shades.com/product-category/shading-systems/motorized-shade-systems/motorized-shades/

1. Description: Single roller, motor-operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and other components necessary for complete installation.
    a. Drop Position: Regular roll.
    b. Roll Direction: Roll down, closed position is at window sill.
    c. Mounting: Wall mounted.
    d. Size: As indicated on drawings.
    e. Fabric: to be selected to match existing shade
2. Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
    a. Hardware Type: Universal brackets.
3. Roller Tubes: As required for type of shade operation; designed for removal without removing mounting hardware.
    a. Material: Extruded aluminum or steel, with wall thickness and material selected by manufacturer.
    b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.

**2.03 SHADE FABRIC**

A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.

**2.04 ROLLER SHADE FABRICATION**

A. Field measure finished openings prior to ordering or fabrication.

**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. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

**3.04 SYSTEM STARTUP**

A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

**3.05 CLEANING**

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

**3.06 CLOSEOUT ACTIVITIES**

**3.07 PROTECTION**

A. Protect installed products from subsequent construction operations.

**3.08 MAINTENANCE**

**END OF SECTION**

## SECTION 14-21-00 - ELECTRIC TRACTION ELEVATORS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Electric traction elevator systems.

B. Maintenance and service.

#### 1.02 RELATED REQUIREMENTS

A. Section 09-68-13 - TILE CARPETING.

B. Section 21-13-00 - FIRE-SUPPRESSION SPRINKLER SYSTEMS.

C. Section 22-05-13 - Common Motor Requirements for Plumbing Equipment.

D. Division 23, Heating, Ventilating, and Air Conditioning (HVAC).

E. Section 26-05-33.13 - CONDUIT FOR ELECTRICAL SYSTEMS.

F. Section 26-05-83 - WIRING CONNECTIONS

G. Division 27, Communications.

H. Division 28, Electronic Safety and Security.

#### 1.03 REFERENCE STANDARDS

A. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices.

B. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, and Dumbwaiters.

C. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors.

D. UL (DIR) - Online Certifications Directory.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other trades to provide conduits for proper installation of wiring, including:
    a. Elevator equipment devices remote from elevator machine room or hoistway.
    b. Telephone service for machine room.
    c. Elevator pit for lighting and sump pump.

#### 1.05 SUBMITTALS

A. See Section 01 10 00 Short Form General Requirements for submittal procedures.

B. Product Data: Submit data on the following items:

1. Signal and operating fixtures, operating panels, and indicators.
2. Car design, dimensions, layout, and components.
3. Car and hoistway door and frame details.
4. Electrical characteristics and connection requirements.

5. Expected heat dissipation of elevator equipment in hoistway expressed in BTUs.
6. Color selection chart for cab and entrances.

C. Shop Drawings: Submit layout drawings. Include appropriate plans, elevations, sections, diagrams, and details on the following:
   1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
   2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
   3. Rail Bracket Spacing: Maximum loads imposed on guide rails requiring load transfer to building structural framing.
   4. Individual weight of principal components; load reaction at points of support.
   5. Loads on hoisting beams.
   6. Clearances and overtravel of car and counterweight.
   7. Locations in hoistway of traveling cables and connections for car lighting and telephone.
   8. Location and sizes of hoistway entrances, car doors and frames.
   9. Clear inside hoistway and pit dimensions.
   10. Location and sizes of access doors.
   11. Applicable seismic design data certified by licensed professional structural engineer.
   12. Interface with building security system.
   13. Electrical characteristics and connection requirements.
   14. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.
D. Samples: Submit samples illustrating car interior finishes in form of cut sheets.
E. Test Reports: Submit results of required testing. Reports of tests previously performed on same design acceptable.
F. Manufacturer's qualification statement.
G. Installer's qualification statement.
H. Operation and Maintenance Data: Provide electronic copy of manufacturer's standard operations and maintenance manuals including:
   1. Parts catalog with complete list of equipment replacement parts.
      a. Identify each entry with equipment description and identifying code.
      b. If parts catalog available online, provide web address and access instructions.
   2. Operation and maintenance manual.
   3. Schematic drawings of equipment and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.
I. Executed warranty.
J. Initial Maintenance Contract:

1. Require elevator contractor to provide initial maintenance service consisting of regular examinations and adjustments by elevator contractor of 12 months after elevator has been turned over for customer's use. Required performance of this service by elevator contractor and not subcontracted.
2. Require qualified employees perform work during regular working hours on normal business days.
3. Service to exclude adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than elevator contractor.
4. Provide only manufacturer-approved genuine parts and supplies as used in manufacture and installation of original equipment.

K. Maintenance Contract: Submit proposal to Owner for standard _____ -year continuing maintenance contract agreement in accordance with and requirements as indicated, starting on date initial maintenance contract scheduled to expire.
1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and renewal options.

**1.06 QUALITY ASSURANCE**

A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.
B. Manufacturer shall have a minimum of fifteen years of experience in the fabrication, installation and service of eleva
C. Installer: Elevators shall be installed by the manufacturer.
D. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permits as required by the elevator inspection authority, and make such tests as are called for by the regulations of such authorities. These tests shall be made in the presence of such authorities or their authorized representitives.
E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Provide suitable storage area on-site for elevator equipment in the event building or site not ready to receive elevator equipment upon delivery.
B. If elevator equipment stored off-site, obtain approval from Owner and make appropriate arrangements with manufacturer for delivery.
C. Contractor responsible for costs to deliver elevator equipment to site from off-site storage or to move on-site elevator equipment to off-site storage.

**1.08 WARRANTY**

A. See Division 1 for additional warranty requirements.
B. Manufacturer Warranty: Provide 1-year manufacturer's warranty for elevator operating equipment and devices. Complete forms in Owner's name and register with manufacturer.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

A. Basis of Design: Otis Elevator Company; Gen3 Edge or Equal.
B. Substitutions: See Section 01 10 00 Short Form General Requirements.
C. Source Limitations: Provide elevator and associated equipment and components produced by single manufacturer and obtained from single supplier.

**2.02 GENERAL**

A. Provide AC gearless machine using embedded permanent magnets located at top of hoistway or in machine room above hoistway.
B. Provide polyurethane coated-steel belts for elevator hoisting.
C. Provide regenerative drive to capture normally wasted energy and feed clean power back into building's power grid.
D. Provide LED lighting standard in ceiling lights and elevator fixtures.
E. Provide sleep mode operation for LED ceiling lights and car fan.

**2.03 PERFORMANCE**

A. Elevators:
    1. Car Speed: Plus or minus 3 percent of contract speed under loading condition or direction of travel.
    2. Car Capacity: Safely lower, stop and hold up to 120 percent of rated load (code required).
    3. Ride Quality:
        a. Vertical Vibration: Maximum 20 mg.
        b. Horizontal Vibration: Maximum 12 mg.
        c. Vertical Jerk: Maximum 4.59 plus or minus 1 feet/sec3.
        d. Acceleration/Deceleration: Maximum 2.62 feet/sec3.
        e. In-Car Noise: 55 to 60 dBA.
        f. Stopping Accuracy: Plus or minus 0.375 inch maximum, plus or minus 0.25 inch typical.
        g. Re-Leveling Distance: Plus or minus 1.5 inches.

**2.04 PERFORMANCE CONTINUED**

A. Equipment: Gearless, machine-roomless elevator with the controller in the entrance frame at the top of the hoistway.
B. Quantity of Elevators: 1.
C. Elevator Stop Designations: 1,2,3.
D. Stops (Maximum):
    1. 3 stops for 200 fpm model.
E. Connectivity: Enhanced Emergency Communication Connectivity: Provide elevator with non-proprietary emergency communications equipment to meet the requirements of 2024 IBC and ASME A17.1 2022.
    1. Basis of Design: K-Tech Connect as manufactured by K-Tech International, or approved equal.

2. NPS dispatch to provide 24/7 monitoring and receive emergency communications from elevator.
    a. Contractor to provide software required for communicating with elevator for installation at primary and backup dispatch centers.
        1) Coordinate with COR and NPS IT for software installation.
            (a) Hardware required at dispatch centers to be provided by NPS.
            (b) Offsite hardware requirements must be documented in shop drawings. It is the contractor's responsibility to coordinate any hardware requirements with NPS well in advance of software installation and commissioning to allow sufficient lead time for NPS procurement (which could take several months).
        2) Contractor shall commission the system and ensure operation to meet all code requirements.
        3) Contractor to provide traininig in operating communications software.
        4) Contractor shall provide support for communications software during warranty period as identified in Division 01.
    b. Software required by non-proprietary communications equipment must be capable of approval by NPS IT.
    c. Software required by non-proprietary communications equipment must not have an on-going subscription pricing model.
3. Elevator internet connectivity to be coordinated with COR and NPS IT prior to approval of shop drawings.
4. System must include UPS capable of providing 4 hours of backup power, minimum, to the communications system in the event of power failure
5. System must include a remote communications station capable of being located on site in a non-public facing area. Coordinate location with COR.

F. Capacity: 3500 lbs.
G. Drive System: Regenerative.
H. Openings:
    1. In-line.
I. Travel Distance (Maximum): 34ft 9 in
J. Operation Control Type: Electronic Controls
K. Service Control:
    1. Standard service control only.
L. Elevator Pit Depth:
    1. 4 feet, 6 inches.
M. Overhead (Underside of Beam): See drawings
N. Cab:
    1. Platform Size:
        a. Front Opening: 6 feet, 6-3/4 inches wide by 6 feet, 1-1/8 inches deep.

2. Interior Car Height: 93 inches.
3. Clear Cab Height:
    a. 7 feet, 9 inches with 5/16-inch floor recess and 4-LED ceiling.
4. Entrance Type and Width:
    a. 3500 Single-Speed Side-Opening Doors: 42 inches.
5. Entrance Height: 7 feet.
6. Electrical Power: 208 V plus or minus 5 percent of normal; three-phase with separate equipment grounding conductor; 60 Hz.
7. Shunt trip: Control spaces automatically disconnect the main line power prior to the application of water.
8. Car Lighting Power Supply: 120 V, 1-phase, 15 A, 60 Hz.
9. Signal Fixtures: Manufacturer's standard with metal button targets.
10. Machine Location: Rail-mounted at top of hoistway.
11. Controller Location:
    a. Controller in entrance frame at the top landing.
12. Equipment Car Components:
    a. Car Frame and Safety: Provide car frame fabricated from formed or structural steel members with adequate bracing to support platform and car enclosures. Type B car safety, flexible guide clamp type integral to car frame.
13. Cab Finishes and Equipment:
    a. Premium Cab Options: Steel shell cab with raised laminate wall panels.
    b. Car Front Finish: Brushed stainless steel.
    c. Car Door Finish: Brushed stainless steel.
    d. Ceiling Type: Flat steel ceiling with four LED lights.
    e. Ceiling Finish: Real White (EWO).
    f. Emergency Car Lighting: Provide emergency power unit employing 6-V sealed rechargeable battery and totally static circuits to illuminate elevator car if building power fails.
    g. Fan:
        1) Provide one-speed 120 VAC fan mounted to ceiling to facilitate in-car air circulation and meeting requirements.
        2) Rubber-mount fan to prevent transmission of structural vibration and include baffle to diffuse audible noise. Provide switch in car-operating panel to control fan.
    h. Handrail:
        1) Provide handrails on rear wall and side walls of car enclosure.
        2) Round Bar: 1-1/2-inch diameter with brushed steel finish.
    i. Threshold: Extruded aluminum finish.
    j. Emergency Exit Contact: Provide electrical contact on cartop exit.

k. Guides:
    1) Provide 3-inch diameter roller guides at top and bottom. Counterweight to have slide type guides at top and bottom.
l. Platform: Construct car platform of metal. Mount load-weighing device on belts at top of hoistway.
m. Elevator Pads & Grommets: Provide standard vinyl (light grey) pads with standard grommet holes. Pads to cover 3 sides of the elevator cab to protect the raised laminate finish. Wall studs (stainless steel) to support pads to be provided in the elevator cab and coordinated with the grommet holes on pads. Pads shall cover entire vertical surface of elevator walls from floor to ceiling.

O. Operation:
1. Simplex Collective Operation:
    a. Using microprocessor-based controller, automatic operation by means of car and hall buttons.
2. Standard Operation Features:
    a. Full collective operation.
    b. Anti-nuisance.
    c. Fan and light protection.
    d. Load-weighing bypass.
    e. Independent service.
    f. Firefighter Service Phase I and Phase II.
    g. Top of car inspection.
    h. Car Secure Access.
3. Other Operation Features:
    a. Zoned access at bottom landing.
    b. Zoned access at upper landing.
    c. Provision for Car Reader in Car surface mounted to COP (Card Reader provided and installed by others).
    d. Keyed access to 3rd Floor Level.
    e. Automatic Rescue Operation (Battery Backup)
4. Door Control Features:
    a. Door control to open doors automatically when car arrives at landing in response to normal hall or car call.
    b. Provide elevator doors with reopening device to stop and reopen car doors and hoistway doors automatically if doors become obstructed by object or person.
    c. Door Protection:
        1) Three-dimensional, multibeam array projecting across car door opening.
    d. Door nudging operation to occur if doors prevented from closing for adjustable period of time.

5. Provide equipment according to Seismic Zone 0.

## 2.05 HOISTWAY AND HOISTWAY ENTRANCES

A. Hoistway Size: As indicated on drawings.

B. Hoistway Fire Rating: 2 hours provided.

C. Components:

1. Machine: AC gearless machine, with synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at top of hoistway.
2. Governor: Tension type car-mounted governor.
3. Buffers, Car, and Counterweight: Polyurethane-type buffers for speeds of 150 fpm and 200 fpm.
4. Hoistway Operating Devices:
    a. Emergency stop switch in pit.
    b. Terminal stopping switches.
5. Positioning System: Consisting of encoder, reader box, and door zone vanes.
6. Guide Rails and Attachments: Provide tee-section steel rails with brackets and fasteners. Side counterweight arrangements to have dual-purpose bracket combining both counterweight guide rails and one of car guide rails, attached to building fastening.
7. Coated-Steel Belts: Provide polyurethane coated belts with high-tensile grade, zinc-plated steel cords and flat profile on running surface and backside of belt. Driving sheaves and deflector sheaves to have crowned profile to ensure center tracking of belts. Provide continuous monitoring system using resistance based technology to continuously monitor integrity of coated steel belts and provide advance notice of belt wear.
8. Governor Rope: Steel with at least eight strands wound about sisal core center.
9. Fascia: Provide galvanized sheet steel in accordance with code requirements.

D. Hoistway Entrances:

1. Fire Rating, Entrance and Doors: fire-rated for 1-1/2 hours.
2. Hoistway Door Material: Brushed stainless steel with vertical channel reinforcements.
3. Doors: Provide entrance doors of metal construction with vertical channel reinforcements.
4. Door Operation: Side opening, single speed.
5. Door Width: 42 inches.
6. Door Height: 84 inches.
7. Sills: Extruded aluminum.
8. Frames:
    a. Bolted construction for complete one-piece unit assembly.
    b. Securely fasten frames to fixing angles mounted in hoistway.
    c. Provide fire-rated steel.
    d. Entrance Profile (Jamb Face) Width: 2-7/8 inches (733 mm).
9. Finish: Brushed stainless steel.

a. As selected by Architect from manufacturer's color chart. Color selected from manufacturer's color chart.

10. Entrance Marking Plates: Mark entrance jambs with 4- by 4-inch plates having raised floor markings with Braille located adjacent to floor marking. Provide marking plates on both sides of entrance.
11. Sight Guards: Provide sight guards at doors painted to match with painted doors, painted black for stainless steel doors.

**2.06 EQUIPMENT SIGNAL DEVICES AND FEATURES**

A. Car Operating Panel:
   1. Provide car operating panel including push buttons, key switches, and message indicators with satin stainless steel finish.
   2. Car Operating Panel (COP) to Include:
      a. Raised markings and Braille to left side of each push-button.
      b. Digital, LED car position indicator at top of and integral to car operating panel.
      c. Door open and door close buttons.
      d. Inspection key switch.
      e. Elevator data plate marked with elevator capacity and car number.
      f. Help Button: Initiates two-way communication between car and location inside building, switching over to another location if call goes unanswered, where personnel are available who can take appropriate action. Provide visual indicators for call initiation and call acknowledgement.
      g. Landing Passing Signal: Chime bell to sound in car to signal car either stopping at or passing floor served by elevator.
      h. Standard:
         1) In-car stop switch (toggle or key unless local code prohibits use).
         2) Firefighter hat.
         3) Firefighter Phase II key switch.
         4) Call cancel button.

B. Hall Fixtures: Provide hall fixtures with necessary push buttons and key switches for elevator operation including:
   1. Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the wall. Buttons shall be in vertically mounted fixture. Fixture shall be Brished Stainless Steel Finish.
   2. Hall Buttons: Vandal Resistant Flat Flush Mounted Brushed Stainless-Steel button with blue LED illuminating center jewel.

C. Car Lantern and Chime: Provide directional lantern visible from corridor in car entrance. When car stops and doors are opening, lantern to indicate direction of car travel, and chime to sound.

D. Access Control:
   1. Access key switch at lowest floor and top floor in entrance jamb.

2. Card reader provisions. See electrical.

**2.07 MATERIALS**

**2.08 FINISHES**

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify existing conditions before starting this work.

B. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work performed. Do not proceed with work until unsatisfactory conditions are corrected.

C. Verify hoistway and pit are ready for work of this section.

D. Verify hoistway shaft and openings are of correct size and within tolerance.

E. Verify location and size of machine foundation and position of machine foundation bolts.

F. Verify electrical power available and of correct characteristics.

**3.02 PREPARATION**

A. Arrange for temporary electrical power for installation work and testing of elevator components. See Section Division 1 for additional requirements.

B. Maintain elevator pit excavation free of water.

**3.03 INSTALLATION**

A. Coordinate this work with installation of hoistway wall construction.

B. Install system components, and connect equipment to building utilities.

C. Provide conduit, electrical boxes, wiring, and accessories; see Sections 26-05-33.13 and 26-05-83.

D. Mount machines and motors on vibration and acoustic isolators.

1. Place on structural supports and bearing plates.
2. Securely fasten to building supports.
3. Prevent lateral displacement.

E. Install hoistway, elevator equipment, and components in accordance with approved shop drawings and manufacturer's written instructions.

F. Install guide rails to allow for expansion and contraction movement.

G. Accurately machine and align guide rails, forming smooth joints with machined splice plates.

H. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.

I. Structural Metal Surfaces: Clean surfaces of rust, oil, or grease; wipe clean with solvent; prime with two coats.

J. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.

K. Adjust equipment for smooth and quiet operation.

**3.04 TOLERANCES**

A. Guide Rail Alignment: Plumb and parallel to each other in accordance with and .

B. Car Movement on Aligned Guide Rails: Smooth movement, without objectionable lateral or oscillating movement or vibration.

**3.05 FIELD QUALITY CONTROL**

A. See Section Division 1 for additional requirements.

B. Testing and inspection: Provide 3rd party elevator inspection by qualified firm at the completion of the project. Inspection shall be scheduled so COR and contractor is present. Provide final report to CO prior to punch list and final acceptance for occupancy. All deficiency findings shall be addressed as prior to NPS punch list review.

**3.06 CLEANING**

A. See Section Division 1 for additional requirements.

B. Remove protective coverings from finished surfaces.

C. Clean surfaces and components in accordance with manufacturers written instructions.

**3.07 PROTECTION**

A. Do not permit construction traffic within car after cleaning.

B. Protect installed products until Date of Substantial Completion.

C. Touch up, repair, or replace damaged products and materials before Date of Substantial Completion.

**3.08 MAINTENANCE AND SERVICE**

A. Submit proposal for continuation of maintenance contract in accordance with and requirements as indicated for installed elevator equipment.

B. Provide initial maintenance contract of elevator system and components in accordance with and requirements as indicated for 12 months from Date of Substantial Completion.

C. Include systematic examination, adjustment, and lubrication of elevator equipment.

D. Maintain and repair or replace parts whenever required using parts produced by original equipment manufacturer.

E. Periodic lubrication of elevator components, including sheaves, rails, belts, ropes, car and double weight traction (DWT) guides, not required.

F. Provide emergency call back service during regular working hours throughout period of this maintenance contract.

**END OF SECTION**

## SECTION 21-05-00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Above ground piping.
B. Escutcheons.
C. Mechanical couplings.
D. Pipe hangers and supports.
E. Pipe sleeves.
F. Pipe sleeve-seal systems.
G. Piping specialties.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
D. Operation and Maintenance Data: Include installation instructions and spare parts lists.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.
    2. Extra Valve Stem Packings: Two for each type and size of valve.

#### 1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.
B. Provide temporary protective coating on cast iron and steel valves.
C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

#### 1.05 WARRANTY

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

A. Sprinkler-based System:
    1. Comply with NFPA 13 .
    2. See Section 21-13-00.
B. Welding Materials and Procedures: Comply with ASME BPVC-IX.
C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

#### 2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A135/A135M Schedule 10 or ASTM A795 Schedule 40, black.
   1. Steel Fittings: ASME B16.5 steel flanges and fittings.
   2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
   3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
   4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

**2.03 PIPE SLEEVES**

A. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor.
   2. Provide sealant for watertight joint.
B. Pipe Passing Through Below Grade Exterior Walls:
   1. Zinc-coated or cast-iron pipe.
   2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
C. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.
D. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch greater than external; pipe diameter.
   3. Rated Openings: Caulked tight with firestopping material complying with ASTM E814 in accordance with Section 07-84-00 to prevent the spread of fire, smoke, and gases.

**2.04 PIPE SLEEVE-SEAL SYSTEMS**

A. Manufacturers:
   1. Advance Products & Systems, Inc.
   2. GPT, a company of Enpro Industries, Inc.
   3. Metraflex Company.
   4. Pipeline Seal and Insulatore, Inc.
   5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.
B. Modular Mechanical Seals:
   1. Elastomer-based interlocking links to continuously fill annular space between pipe and wall-sleeve.
   2. Watertight seal between pipe and wall-sleeve.
   3. Size and select seal component materials in accordance with service requirements.
   4. Service Requirements:
      a. Corrosion resistant.

b. Underground, buried, and wet conditions.

5. Glass-reinforced plastic pressure end plates.

C. Wall Sleeve: PVC material with waterstop collar, and nailer end caps.

D. Sleeve-Forming Disk: Nonconductive plastic-based material, 3 inch thick.

**2.05 ESCUTCHEONS**

A. Material:

1. Chrome-plated.
2. Metals and Finish: Comply with ASME A112.18.1.

B. Construction:

1. One-piece with set screw or spring clip fastener for new pipes.
2. Split-Plate with concealed hinge and spring clip fasteners on existing pipes.
3. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

**2.06 PIPE HANGERS AND SUPPORTS**

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Vertical Support: Steel riser clamp.

**2.07 MECHANICAL COUPLINGS**

A. Rigid Mechanical Couplings for Grooved Joints:

1. Dimensions and Testing: Comply with AWWA C606.
2. Minimum Working Pressure: 300 psig.
3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
4. Housing Coating: Factory applied orange enamel.
5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.

**2.08 PIPING SPECIALTIES**

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:

1. Activate electric alarm.
2. Test and drain valve.
3. Replaceable internal components without removing valve from installed position.

B. Auxiliary Drains: Condensate collection drain for each section of trapped pipe in preaction or dry fire protection system.

C. Air Venting Valves:

D. Backflow Preventer: Reduced-pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.

E. Commercial Riser Manifold: Preassembled and tested riser manifold in accordance with NFPA 13.

F. Test Connections:

1. Inspector's Test Connection for Preaction and Dry Pipe Systems:
    a. Provide test connections approximately 6 feet above floor for each or portion of each sprinkler system equipped with an alarm device, located at most remote part of each system.
    b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
    c. Supply discharge orifice with same size as corresponding sprinkler orifice.
    d. Limit vertical height of exterior wall penetration to 2 feet above finished grade.
2. Backflow Preventer Test Connection:
    a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5-inch National Standard male hose threads with cap and chain.
    b. Provide one valve for each 250 gpm of system demand or fraction thereof.
    c. Provide permanent sign reading "Test Valve." See Section 21-05-53.

G. Water Flow Switch: Vane-type switch for mounting horizontally or vertically, with two contacts; rated 10 A at 125 VAC and 2.5 A at 24 VDC.

H. Fire Department Connections:

1. Type: Flush, wall mount made of corrosion-resistant metal complying with UL 405.
    a. Inlets: Two-way, 2-1/2 inch swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 or authority having jurisdiction. Brass caps with gaskets, chains, and lugs.
    b. Configuration: Vertical.
    c. Outlet: Back with pipe threads, 4 NPS.
        1) Location: Back.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

### 3.02 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Pipe Hangers and Supports:
    1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
    2. Place hangers within 12 inches of each horizontal elbow.
    3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
    4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
    5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
H. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
I. Structural Considerations:
    1. Do not penetrate building structural members unless indicated.
J. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
    1. Aboveground Piping:
        a. Pack solid using mineral fiber complying with ASTM C592.
        b. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.
    2. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Section 07-84-00 to prevent the spread of fire, smoke, and gases.
K. Manufactured Sleeve-Seal Systems:
    1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
    2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
    3. Locate piping in center of sleeve or penetration.
    4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
    5. Tighten bolting for a watertight seal.
    6. Install in accordance with manufacturer's recommendations.
L. Escutcheons:
    1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
    2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.

3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

M. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

**3.03 CLEANING**

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION**

## SECTION 21-05-23 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Two-piece ball valves with indicators.
B. Iron butterfly valves with indicators.
C. Check valves.
D. Bronze OS&Y gate valves.
E. Trim and drain valves.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications:
    1. Obtain valves for each valve type from single manufacturer.
B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
    1. Protect internal parts against rust and corrosion.
    2. Protect threads and flange faces.
    3. Protect threads, flange faces, and weld ends.
    4. Set valves open to minimize exposure of functional surfaces.
B. Use the following precautions during storage:
    1. Maintain valve end protection and protect flanges and specialties from dirt.
        a. Provide temporary inlet and outlet caps.
        b. Maintain caps in place until installation.
    2. Store valves in shipping containers and maintain in place until installation.
        a. Store valves indoors and maintain at higher than ambient dew point temperature.
        b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
C. Use the following precautions for handling:
    1. Do not use operating handles or stems as lifting or rigging points.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

A. Comply with NFPA 13 and NFPA 13R for valves.

B. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

**2.02 TWO-PIECE BALL VALVES WITH INDICATORS**

A. Manufacturers:

1. Anvil International, Inc.
2. Kennedy Valve.
3. Milwaukee Vavle Company
4. NIBCO INC.
5. Tyco Fire & Building Products LP
6. Victaulic.
7. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. UL 1091, except with ball instead of disc and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 1112.

C. Description:

1. Minimum Pressure Rating: 175 psig.
2. Body Design: Two piece.
3. Body Material: Forged brass or bronze.
4. Port Size: Full.
5. Seat: PTFE.
6. Stem: Bronze or stainless steel.
7. Ball: Chrome-plated brass.
8. Actuator: Quarter turn lever handle.
9. End Connections for Valves 2 NPS and smaller: Threaded ends.

**2.03 IRON BUTTERFLY VALVES WITH INDICATORS**

A. Manufacturers:

1. Anvil International, Inc.
2. Kennedy Valve.
3. Milwaukee Valve Company.
4. NIBCO INC.
5. Tyco Fire & Building Products LP.
6. Victaulic.
7. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. UL 1091 and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 112.

C. Minimum Pressure Rating: 175 psig.

D. Body Material: Cast or ductile iron with nylon, EPDM, or epoxy coating.

E. Seat: EPDM.

F. Stem: Stainless steel.

G. Disc: Ductile iron, nickel plated.
H. Actuator: Worm gear or traveling nut.
I. Supervisory Switch: Internal or external.
J. Body Design: Grooved-end connections.

**2.04 CHECK VALVES**

A. UL 312 and FM (AG) standard listing for check valves, Class Number 1045.
B. Minimum Pressure Rating: 250 psig.
C. Type: Swing check valve.
D. Body Material: Cast iron, ductile iron.
E. End Connections: Flanged or grooved.

**2.05 BRONZE OS&Y GATE VALVES**

A. Manufacturers:
    1. Anvil International, Inc.
    2. Kennedy Valve.
    3. Milwaukee Valve Company.
    4. NIBCO INC.
    5. Tyco fire & Building Products LP.
    6. Victaulic.
    7. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.
B. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
C. Minimum Pressure Rating: 175 psig.
D. Body and Bonnet Material: Bronze.
E. Wedge: One-piece bronze or brass.
F. Wedge Seat: Bronze.
G. Stem: Bronze or brass.
H. Packing: Non-asbestos PTFE.
I. Supervisory Switch: External.
J. End Connections: Threaded.

**2.06 TRIM AND DRAIN VALVES**

A. Ball Valves:
    1. Description:
        a. Pressure Rating: 175 psig.
        b. Body Design: Two piece.
        c. Body Material: Forged brass or bronze.
        d. Port Size: Full or standard.
        e. Seat: PTFE.
        f. Stem: Bronze or stainless steel.

g. Ball: Chrome-plated brass.
h. Actuator: Hand-lever.
i. End Connections for Valves 2 NPS and smaller: Threaded ends.

B. Angle Valves:
1. Description:
a. Pressure Rating: 175 psig.
b. Body Material: Brass or bronze.
c. Ends: Threaded.
d. Stem: Bronze.
e. Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron, bronze, or aluminum.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Confirm valve interior to be free of foreign matter and corrosion.
B. Remove packing materials.
C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
D. Examine valve threads and mating pipe for form and cleanliness.
E. Examine mating flange faces for conditions that might cause leakage.
1. Check bolting for proper size, length, and material.
2. Verify gasket for size, defects, damage, and suitable material composition for service.
3. Replace all defective valves with new valves.

### 3.02 INSTALLATION

A. Comply with specific valve installation requirements and application in the following Sections:
1. Section 21-12-00 for application of valves in fire-suppression standpipes.
2. Section 21-13-00 for application of valves in wet and dry pipe, fire-suppression sprinkler systems.
B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
1. Install permanent identification signs indicating portion of system controlled by each valve.
C. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
D. Valves in horizontal piping installed with stem at or above the pipe center.
E. Position valves to allow full stem movement.
F. Install valve tags. Comply with Section 21-05-53 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

**END OF SECTION**

## SECTION 21-05-53 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Pipe markers.

### PART 2 PRODUCTS

#### 2.01 IDENTIFICATION APPLICATIONS

A. Piping: Pipe markers.

#### 2.02 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Color code as follows:

1. Fire Quenching Fluids: Red with white letters.

### PART 3 EXECUTION

#### 3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 09-91-23 for stencil painting.

#### 3.02 INSTALLATION

A. Install plastic pipe markers in accordance with manufacturer's instructions.

B. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

**END OF SECTION**

## SECTION 21-13-00 - FIRE-SUPPRESSION SPRINKLER SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. System design, installation, and certification.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Shop Drawings:

1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories.
3. Submit shop drawings to Authorities Having Jurisdiction for approval. Submit proof of approval to Architect.
4. Shop drawings must be stamped by a licensed Fire Protection Engineer or a qualified Technician with Nicet Level III certification.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS for additional provisions.
2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
3. Sprinkler Wrenches: For each sprinkler type.

#### 1.04 QUALITY ASSURANCE

A. Comply with FM (AG) requirements.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Sprinklers, Valves, and Equipment:

#### 2.02 SPRINKLER SYSTEM

A. Sprinkler System: Modify existing system to provide full coverage of renovated spaces as required by NFPA 13.

B. Occupancy: Light hazard; comply with NFPA 13.

C. Water Supply: Determine volume and pressure from water flow test data.

D. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

### 2.03 SPRINKLERS

A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

B. Exposed Area Type: Pendant type with guard.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
   1. Response Type: Quick.
   2. Coverage Type: Standard.
   3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

D. Guards: Finish to match sprinkler finish.

E. Flexible Drop System: Stainless steel, multiple use, open gate type.
   1. Application: Use to properly locate sprinkler heads.
   2. Include all supports and bracing.
   3. Provide braided type tube as required for the application.
   4. Manufacturers:

### 2.04 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:

B. Test Connections:

C. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.

D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Locate outside alarm gong on building wall as indicated.

D. Place pipe runs to minimize obstruction to other work.

E. Place piping in concealed spaces above finished ceilings.

F. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

G. Flush entire piping system of foreign matter.

H. Install guards on sprinklers where indicated.

I. Hydrostatically test entire system.

J. Require test be witnessed by Fire Marshal.

**3.02 INTERFACE WITH OTHER PRODUCTS**

A. Ensure required devices are installed and connected as required to fire alarm system.

**END OF SECTION**

## SECTION 22-00-01 - GENERAL PLUMBING REQUIREMENTS

### PART 1 GENERAL

#### 1.01 DESCRIPTION OF WORK

A. This Division includes all labor, materials, equipment, tools, supervision, start-up services, Owner training, etc., including all incidental and related items, necessary to complete installation and successfully test and start up and operate the Plumbing systems indicated on the drawings, and as described in each Section of Division 220000 Specifications.

B. All work shall be completed in compliance with local codes, rules, and regulations. In the event that the plans conflict with any rules, regulation, or codes, the rules, regulations, and codes shall govern. Where the plans exceed code requirements, the plans shall govern.

C. The Contractor and his Subcontractors shall include all materials, labor, and necessary equipment in his bid.

#### 1.02 DRAWINGS

A. The drawings are generally diagrammatic and show general location and arrangement of equipment, piping, and accessories. The contractor shall provide and install all necessary equipment, fittings, offsets and other components required to adapt to field conditions, interferences, and code requirements to deliver a complete and functional system.

B. Deviations from the drawings, with the exception of changes to field conditions, and do not effect system functionality, shall not be made without the written approval of the Engineer.

C. Architectural and Structural drawings take precedence in all matters pertaining to the building structure. Plumbing drawings take precedence in all matter pertaining to Plumbing work and electrical drawings to electrical work. Where conflicts between trades exist, report conflicts or differences to the Architect and Engineer.

#### 1.03 COORDINATION

A. The Contractor shall examine the plans and coordinate with other trades for scheduling of work.

B. Coordinate all penetrations with architectural and structural trades.

C. Refer to architectural plans for exact locations and heights of fixtures.

D. Refer to architectural plans for coordination of all ceiling mounted access panels for Plumbing equipment that requires access.

E. All Plumbing equipment and piping located above ceiling shall be installed to preserve ceiling heights listed on architect ceiling plans.

#### 1.04 GUARANTEE

A. Contractor shall guarantee the all labor, materials, and equipment are free from defects. Contractor shall agree to replace or repair any part of thier project scope that becomes defective within one year from substantial completion and following acceptance from the Owner.

#### 1.05 PERMITS AND FEES

A. The Contractor shall be responsible for coordinating and obtaining all applicable agency approvals for utility connections and permits.

#### 1.06 ACTION SUBMITTALS

A. Provide product submittals for all required specification sections. Submittals shall be submitted in PDF format.

B. Contractor shall review and mark with approval stamp before submitting to Architect.

**1.07 EQUIPMENT AND MATERIAL MANUFACTURERS**

A. All equipment shall be provided with normally supplied accessories needed for complete installation.

B. All equipment shall be new and shall be standard products from the current manufacturer product line offering.

C. If an alternate manufacturer to the basis of design is submitted and approved, the Contractor shall assume all costs required to adapt the system to the submitted piece of equipment, including, but not limited to: piping, electrical work, and building alterations. Alternate equipment shall conform to all space requirements and operating conditions.

**1.08 QUALITY ASSURANCE**

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

**1.09 FIELD CONDITIONS**

A. Interruption of Existing Sanitary Waste and Domestic Water Serice: Do not interrupt service to facilities occupied by Owner or others unless permetted unde the following conditions and then only after arranging to provided temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste or domestic water service.
2. Do not proceed with interruption of service without Owner's written permission.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

**3.01 PROTECTION AND HANDLING OF EQUIPMENT**

A. The Contractor shall be responsible for ensuring all equipment and materials delivered to the site are protected from theft and damage until time of project turnover to the Owner.

B. All Plumbing fixtures and pipings shall be protected from damage and use after installation.

**3.02 FIELD QUALITY CONTROL**

A. Insp

1. Do not enclose, cover, or put piping into operation until is has been inspected and approved by authority having jurisdiction.
2. During installation, notify authority having jurisdiction at least one day before inspection must be made. Perform tests specifiedbelow in presence of authorities having jurisdiction:
    a. Rough-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

b. Final Inspection: Arrange for authorities having jurisdiction to observe required piping tests.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: prepare inspection reportsand have the signed by authorities having jurisdiction.
5. Piping and specialities shall be considered defective if they do not pass tests and inspections.

B. Prepare test and inspection reports. Reports shall be included with final Operations and Maintenance manual provided to Owner.

**3.03 OPERATION AND MAINTANCE**

A. Prior to final inspections, the Contractor shall provide training to the Owner on operation, adjustment, and maintenance on all installed equipment.

B. The Contractor shall prepare and turnover to the Owner a binder with all operation and maintained manuals for all equipment installed.

**3.04 ACCESSIBILITY**

A. All equipment installed shall fit within the designated space with adequate access for service and maintained and required by the manufacturer.

**3.05 CLEANING AND PROTECTION**

A. Each trade is responsible for maintain a clean and hazard free work area.

B. Protect sanitary waste, vent piping, and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. After each piece of equipment has been installed and tested, each system shall be cleaned and flushed.

**3.06 PAINTING**

A. All exposed plumbing systems in finished areas shall be painted to match surrounding finishes, unless restricted by code. See architectural plans for finishes.

**END OF SECTION**

## SECTION 22-05-17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Pipe sleeve-seals.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

#### 1.03 QUALITY ASSURANCE

A. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

#### 1.05 WARRANTY

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS, for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 PIPE SLEEVES

A. Vertical Piping:

1. Sleeve Length: 1 inch above finished floor.
2. Provide sealant for watertight joint.

B. Plastic: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

C. Pipe Passing Through Mechanical Room Floors above Basement:

1. Galvanized steel pipe.
2. Connect sleeve with floor plate except in mechanical rooms.

D. Clearances:

1. Provide allowance for insulated piping.
2. Wall, Floor, Partitions, and Beam Flanges: 1 inch greater than external pipe diameter.
3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07-84-00 to prevent the spread of fire, smoke, and gases.

#### 2.02 PIPE-SLEEVE SEALS

A. Manufacturers:

1. Advance Products & Systems, LLC.
2. Flexicraft Industries.
3. Pipeline Seal and insulator, Inc.
4. Proco Products, Inc.
5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
3. Size and select seal component materials in accordance with service requirements.
4. Glass-reinforced plastic pressure end plates.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

### 3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Provide sleeves when penetrating floors and walls. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

E. Aboveground Piping:
   1. Pack solid using mineral fiber complying with ASTM C592.
   2. Fill space with an elastomer caulk to a depth of 0.50 inch where penetrations occur between conditioned and unconditioned spaces.

F. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 07-84-00 to prevent the spread of fire, smoke, and gases.

G. Manufactured Sleeve-Seal Systems:
   1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   3. Locate piping in center of sleeve or penetration.
   4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
   5. Tighten bolting for a water-tight seal.
   6. Install in accordance with manufacturer's recommendations.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

### 3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION**

## SECTION 22-05-23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Ball valves.

B. Butterfly valves.

C. Check valves.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

#### 1.03 QUALITY ASSURANCE

A. Manufacturer:

1. Obtain valves for each valve type from single manufacturer.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Secure check valves in either the closed position or open position.
5. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.
    a. Provide temporary inlet and outlet caps.
2. Store valves in shipping containers and maintain in place until installation.
    a. Store valves indoors in dry environment.
    b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

#### 1.05 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

A. Handle large valves with sling, modified to avoid damage to exposed parts.

B. Avoid the use of operating handles or stems as rigging or lifting points.

### PART 2 PRODUCTS

#### 2.01 APPLICATIONS

A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

B. Provide the following valves for the applications if not indicated on drawings:

1. Shutoff: Ball or butterfly.
2. Swing Check (Pump Outlet):
    a. 2 inch and Smaller: Bronze swing check valves with bronze disc.

C. Required Valve End Connections for Non-Wafer Types:

1. Copper Tube:
    a. 2 inch and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
    b. 2-1/2 inch to 4 inch: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

D. Domestic, Hot and Cold Water Valves:
1. 2 inch and Smaller:
    a. Bronze: Provide with solder-joint ends.
    b. Ball: Two piece, full port, bronze with stainless-steel trim.
    c. Bronze Swing Check: Class 125, bronze disc.
2. 2-1/2 inch and Larger:
    a. Iron, 2-1/2 inch to 4 inch: Provide with flanged ends.
    b. Iron Single-Flange Butterfly: 200 CWP, EPDM seat, aluminum-bronze disc.

**2.02 GENERAL REQUIREMENTS**

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
B. Valve Sizes: Match upstream piping unless otherwise indicated.
C. Valve Actuator Types:
1. Hand Lever: Quarter-turn valves 6 inch and smaller.
D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.
4. Memory Stops: Fully adjustable after insulation is installed.
E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Grooved End Connections: AWWA C606.
F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Solder-joint Connections: ASME B16.18.
3. Building Services Piping Valves: ASME B31.9.
G. Potable Water Use:
1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
H. Valve Bypass and Drain Connections: MSS SP-45.
I. Source Limitations: Obtain each valve type from a single manufacturer.

## 2.03 BRONZE, BALL VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Stainless Steel Trim:
   1. Comply with MSS SP-110.
   2. WSP Rating: 150 psi.
   3. WOG Rating: 600 psi.
   4. Body: Forged bronze or dezincified-brass alloy.
   5. Ends Connections: Pipe thread or solder.
   6. Seats: PTFE.
   7. Stem: Stainless steel, blowout proof.
   8. Ball: Stainless steel, vented.
   9. Manufacturers:
      a. Apollo Valves; _____: www.apollovalves.com/#sle.
      b. Milwaukee Valve Company.
      c. Victaulic.
      d. Hammond.
      e. Grinnell.
      f. Watts.
      g. Crane.
      h. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

## 2.04 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug Style; Bi-directional dead-end service without use of downstream flange:
   1. Class 125 or Class 150 flanges.
   2. Comply with MSS SP-67, Type I.
   3. Lug Style, Service Pressure Ratings:
      a. 100 psi for sizes 14 to 24 inch.
      b. 150 psi for sizes 2 to 12 inch.
      c. Vacuum down to 29.9 in-Hg.
   4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
   5. Stem: One or two-piece stainless steel.
   6. Seat: EPDM.
   7. Disc: Aluminum-bronze.
   8. Finish: Epoxy coated.
   9. Operator: Lockable handle over direct-mount actuator base.
   10. Manufacturers:
      a. Apollo Valves; _____: www.apollovalves.com/#sle.

b. Hammond Valve..
c. Milwaukee Valve Company.
d. Watts.
e. Crane
f. Victaulic
g. Mueller
h. Grinnell.
i. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

**2.05 BRONZE, SWING CHECK VALVES**

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125:
1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Horizontal or vertical flow.
3. CWP Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded or soldered.
6. Disc: Bronze.
7. Manufacturers:
a. Apollo Valves; _____: www.apollovalves.com/#sle.
b. Mueller.
c. Watts.
d. Metraflex.
e. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
B. Verify valve parts to be fully operational in all positions from closed to fully open.
C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
D. Should valve is determined to be defective, replace with new valve.

**3.02 INSTALLATION**

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Install check valves where necessary to maintain direction of flow as follows:
   1. Swing Check: Install horizontal maintaining hinge pin level.
   2. Orient plate-type and center-guided into horizontal or vertical position, between flanges.

**END OF SECTION**

## SECTION 22-05-29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Prefabricated trapeze-framed systems.

B. Strut systems for pipe or equipment support.

C. Beam clamps.

D. Pipe hangers.

E. Pipe rollers and roller supports.

F. Pipe supports, guides, shields, and saddles.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03-30-00.

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

#### 1.04 QUALITY ASSURANCE

A. Comply with applicable building code.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.

B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.

C. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

D. Materials for Metal Fabricated Supports: Comply with Section 05-50-00.

1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.

E. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

**2.02 PREFABRICATED TRAPEZE-FRAMED SYSTEMS**

A. Prefabricated Trapeze-Framed Metal Strut Systems:
1. MFMA-4 compliant, pre-fabricated, MSS SP-58 Type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
2. Strut Channel or Bracket Material:
a. Indoor Dry Locations: Use zinc-plated steel or galvanized steel.
3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
5. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.

**2.03 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT**

A. Strut Channels:
1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

B. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.

C. Channel Nuts:
1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

**2.04 BEAM CLAMPS**

A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.

B. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

C. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

**2.05 PIPE HANGERS**

A. Swivel Ring Hangers, Adjustable:
1. MSS SP-58 type 10, epoxy-painted, zinc-colored.
2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
3. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.

B. Clevis Hangers, Adjustable:
1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.

2. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

**2.06 PIPE ROLLERS AND ROLLER SUPPORTS**

A. MSS SP-58 type 43 based on required load, nonconductive and corrosion resistant.

B. Material: Zinc plated ASTM A36/A36M carbon steel or ASTM A47/A47M malleable iron.

**2.07 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES**

A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

B. Pipe Shields for Insulated Piping:

1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
2. General Construction and Requirements:
    a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
    b. Shields Material: UV-resistant polypropylene with glass fill.
    c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
    d. Service Temperature: Minus 40 to 178 degrees F.
    e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

C. Pipe Supports:

1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up to 122 degrees F:
    a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
    b. Support From Below: MSS SP-58 types 35 through 38.

D. Pipe Supports, Thermal Insulated:

1. General Requirements:
    a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    c. Provide pipe supports for 1/2 to 30 inch iron pipes.
    d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
2. PVC Jacket:
    a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
    b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
    c. Minimum Thickness: 60 mil, 0.06 inch.

**PART 3 EXECUTION**

## 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

## 3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:

1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

## 3.03 FIELD QUALITY CONTROL

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**

## SECTION 22-05-53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

### PART 2 PRODUCTS

#### 2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Nameplates:

1. Control panels, transducers, and other related control equipment products.

B. Tags:

1. Piping: 3/4 inch diameter and smaller.

C. Pipe Markers: 3/4 inch diameter and higher.

#### 2.02 NAMEPLATES

A. Description: Laminated piece with up to three lines of text.

1. Letter Color: White.
2. Letter Height: 1/4 inch.

#### 2.03 TAGS

A. Metal: Brass, 19 gauge 1-1/2 inch in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.

#### 2.04 STENCILS

#### 2.05 PIPE MARKERS

A. Comply with ASME A13.1.

B. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.

C. Identification Scheme, ASME A13.1:

1. Primary: External Pipe Diameter, Uninsulated or Insulated.
    a. 3/4 to 1-1/4 inches: Use 8 inch field-length with 1/2 inch text height.
    b. 1-1/2 to 2 inches: Use 8 inch field-length with 3/4 inch text height.
    c. 2-1/2 to 6 inches: Use 12 inch field-length with 1-1/4 inch text height.
2. Secondary: Color scheme per fluid service.
    a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.

### PART 3 EXECUTION

#### 3.01 PREPARATION

A. Degrease and clean surfaces to receive identification products.

**3.02 INSTALLATION**

A. Install tags in clear view and align with axis of piping

B. Install plastic pipe markers in accordance with manufacturer's instructions.

C. Apply ASME A13.1 Pipe Marking Rules:

1. Place pipe marker adjacent to changes in direction.
2. Place pipe marker adjacent each valve port and flange end.
3. Place pipe marker at both sides of floor and wall penetrations.
4. Place pipe marker every 25 to 50 feet interval of straight run.

**END OF SECTION**

## SECTION 22-07-19 - PLUMBING PIPING INSULATION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Flexible elastomeric cellular insulation.

B. Glass fiber insulation.

C. Jacketing and accessories.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

#### 1.04 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

### PART 2 PRODUCTS

#### 2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

#### 2.02 GLASS FIBER INSULATION

A. Manufacturers:

1. CertainTeed Corporation: www.certainteed.com/#sle.
2. Johns Manville Corporation: www.jm.com/#sle.
3. Knauf Insulation: www.knaufinsulation.com/#sle.
4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
5. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
6. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.

1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 650 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

#### 2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturers:

1. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
2. Armacell LLC: www.armacell.us/#sle.
3. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

**2.04 JACKETING AND ACCESSORIES**

A. PVC Plastic Jacket:
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil, 0.010 inch.
e. Connections: Brush on welding adhesive.
2. Covering Adhesive Mastic: Compatible with insulation.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

**3.02 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

D. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

G. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07-84-00.

I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor):

**3.03 SCHEDULES**

A. Plumbing Systems:
1. Domestic Hot Water Supply:
a. Glass Fiber Insulation:
1) Pipe Size Range: All Sizes.
2) Thickness: 1 inch.
2. Domestic Hot Water Recirculation:
a. Glass Fiber Insulation:
1) Pipe Size Range: All sizes.
2) Thickness: 1 inch.
3. Domestic Cold Water:
a. Glass Fiber Insulation:
b. Pipe Size Range: 1 inch and smaller.
(a) Thickness: 1/2 inch.
c. Pipe Size Range: 1-1/4 inch and larger.
(a) Thickness: 1 inch.

**END OF SECTION**

## SECTION 22-10-05 - PLUMBING PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Sanitary waste piping, buried within 5 feet of building.

B. Sanitary waste piping, above grade.

C. Domestic water piping, above grade.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

#### 1.03 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

#### 1.05 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.

#### 2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron.
2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless.

1. Fittings: Cast iron.
2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

#### 2.03 SANITARY WASTE PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.

1. Fittings: Cast iron.

2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

**2.04 DOMESTIC WATER PIPING, ABOVE GRADE**

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, alloy Sn95 solder.
3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
    a. Manufacturers:
        1) Anvil International: www.anvilintl.com/#sle.
        2) Apollo Valves: www.apollovalves.com/#sle.
        3) Grinnell Products: www.grinnell.com/#sle.

**2.05 PIPE FLANGES, UNIONS, AND COUPLINGS**

A. Unions for Pipe Sizes 3 inch and Under:

1. Ferrous Pipe: Class 150 malleable iron threaded unions.
2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Sizes Over 1 inch:

1. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. No-Hub Couplings:

1. Testing: In accordance with ASTM C1277 and CISPI 310.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.

D. Shielded, Heavy Duty No-Hub Couplings:

1. Testing: In accordance with ASTM C1540 and FM 1680.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.

E. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

**2.06 PIPE HANGERS AND SUPPORTS**

A. See Section 22-05-29 for additional requirements.

B. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

### 3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Remove scale and dirt, on inside and outside, before assembly.
C. Prepare piping connections to equipment with flanges or unions.

### 3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
C. Install piping to maintain headroom, conserve space, and not interfere with use of space.
D. Group piping whenever practical at common elevations.
E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
F. Provide access where valves and fittings are not exposed.
G. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
I. Install bell and spigot pipe with bell end upstream.
J. Install valves with stems upright or horizontal, not inverted. See Section 22-05-23.
K. Install water piping to ASME B31.9.
L. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
M. Pipe Hangers and Supports:
    1. Install in accordance with ASME B31.9.

### 3.04 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.
B. Install unions downstream of valves and at equipment or apparatus connections.

### 3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (2%) slope.
B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

### 3.06 FIELD TESTS AND INSPECTIONS

A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.

B. Domestic Water Systems:

1. Perform hydrostatic testing for leakage prior to system disinfection.
2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
3. General:
    a. Fill the system with water and raise static head to 10 psi above service pressure. Minimum static head of 50 to 150 psi. As an exception, certain codes allow a maximum static pressure of 80 psi.

C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

**3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

A. Disinfect water distribution system in accordance with Section 33-01-10.58.

B. Prior to starting work, verify system is complete, flushed, and clean.

C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

**3.08 SCHEDULES**

A. Pipe Hanger Spacing:

1. Metal Piping:
    a. Pipe Size: 1/2 inch to 1-1/4 inch:
        1) Maximum Hanger Spacing: 6.5 ft.
        2) Hanger Rod Diameter: 3/8 inches.
    b. Pipe Size: 1-1/2 inch to 2 inch:
        1) Maximum Hanger Spacing: 10 ft.
        2) Hanger Rod Diameter: 3/8 inch.
    c. Pipe Size: 2-1/2 inch to 3 inch:
        1) Maximum Hanger Spacing: 10 ft.
        2) Hanger Rod Diameter: 1/2 inch.
    d. Pipe Size: 4 inch to 6 inch:

**END OF SECTION**

## SECTION 22-10-06 - PLUMBING PIPING SPECIALTIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Drains.

B. Cleanouts.

C. Washing machine boxes and valves.

D. Water hammer arrestors.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS for additional provisions.
2. Extra Loose Keys for Outside Hose Bibbs: One.
3. Extra Hose End Vacuum Breakers for Hose Bibbs: One.

#### 1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

#### 2.02 DRAINS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Josam Company: www.josam.com/#sle.
3. MIFAB, Inc: www.mifab.com/#sle.
4. Zurn Industries, LLC: www.zurn.com/#sle.
5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Floor Drains:

1. Manufacturers:
   a. ACO, Inc: www.acobuildingdrainage.us/#sle.
   b. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
   c. MIFAB, Inc: www.mifab.com/#sle.
   d. Zurn Industries, LLC: www.zurn.com/#sle.
   e. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

C. Floor Drain:

1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, adjustable nickel-bronze strainer.
    a. Strainer: Provide square strainer when installed in tile floor and round strainer in all other applications unless otherwise noted on plans.

**2.03 CLEANOUTS**

A. Manufacturers:
    1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
    2. Josam Company: www.josam.com/#sle.
    3. MIFAB, Inc: www.mifab.com/#sle.
    4. Zurn Industries, LLC: www.zurn.com/#sle.
    5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.
B. Cleanouts at Exterior Surfaced Areas:
    1. Round cast nickel bronze access frame and non-skid cover.
C. Cleanouts at Exterior Unsurfaced Areas:
    1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.
D. Cleanouts at Interior Finished Floor Areas:
    1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.
E. Cleanouts at Interior Finished Wall Areas:
    1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.
F. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

**2.04 WASHING MACHINE BOXES AND VALVES**

A. Box Manufacturers:
    1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
    2. Oatey Supply Chain Services, Inc: www.oatey.com/#sle.
    3. Viega LLC: www.viega.us/#sle.
    4. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.
B. Description: Metal preformed rough-in box with brass quarter turn valves with water hammer arre, socket for 2 inch waste, slip in finishing cover.

**2.05 WATER HAMMER ARRESTORS**

A. Manufacturers:
    1. Cash Acme, a brand of Reliance Worldwide Corporation; _____: www.cashacme.com/#sle.
    2. Jay R. Smith Manufacturing Company; _____: www.jrsmith.com/#sle.
    3. Watts Regulator Company, a part of Watts Water Technologies; _____: www.wattsregulator.com/#sle.

4. Zurn Industries, LLC; _____: www.zurn.com/#sle.
5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Water Hammer Arrestors:
1. Copper construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Install floor cleanouts at elevation to accommodate finished floor.

D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to flush valve plumbing fixtures..

**END OF SECTION**

## SECTION 22-30-00 - PLUMBING EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Commercial electric water heaters.

B. Diaphragm-type compression tanks.

C. In-line circulator pumps.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittals procedures.

B. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### 1.04 QUALITY ASSURANCE

#### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

#### 1.06 WARRANTY

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS for additional warranty requirements.

B. Provide five year manufacturer warranty for domestic water heaters.

### PART 2 PRODUCTS

#### 2.01 WATER HEATERS

A. Commercial Electric Water Heaters:

1. Type: Factory-assembled and wired, electric, vertical storage.
2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
3. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
4. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
5. Accessories:
    a. Drain valve.
    b. Temperature and Pressure Relief Valve: ASME labeled.
6. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

#### 2.02 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

B. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

### 2.03 IN-LINE CIRCULATOR PUMPS

A. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.

B. Impeller: Bronze.

C. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

D. Seal: Carbon rotating against a stationary ceramic seat.

E. Drive: Flexible coupling.

### 2.04 ELECTRICAL WORK

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

C. Domestic Water Storage Tanks:

1. Provide steel pipe support, independent of building structural framing members.
2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

D. Pumps:

1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

### 3.02 FIELD QUALITY CONTROL

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.

**END OF SECTION**

## SECTION 22-40-00 - PLUMBING FIXTURES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Flush valve water closets.

B. Lavatories.

C. Sinks.

D. Under-lavatory pipe supply covers.

E. Bottle filling drinking fountains.

F. Electric water coolers.

G. Bi-level, electric water coolers.

H. Mop sinks.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

#### 1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

#### 1.05 WARRANTY

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS for additional warranty requirements.

B. Provide five year manufacturer warranty for electric water cooler.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

#### 2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for installation of plumbing systems.

B. Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation.

#### 2.03 FLUSH VALVE WATER CLOSETS

A. Water Closets:

1. Vitreous china, ASME A112.19.2, wall hung, siphon jet flush action, china bolt caps.
2. Flush Valve: Exposed (top spud).
3. Flush Operation: Sensor operated.
4. Handle Height: 44 inches or less.

B. Flush Valves:

1. Valve Supply Size: 1 inch.

2. Valve Outlet Size: 1-1/2 inches.
3. Sensor-Operated:
    a. Type: ASME A112.19.5; chloramine-resistant clog-resistant dual-seat diaphragm valve complete with vacuum breaker, stops and accessories.
    b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.
    c. Supplied Volume Capacity: 1.6 gal per flush.

C. Toilet Seats:
1. Plastic: Solid, white finish, enlongated shape, open front, slow-closing hinged seat cover, extended back complete with self-sustaining hinges, and brass bolts with covers.

**2.04 LAVATORIES**

A. Wall-Hung Basin:
1. Vitreous China, Grade A: ASME A112.19.2; white rectangular commercial-grade sink with predrilled holes, rear-center drain, front overflow, and hanger. Size as indicated on drawings with 4 inch centerset spacing.
2. Carrier:
    a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.

B. Supply Faucet:
1. ASME A112.18.1; chrome plated combination supply fitting with open grid strainer, water economy aerator with maximum flow of 1.2 gpm, indexed handles.

C. Sensor Operated Faucet:
1. Spout Style: Standard.
2. Mixing Valve: Internal, automatic.
3. Water Supply: 3/8 inch compression connections.
4. Aerator: Vandal resistant, 0.5 gpm, laminar flow device.
5. Finish: Polished chrome.

D. Thermostatic Mixing Valve:
1. ASSE 1070 listed with combination stop, strainer, and check valves, and flexible stainless steel connectors.

**2.05 SINKS**

A. Single Compartment Bowl
1. ASME A112.19.3; 20 gauge, 0.0359 inch thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.

B. Kitchen Faucets: See plumbing fixture schedule on plans for faucet requirements.

**2.06 UNDER-LAVATORY PIPE SUPPLY COVERS**

A. General:
1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.

2. Construction: 1/8 inch PVC with antimicrobial, antifungal and UV resistant properties.
    a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
    b. Comply with ICC A117.1.

**2.07 ELECTRIC WATER COOLERS**

A. Water Cooler: Electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
    1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
    2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

B. Bottle Filler: Materials to match fountain.

**2.08 MOP SINKS**

A. Terrazzo Mop Sink Manufacturers:

B. Material: Precast terrazzo composed of marble chips cast in Portland cement.

C. Type: Rectilinear, standard height.

D. Tiling Flange Construction: Galvanized steel.

E. Grid strainer: Stainless steel; integral; removable.

F. Dimensions: As indicated on drawings.

G. Accessories:
    1. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.
    2. Hose clamp hanger.
    3. Mop hanger.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

**3.02 PREPARATION**

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

**3.03 INSTALLATION**

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports and bolts.

**3.04 INTERFACE WITH WORK OF OTHER SECTIONS**

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

**3.05 ADJUSTING**

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

**3.06 CLEANING**

A. Clean plumbing fixtures and equipment.

**3.07 PROTECTION**

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION**

## SECTION 23-00-01 - GENERAL HVAC REQUIREMENTS

### PART 1 GENERAL

#### 1.01 DESCRIPTION OF WORK

A. This Division includes all labor, materials, equipment, tools, supervision, start-up services, Owner training, etc., including all incidental and related items, necessary to complete installation and successfully test and start up and operate the HVAC systems indicated on the drawings, and as described in each Section of Division 230000 Specifications.

B. All work shall be completed in compliance with local codes, rules, and regulations. In the event that the plans conflict with any rules, regulation, or codes, the rules, regulations, and codes shall govern. Where the plans exceed code requirements, the plans shall govern.

C. The Contractor and his Subcontractors shall include all materials, labor, and necessary equipment in his bid.

#### 1.02 DRAWINGS

A. The drawings are generally diagrammatic and show general location and arrangement of equipment, piping, and accessories. The contractor shall provide and install all necessary equipment, fittings, offsets and other components required to adapt to field conditions, interferences, and code requirements to deliver a complete and functional system.

B. Deviations from the drawings, with the exception of changes to field conditions, and do not effect system functionality, shall not be made without the written approval of the Engineer.

C. Architectural and Structural drawings take precedence in all matters pertaining to the building structure. HVAC drawings take precedence in all matter pertaining to HVAC work and electrical drawings to electrical work. Where conflicts between trades exist, report conflicts or differences to the Architect and Engineer.

#### 1.03 COORDINATION

A. The Contractor shall examine the plans and coordinate with other trades for scheduling of work.

B. Coordinate all penetrations with architectural and structural trades.

C. Refer to architectural plans for exact locations and heights of fixtures.

D. Refer to architectural plans for coordination of all ceiling mounted access panels for HVAC equipment that requires access.

E. All HVAC equipment and piping located above ceiling shall be installed to preserve ceiling heights listed on architect ceiling plans.

#### 1.04 PERMITS AND FEES

A. The Contractor shall be responsible for coordinating and obtaining all applicable agency approvals for utility connections and permits.

#### 1.05 ACTION SUBMITTALS

A. Provide product submittals for all required specification sections. Submittals shall be submitted in PDF format.

B. Contractor shall review and mark with approval stamp before submitting to Architect.

#### 1.06 EQUIPMENT AND MATERIAL MANUFACTURERS

A. All equipment shall be provided with normally supplied accessories needed for complete installation.

B. All equipment shall be new and shall be standard products from the current manufacturer product line offering.

C. If an alternate manufacturer to the basis of design is submitted and approved, the Contractor shall assume all costs required to adapt the system to the submitted piece of equipment, including, but not limited to: piping, sheet metal, electrical work, and building alterations. Alternate equipment shall conform to all space requirements and operating conditions.

**1.07 QUALITY ASSURANCE**

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

**3.01 PROTECTION AND HANDLING OF EQUIPMENT**

A. The Contractor shall be responsible for ensuring all equipment and materials delivered to the site are protected from theft and damage until time of project turnover to the Owner.

B. All HVAC fixtures, ductwork, and pipings shall be protected from damage and use after installation.

**3.02 FIELD QUALITY CONTROL**

A. Field Service: Engage a trained service representative to test and inspect all installed equipment, assemblies and installations.

B. Perform functional tests on all installed equipment.

C. Any equipment that does not pass tests and inspections shall be considered defective.

D. Prepare test and inspection reports. Reports shall be included in Operation and Maintenance Manual turned over to Owner.

**3.03 OPERATION AND MAINTANCE**

A. Prior to final inspections, the Contractor shall provide training to the Owner on operation, adjustment, and maintenance on all installed equipment.

B. The Contractor shall prepare and turnover to the Owner a binder with all operation and maintained manuals for all equipment installed.

**3.04 ACCESSIBILITY**

A. All equipment installed shall fit within the designated space with adequate access for service and maintained and required by the manufacturer.

**3.05 CLEANING**

A. Each trade is responsible for maintain a clean and hazard free work area.

B. After each piece of equipment has been installed and tested, each system shall be cleaned and flushed.

**3.06 PAINTING**

A. All exposed HVAC systems in finished areas shall be painted to match surrounding finishes, unless restricted by code. See architectural plans for finishes.

**END OF SECTION**

## SECTION 23-05-17 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

### PART 1 GENERAL

### 1.01 SECTION INCLUDES

A. Pipe sleeves.

### 1.02 QUALITY ASSURANCE

### PART 2 PRODUCTS

### 2.01 PIPE SLEEVES

A. Pipe Sleeves: Schedule 40, galvanized steel pipe with plain ends.
   1. Schedule 40, galvanized steel pipe with plain ends.
   2. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudnal joints.

B. Vertical Piping:
   1. Sleeve Length: 1 inch above finished floor in mechanical rooms and other wet areas otherwise flush with the floor.
   2. Provide sealant for watertight joint.
   3. Blocked Out Floor Openings: Provide 1-1/2 inch angle set in silicon adhesive around opening.
   4. Drilled Penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.

C. Pipe passing through interior walls, partitions, and floors. Interior gypsum partition penetrations concealed from view may omit sleeve if penetration is made neat and clean.

D. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, and Partitions: 1 inch greater than external pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 to prevent the spread of fire, smoke, and gases.

### PART 3 EXECUTION

### 3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

### 3.02 INSTALLATION

A. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

B. Structural Considerations:
   1. Do not penetrate building structural members unless indicated.

C. Provide sleeves when penetrating floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

1. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07-84-00 to prevent the spread of fire, smoke, and gases.

D. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

**3.03 CLEANING**

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION**

## SECTION 23-05-19 - METERS AND GAUGES FOR HVAC PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Pressure gauges and pressure gauge taps.

B. Thermometers and thermometer wells.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Operation and Maintenance Data: _____.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.

#### 1.03 FIELD CONDITIONS

A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

### PART 2 PRODUCTS

#### 2.01 PRESSURE GAUGES

A. Manufacturers:

1. Dwyer Instruments, Inc.
2. Omega Engineering, Inc.
3. Ashcroft Inc..
4. [Miljoco Corporation.]
5. [Tel-Tru Manufacturing Company.].
6. [Trerice, H. O. Co.].
7. [Watts Regulator Co.; a div of Watts Water Technologies, Inc.].
8. [Weiss Instruments, Inc].
9. [Winters Instruments - U.S.].
10. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Pressure Gauges: ASME B40.100, UL 393 Sealed cast alumnium or drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel or Cast Alumnium.
2. Window: Glass with stainless steel ring.
3. Size: 4-1/2 inch diameter.
4. Mid-Scale Accuracy: Plus or Minus One percent.
5. Scale: Psi and KPa.

#### 2.02 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass or stainless steel for maximum 150 psi.

B. Needle Valve: Brass, 1/4 inch NPT for minimum 150 psi.

C. Pulsation Damper: Pressure snubber, brass with NPS 1/4 OR NPA 1/2 connections.

D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

**2.03 STEM TYPE THERMOMETERS**

A. Manufacturers:

1. Dwyer Instruments, Inc.
2. Trerice, H.O. Co.
3. Weiss Instruments, Inc.
4. Winters Instruments - U.S.
5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Thermometers - Light Activated Digital.

1. Case: Plastic 5 inch or larger with adjustable angle neck.
2. Stem: Alumnium. Designed for installation in thermowell.
3. Accuracy: 2 percent, per ASTM E77.
4. Calibration: Degrees F and Degrees C.

**2.04 THERMOMETER SUPPORTS (THERMOWELLS)**

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

1. Material:
   a. Copper Piping: Copper Nickel Alloy
   b. Steel Piping: Corrosion Resistant Steel
2. Type: Stepped Shank unless straight or tapered shank is indicated.
3. External Threads: NPS 1/2, NPS 3/4, or NPS 1 ASME B1.20.1 pipe threads.
4. Internal Threads: 1/2, 3/4, or 1 inch ASME B1.1 screw threads.
5. Bore: Diameter required to math thermometer stem.
6. Insertion Length. Length required to match thermometer stem.

B. Heat Transfer Medium: Mixture or graphice and glycerin.

**2.05 TEST PLUGS**

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

C. Install thermowells with extension in insulated piping.

D. Install pressure gauges in the following locations:

1. Suction and discharge of each pump.

E. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation.

F. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

G. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets and in the following locations:
   1. Inlet and outlet of each hydronic zone.
   2. Inlet and outlet of each hydronic boiler or heat exchanger.
   3. Inlet and oulet of all piping at chillers.
   4. Inlet and oulet of each hydronic coil in an air handling unit.
   5. Inlet and oulet of each thermal storage tank.

H. Provide instruments with scale ranges selected according to service with largest appropriate scale.

I. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

J. Locate test plugs adjacent to control device sockets.

**END OF SECTION**

## SECTION 23-05-23 - GENERAL-DUTY VALVES FOR HVAC PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Ball valves.

B. Butterfly valves.

C. Check valves.

D. Chainwheels.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

#### 1.03 QUALITY ASSURANCE

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
2. Protect valve parts exposed to piped medium against rust and corrosion.
3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
5. Secure check valves in either the closed position or open position.
6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:

1. Maintain valve end protection and protect flanges and specialties from dirt.
    a. Provide temporary inlet and outlet caps.
    b. Maintain caps in place until installation.
2. Store valves in shipping containers and maintain in place until installation.
    a. Store valves indoors in dry environment.
    b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

C. Exercise the following precautions for handling:

1. Handle large valves with sling, modified to avoid damage to exposed parts.
2. Avoid the use of operating handles or stems as rigging or lifting points.

### PART 2 PRODUCTS

#### 2.01 APPLICATIONS

A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

B. Provide the following valves for the applications if not indicated on drawings:

1. Throttling (Hydronic): Butterfly and Ball.

2. Throttling (Steam): Globe.
3. Isolation (Shutoff): Butterfly and Ball.
4. Swing Check (Pump Outlet):
    a. Size 2 inch and Smaller: Bronze with bronze disc.
    b. Size 2-1/2 inch and Larger: Iron with lever and weight, lever and spring, center-guided metal, or center-guided with resilient seat.
5. Dead-End: Butterfly, single-flange (lug) type.

C. Required Valve End Connections for Non-Wafer Types:
1. Steel Pipe:
    a. Size 2 inch and Smaller: Threaded ends.
    b. Size 2-1/2 inch and Larger: Grooved or Flanged Ends
2. Copper Tube:
    a. Size 2 inch and Smaller: Threaded ends, except solder-joint valve-ends.
    b. Size 2-1/2 inch and Larger: Grooved ends.

**2.02 GENERAL REQUIREMENTS**

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
1. Handwheel: Valves other than quarter-turn types.
2. Hand Lever: Quarter-turn valves 6 inch and smaller.
3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

D. Valves in Insulated Piping: Provide 2 inch stem extensions and the following features:
1. Gate Valves: Rising stem.
2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: Extended neck.

E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
3. Solder Joint Connections: ASME B16.18.
4. Grooved End Connections: AWWA C606.

F. General ASME Compliance:
1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
2. Building Services Piping Valves: ASME B31.9.

G. Bronze Valves:
1. Fabricate from dezincification resistant material.

2. Copper alloys containing more than 15 percent zinc are not permitted.

H. Source Limitations: Obtain each valve type from a single manufacturer.

**2.03 BRONZE, BALL VALVES**

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze Trim:

1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. CWP Rating: 600 psi.
4. Body: Forged bronze.
5. End Connections: Pipe thread or solder.
6. Seats: PTFE or TFE.
7. Stem: Bronze.
8. Ball: Chrome plated brass.
9. Operator: Provide lockable handle and stem extension.
10. Manufacturers:
    a. Apollo Valves; _____: www.apollovalves.com/#sle.
    b. FNW; X450: www.fnw.com/#sle.
    c. Jomar Valves, a division of Jomar Group; _____: www.jomarvalve.com/#sle.
    d. Conbraco Industries, Inc..
    e. [Crane Co.; Cranve Valve Group; Crane Valves.].
    f. [Hammond Valve.].
    g. [Lance Valves; a division of Advanced Thermal Systems, Inc.].
    h. [Milwaukee Valve Company.].
    i. [NIBCO INC.].
    j. [Red-White Valve Corporation.].
    k. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.].

**2.04 IRON, SINGLE FLANGE BUTTERFLY VALVES**

A. Lug Style; Bidirectional Dead-End Service without Use of Downstream Flange:

1. Comply with MSS SP-67, Type I.
2. Lug Style, CWP Ratings:
    a. Sizes 2 to 12 inch: 150 psi.
    b. Vacuum Service: Down to 29.9 in-Hg.
3. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
4. Stem: One or two-piece stainless steel.
5. Seat: EPDM.
6. Disc: Aluminum-bronze.

7. Manufacturers:
    a. Apollo Valves; _____: www.apollovalves.com/#sle.
    b. FNW; 711: www.fnw.com/#sle.
    c. Jomar Valves, a division of Jomar Group; _____: www.jomarvalve.com/#sle.
    d. Kitz Corporation of America; _____: www.kitzus-kca.com/#sle.
    e. Nexus Valve, Inc; _____: www.nexusvalve.com/#sle.
    f. Cooper Cameron Valves; a division of Cooper Cameron Corp..
    g. [Crane Co.; Crane Valve Group; Jenkins Valves.].
    h. [Crane Co.; Crane Valve Group; Stockham Division.].
    i. [Dezurik Water Controls.].
    j. [Hammond Valve.].
    k. [Kitz Corporation.].
    l. [Milwaukee Valve Corporation.].
    m. [NIBCO INC.].
    n. [Norriseal; a Dover Corporation company.]
    o. [Red-White Valve Corporation.].
    p. [Spence Strainers International; a division of CIRCOR International.].
    q. [Tyco Valves & Conrols; a unit of Tyco Flow Control.].
    r. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.].

**2.05 IRON, GROOVED-END BUTTERFLY VALVES**

A. CWP Rating: 175 psi.
    1. Comply with MSS SP-67, Type I.
    2. Body: Coated ductile iron.
    3. Stem: Two-piece stainless steel.
    4. Disc: Coated ductile iron.
    5. Disc Seal: EPDM.
    6. Manufacturers:
        a. Kitz Corporation of America: www.kitzus-kca.com/#sle.
        b. Tyco FireProducts
        c. Victaulic
        d. Shurjoint
        e. Kennedy

**2.06 HIGH-PERFORMANCE, SINGLE FLANGE BUTTERFLY VALVES**

A. Lug type; Bidirectional dead end service without downstream flange:
    1. Comply with MSS SP-68.
    2. Class 150: CWP Rating: 285 psi at 100 degrees F.
    3. Body: Provide carbon steel, ductile Iron, or stainless steel.
    4. Seat: Metal or reinforced PTFE.

5. Offset stem: Stainless steel.
6. Disc: Carbon steel.
7. Manufacturers:
    a. Apollo Valves; _____: www.apollovalves.com/#sle.
    b. FNW; HPA: www.fnw.com/#sle.
    c. Jomar Valves, a division of Jomar Group; _____: www.jomarvalve.com/#sle.
    d. Kennedy Valve; a division of McWane, Inc..
    e. [Shurjoint Piping Products.].
    f. [Tyco Fire Products LP; Grinnell Mechanical Products.].

**2.07 BRONZE, SWING CHECK VALVES**

A. Class 125:
1. Pressure and Temperature Rating: MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. WSP Rating: 200 psi.
4. Body: Bronze, ASTM B62.
5. End Connections: Threaded or soldered.
6. Disc: Bronze.
7. Manufacturers:
    a. Apollo Valves: www.apollovalves.com/#sle.
    b. Kitz Corporation of America; #22: www.kitzus-kca.com/#sle.
    c. Crane Co.; Crane Valve Group; Crane Valves..
    d. [Crane Co.; Crane Valve Group; Stockham Division.].
    e. [Hammond Valve.].
    f. [Kitz Corporation.].
    g. [Milwaukee Valve Company.].
    h. [NIBCO INC.].
    i. [Powell Valves.].
    j. [Red-White Valve Corporation.].
    k. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.].
    l. [Zy Tech Global Industries, Inc.].

**2.08 IRON, FLANGED END SWING CHECK VALVES**

A. Class 125:
1. 150 psi with metal seats.
2. 200 psi with metal seats and nonmetallic-to-metal seats.

B. Manufacturers:
1. Apollo Valves: www.apollovalves.com/#sle.
2. FNW; 671B: www.fnw.com/#sle.
3. Crane Co.; Crane Valve Group; Crane Valves..

4. [Crane Co.; Crane Valve Group; Jenkins Valves.].
5. [Crane Co.; Crane Valve Group; Stockham Division.].
6. [Hammond Valve.].
7. [Milwaukee Valve Company.].
8. [NIBCO INC.].
9. [Watts Regulator Co.; a division of Watts Water Technologies, Inc.].

### 2.09 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Compact-Wafer:
   1. Comply with MSS SP-125.
   2. Body Material: ASTM A126, gray iron.

### 2.10 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   2. Attachment: For connection to ball, butterfly, and plug valve stems.
   3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
   4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

B. Manufacturers:
   1. Babbit Steam Speciality Co..
   2. Roto Hammer Industries..
   3. Trumbull Industries..

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve determined to be defective, replace with new valve.

### 3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Provide support of piping adjacent to valves such that no force is imposed on valves.

D. Install valves so that stems are horizontal or slope upward from centerline of pipe.

E. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

F. Install check valves where necessary to maintain direction of flow as follows:
   1. Swing Check: Install horizontal maintaining hinge pin level.
   2. Orient plate-type and center-guided into horizontal or vertical position, between flanges.

G. Provide chainwheels on operators for valves 4 NPS and larger where located 96 NPS or more above finished floor, terminating 60 NPS above finished floor.

**END OF SECTION**

## SECTION 23-05-29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Support and attachment components.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03-30-00.

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

#### 1.04 QUALITY ASSURANCE

A. Comply with applicable building code.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### PART 2 PRODUCTS

#### 2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be

supported. Include consideration for vibration, equipment operation, and shock loads where applicable.

4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use stainless steel or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Prefabricated Trapeze-Framed Metal Strut Systems:
1. Manufacturers:
    a. ABB Installation Products: electrification.us.abb.com/#sle.
    b. B-Line, a brand of Eaton Corporation: www.eaton.com/#sle.
    c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
    d. Allied Tube & Conduit..
    e. [Flex-Strut Inc.].
    f. [Wesanco, Inc.].
    g. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
3. Strut Channel or Bracket Material:
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
5. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
6. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
7. Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
    a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

C. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
2. Trim excess length of continuous thread hanger and support rods to 1-1/2 inches.

D. Thermal Insulated Pipe Supports:

1. General Requirements:
    a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    c. Pipe supports to be provided for nominally sized, 1/2 to 30 inch iron pipes.
    d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
2. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

E. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up To 122 degrees F:
    a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
    b. Support From Below: MSS SP-58 Types 35 through 38.
3. Operating Temperatures from 122 to 446 degrees F:
    a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
    b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.

F. Beam Clamps:
1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

G. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. MSS SP-58 type 1 or 8, carbon steel or steel with stainless steel or zinc plated finish.

3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with stainless steel or zinc plated finish.
4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

H. Pipe Hangers:
1. Band Hangers, Adjustable:
a. MSS SP-58 Type 7 or 9, Zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
2. Swivel Ring Hangers, Adjustable:
a. MSS SP-58 Type 10, epoxy-painted, zinc-colored.
b. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
c. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
3. Clevis Hangers, Adjustable:
a. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.
b. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.

I. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

J. Pipe Shields for Insulated Piping:
1. General Construction and Requirements:
a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
b. Shields Material: _____.
c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
d. Minimum Service Temperature: Minus 40 degrees F.
e. Maximum Service Temperature: 178 degrees F.
f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

K. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
7. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.

8. Sheet Metal: Use sheet metal screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Hammer-driven anchors and fasteners are not permitted.
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    a. Comply with MFMA-4.
    b. Channel Material: Use galvanized steel.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive support and attachment components.
C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
H. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
    3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
    4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3-1/2 inch high concrete pad constructed in accordance with Section 03-30-00.
    5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

J. Secure fasteners according to manufacturer's recommended torque settings.

K. Remove temporary supports.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

**3.03 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**

## SECTION 23-05-53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

E. Ceiling tacks.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide manufacturers catalog literature for each product required.

### PART 2 PRODUCTS

#### 2.01 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Air Terminal Units: Tags.

C. Automatic Controls: Tags. Key to control schematic.

D. Control Panels: Nameplates.

E. Dampers: Ceiling tacks, where located above lay-in ceiling.

F. Ductwork: Stencilled painting.

G. Instrumentation: Tags.

H. Major Control Components: Nameplates.

I. Piping: Pipe markers.

J. Pumps: Nameplates.

K. Small-sized Equipment: Tags.

L. Thermostats: Nameplates.

M. Valves: Tags and ceiling tacks where located above lay-in ceiling.

#### 2.02 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.
2. Brimar Industries, Inc: www.pipemarker.com/#sle.
3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
5. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.

B. Letter Color: White.

C. Letter Height: 1/4 inch.

D. Background Color: Black.

E. Plastic: Comply with ASTM D709.

## 2.03 TAGS

A. Manufacturers:
   1. Advanced Graphic Engraving: www.advancedgraphicengraving.com/#sle.
   2. Brady Corporation: www.bradycorp.com/#sle.
   3. Brimar Industries, Inc: www.pipemarker.com/#sle.
   4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
   5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
   6. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

## 2.04 STENCILS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com/#sle.
   2. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
   3. Insite Solutions, LLC: www.stop-painting.com/#sle.
   4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
   5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.

B. Stencils: With clean cut symbols and letters of following size:
   1. Ductwork and Equipment: 2-1/2 inch high letters.

C. Stencil Paint: As specified in Section 09-91-23, semi-gloss enamel, colors complying with ASME A13.1.

## 2.05 PIPE MARKERS

A. Color: Comply with ASME A13.1.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

## 2.06 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

B. Color code as follows:
   1. HVAC Equipment: Yellow.
   2. Fire Dampers and Smoke Dampers: Red.
   3. Heating/Cooling Valves: Blue.

# PART 3 EXECUTION

## 3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

## 3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Section 09-91-23.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Use tags on piping 3/4 inch diameter and smaller.

1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

F. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**

## SECTION 23-05-93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to Architect.
2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
3. Include at least the following in the plan:
    a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
    b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
    c. Identification and types of measurement instruments to be used and their most recent calibration date.
    d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    e. Final test report forms to be used.
    f. Details of how TOTAL flow will be determined; for example:
        1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
        2) Water: Pump curves, circuit setter, flow station, ultrasonic, etc.
    g. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
    h. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
    i. Method of checking building static and exhaust fan and/or relief damper capacity.
    j. Procedures for formal deficiency reports, including scope, frequency and distribution.

C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure: Report data in I-P (inch-pound) units only.
6. Include the following on the title page of each report:
    a. Name of Testing, Adjusting, and Balancing Agency.
    b. Project name.
    c. Project location.
    d. Report date.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 GENERAL REQUIREMENTS**

A. Perform total system balance in accordance with one of the following:
    1. AABC (NSTSB), AABC National Standards for Total System Balance.
    2. SMACNA (TAB).
B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
C. TAB Agency Qualifications:
    1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
    2. Having minimum of three years documented experience.
    3. Certified by one of the following:
        a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.
        b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
        c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

**3.02 EXAMINATION**

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
    1. Systems are started and operating in a safe and normal condition.
    2. Temperature control systems are installed complete and operable.
    3. Proper thermal overload protection is in place for electrical equipment.
    4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
    5. Duct systems are clean of debris.
    6. Fans are rotating correctly.

7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Hydronic systems are flushed, filled, and vented.
12. Proper strainer baskets are clean and in place.
13. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

**3.03 PREPARATION**

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

**3.04 ADJUSTMENT TOLERANCES**

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

**3.05 RECORDING AND ADJUSTING**

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

**3.06 AIR SYSTEM PROCEDURE**

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

J. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

K. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

**3.07 WATER SYSTEM PROCEDURE**

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

**3.08 MINIMUM DATA TO BE REPORTED**

A. Pumps:
   1. Shut off, discharge and suction pressures.
   2. Shut off, total head pressure.

B. Combustion Equipment:
   1. Boiler manufacturer.
   2. Model number.
   3. Serial number.
   4. Firing rate.

C. Heating Coils:
    1. Location.
    2. Service.
    3. Manufacturer.
    4. Air flow, design and actual.
    5. Water flow, design and actual.
    6. Water pressure drop, design and actual.
    7. Entering water temperature, design and actual.
    8. Leaving water temperature, design and actual.
    9. Entering air temperature, design and actual.
    10. Leaving air temperature, design and actual.
    11. Air pressure drop, design and actual.

D. Air Moving Equipment:
    1. Location.
    2. Manufacturer.
    3. Model number.
    4. Serial number.
    5. Air flow, specified and actual.
    6. Return air flow, specified and actual.
    7. Outside air flow, specified and actual.
    8. Total static pressure (total external), specified and actual.
    9. Inlet pressure.
    10. Discharge pressure.
    11. Fan RPM.

E. Return Air/Outside Air:
    1. Identification/location.
    2. Design air flow.
    3. Design return air flow.
    4. Actual return air flow.
    5. Design outside air flow.
    6. Actual outside air flow.
    7. Return air temperature.
    8. Outside air temperature.
    9. Design outside/return air ratio.
    10. Actual outside/return air ratio.

F. Exhaust Fans:
    1. Location.
    2. Manufacturer.

3. Model number.
4. Serial number.
5. Total static pressure (total external), specified and actual.
6. Discharge pressure.
7. Fan RPM.

G. Duct Traverses:
1. System zone/branch.
2. Duct size.
3. Area.
4. Design velocity.
5. Design air flow.
6. Test velocity.
7. Test air flow.
8. Duct static pressure.
9. Air temperature.

H. Duct Leak Tests:
1. Description of ductwork under test.
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Maximum allowable leakage duct capacity times leak factor.
5. Test apparatus:
   a. Blower.
   b. Orifice size.
   c. Calibrated.
6. Test static pressure.
7. Test orifice differential pressure.
8. Leakage.

I. Terminal Unit Data:
1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Maximum design air flow.
10. Maximum actual air flow.

11. Inlet static pressure.

J. Air Distribution Tests:
    1. Air terminal number.
    2. Room number/location.
    3. Terminal type.
    4. Terminal size.
    5. Area factor.
    6. Design velocity.
    7. Design air flow.
    8. Test (final) velocity.
    9. Test (final) air flow.
    10. Percent of design air flow.

**END OF SECTION**

## SECTION 23-07-13 - DUCT INSULATION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct liner.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### 1.04 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

### PART 2 PRODUCTS

#### 2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

#### 2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. CertainTeed Corporation.
2. Johns Manville; _____.
3. Knauf Insulation.
4. Owens Corning Corporation.
5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Insulation: ASTM C553; flexible, noncombustible blanket with FRK facing.

1. K value: Minimum Out of Package 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 250 degrees F.
3. Maximum Water Vapor Absorption: < 3.0 percent by weight.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.

3. Secure with pressure-sensitive tape.

D. Indoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

**2.03 DUCT LINER**

A. Manufacturers:

1. Armacell LLC.
2. CertainTeed Corporation
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning Corporation.
6. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Note: Choose the liner type - Elastomeric Foam or Glass Fiber.

C. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.

1. Minimum Service Temperature: Minus 40 degrees F.
2. Maximum Service Temperature: 180 degrees F.
3. Fungal Resistance: No growth when tested according to ASTM G21.
4. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F.
5. Minimum Noise Reduction Coefficients:
    a. 1 inch Thickness: 0.40.
6. Connection: Waterproof vapor barrier adhesive.

D. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with ASTM C916.

E. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; rigid board and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.

1. Fungal Resistance: No growth when tested according to ASTM G21.
2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
3. Service Temperature: Up to 250 degrees F.
4. Minimum Noise Reduction Coefficients:
    a. 1 inch Thickness: 0.45.

F. Adhesive: Waterproof, fire-retardant type, ASTM C916.

G. Liner Fasteners: Galvanized steel, self-adhesive pad or welded with integral head.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Test ductwork for design pressure prior to applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

**3.02 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. External Duct Insulation Application:

1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires.
3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

C. Duct and Plenum Liner Application:

1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for air-flow. Increase duct size to allow for insulation thickness.

**3.03 SCHEDULES**

A. All duct insulation to meet or exceed local energy code requirements.

B. Supply Ducts:

1. Exposed: Duct Liner, Minimum R-6
2. Concealed: Fiberglass Duct Wrap, MinimumR-6 .
3. Unconditioned Spaces: Fiberglass Duct Wrap, Minimum R-12 .

C. Return Transfer Ducts:

1. 1 inch accoustic duct liner.

**END OF SECTION**

## SECTION 23-07-19 - HVAC PIPING INSULATION

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Piping insulation.

B. Jacketing and accessories.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

#### 1.03 QUALITY ASSURANCE

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

#### 1.05 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

### PART 2 PRODUCTS

#### 2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

#### 2.02 GLASS FIBER, RIGID

A. Manufacturers:

1. CertainTeed Corporation.
2. Johns Manville Corporation
3. Knauf Insulation.
4. Owens Corning Corporation
5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.

1. K Value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum Service Temperature: 650 degrees F.
3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

#### 2.03 JACKETING AND ACCESSORIES

A. PVC Plastic.

1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    a. Minimum Service Temperature: 0 degrees F.
    b. Maximum Service Temperature: 150 degrees F.
    c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
    d. Thickness: 10 mil, 0.010 inch.
    e. Connections: Brush on welding adhesive.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
    1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. Inserts and Shields:
    1. Application: Piping 1-1/2 inches diameter or larger.
    2. Insert location: Between support shield and piping and under the finish jacket.
    3. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
    4. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range. Wood or other absorptive material is not acceptable.

G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07-84-00.

### 3.03 SCHEDULE

A. Heating Systems: Mineral Fiber Insulation
    1. Heating Water Supply and Return:
        a. Pipe size less than or Equal to 1-1/2 inch: 1-1/2 inch thick.
        b. Pipe size greater than 1-1/2 inch: 2 inches thick.

**END OF SECTION**

## SECTION 23-09-13 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Air Supply System:
B. Control panels.
C. Control Valves:
    1. Ball valves and actuators.
D. Pressure independent valves and actuators.
E. HVAC&R Sensors:
    1. Temperature sensors.
    2. Humidity sensors.
    3. Static pressure (air pressure) sensors.
    4. Current sensors.
F. Thermostats:
    1. Electric room thermostats.
G. Time clocks.
H. Flow Sensors:
    1. Airflow measurement array (AFMA).
    2. Thermal dispersion flow meter.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

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

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
D. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01-60-00 - PRODUCT REQUIREMENTS for additional provisions.

#### 1.04 QUALITY ASSURANCE

A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in State Name.

**1.05 WARRANTY**

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS for additional warranty requirements.

**PART 2 PRODUCTS**

**2.01 EQUIPMENT - GENERAL**

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

**2.02 AIR SUPPLY SYSTEM**

**2.03 CONTROL PANELS**

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.

**2.04 CONTROL VALVES**

A. Ball Valves and Actuators:
   1. Service: Use for hot water.
   2. Flow Characteristic: Include 2-way operation configured to fail normally open (NO).
   3. Replacements in Kind: Provide pressure-independent type.
   4. Rangeability: 500 to 1.
   5. ANSI Rating: Class 150.
   6. Leakage: Class IV (0.1 percent of rated capacity) per ANSI/FCI 70-2.
   7. Body Size:
      a. Under 2-1/2 inches:
         1) Connection: NPT.
         2) Materials:
            (a) Body: Brass.
            (b) Flanges: Ductile iron.
            (c) Ball: Chrome-plated brass.
            (d) Stem: Nickel-plated brass.
            (e) Seat: Graphite-reinforced PTFE with EPDM O-Ring backing.
            (f) Stem Seal: EPDM O-Rings.
            (g) Flow Control Disk: Thermoplastic synthetic-resin.
      b. Service Temperature:
         1) Fluid Side: 0 to 284 degrees F liquid or 25 psig steam.
         2) Ambient Side: From minus 4 to 122 degrees F.
   8. Actuator Requirements:
      a. Assembly: Factory-mounted.
      b. Input: 0 to 5 VDC configured for proportional control.

c. Accessories: Provide with valve position indicator and manual override.

## 2.05 PRESSURE INDEPENDENT VALVES AND ACTUATORS

A. Actuator Requirements:
   1. Assembly: Factory-mounted.
   2. Input: 0 to 5 VDC configured for proportional control.
   3. Accessories: Provide with fail-safe battery pack, manual override, and valve position indicator.

## 2.06 HVAC&R SENSORS

A. Temperature Sensors:
   1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
   2. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F.
   3. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
   4. Temperature Sensing Device: Compatible with project DDC controllers.
   5. Performance Characteristics:

B. Humidity Sensors:
   1. Duct Mounted Sensor: Voltage type encased in a die-cast metal, weather-proof housing.
      a. Humidity:
         1) HS Element: Digitally profiled thin-film capacitive.
         2) Accuracy: 1 percent at 10 to 80 percent relative humidity at 77 degrees F, multi-point calibration, NIST traceable.
            (a) Plus/minus 1 percent at 20 to 40 percent RH in mA output mode; (multi-point calibration, NIST traceable).
         3) Scaling: 0 to 100 percent RH.
      b. Temperature Effect:
         1) Duct Mounted: Plus/minus 0.18 percent per degree F.

C. Static Pressure (Air Pressure) Sensors:
   1. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
   2. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
   3. Accuracy: One percent of full scale with repeatability 0.3 percent.

D. Current Sensors:
   1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 in-wc.
   2. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

## 2.07 THERMOSTATS

A. Electric Room Thermostats:
   1. Type: NEMA DC 3, 24 volts, with setback/setup temperature control.

2. Service: Cooling and heating.

**2.08 TIME CLOCKS**

A. Seven day programming switch timer with synchronous timing motor and seven day dial, continuously charged Ni-cad battery driven power failure 8 hour carry over and multiple switch trippers to control systems for minimum of two and maximum of eight signals per day with two normally open and two normally closed output switches.

**2.09 FLOW SENSORS**

A. Airflow Measurement Array (AFMA):
   1. Airflow Straighteners:
      a. Provide AFMA's with an airflow straightener if required by the AFMA manufacturer's published installation instructions.
      b. In the absence of published documentation, provide airflow straighteners if there is any duct obstruction within 5 duct diameters upstream of the AFMA.
   2. Outdoor Air Temperature: In outside air measurement or in low-temperature air delivery applications, provide an AFMA certified by the manufacturer to be accurate as specified over a temperature range of minus 20 to 120 degrees F.
   3. Electronic:
      a. Each electronic AFMA to consist of an array of velocity sensing elements of the resistance temperature detector (RTD) or thermistor type.
      b. Sensing Elements: Distributed across the duct cross section in the quantity and pattern specified or recommended by the published application data of the manufacturer.
      c. Electronic AFMA's: Accuracy of plus/minus 5 percent over a range of 125 to 5,000 fpm and temperature compensated output over a range of 32 to 212 degrees F.

B. Thermal Dispersion Air Flow Meter:
   1. Provide thermal dispersion flow meters complete with matched transducers, self aligning installation hardware, and transducer cables.
   2. Optimize thermal dispersion transducer for the specific duct or pipe and process conditions for the application.
   3. Air Velocity Monitoring Range: 0 to 2000 fpm, unidirectional. Factory configure monitor calculate airflow and air velocity from listed range.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify existing conditions before starting work.

B. Verify that systems are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

F. Ensure installation of components is complementary to installation of similar components.

G. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

**3.02 INSTALLATION**

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches above floor. Align with lighting switches and humidistats; see Section 26-27-26.

C. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

D. Provide separable sockets for liquids and flanges for air bulb elements.

E. Provide valves with position indicators and with pilot positioners where sequenced with other controls.

F. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

G. Provide conduit and electrical wiring in accordance with Section 26-05-83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

**3.03 MAINTENANCE**

A. Provide service and maintenance of control system for one year from Date of Substantial Completion.

B. Provide complete service of controls systems, including call backs, and submit written report of each service call.

C. In addition to normal service calls, make minimum of 2 complete normal inspections of approximately 4 hours duration to inspect, calibrate, and adjust controls.

**END OF SECTION**

## SECTION 23-09-23 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. System description.

B. Operator interface.

C. Power supplies and line filtering.

D. System software.

E. Controller software.

F. HVAC control programs.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide data for each system component and software module.

C. Shop Drawings:

1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
2. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
3. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
4. Indicate description and sequence of operation of operating, user, and application software.

D. Operation and Maintenance Data:

1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

F. Maintenance Materials:

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.

#### 1.03 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 70.

#### 1.04 WARRANTY

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS for additional warranty requirements.

B. Provide five year manufacturer's warranty for field programmable micro-processor based units.

### 1.05 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
   1. Limiting use of software to equipment provided under these specifications.
   2. Limiting copying.
   3. Preserving confidentiality.
   4. Prohibiting transfer to a third party.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

A. Delta Controls: www.deltacontrols.com/#sle.
B. Honeywell International, Inc: www.honeywell.com/#sle.
C. Johnson Controls, Inc: www.johnsoncontrols.com/#sle.
D. Schneider Electric: www.schneider-electric.us/#sle.
E. Siemens AG, Building Technologies Division: www.siemens.com/#sle.
F. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

### 2.02 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23-09-13.
E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

### 2.03 OPERATOR INTERFACE

A. PC Based Work Station:
B. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.
C. Hardware:

### 2.04 CONTROLLERS

A. Building Controllers:
   1. General:

a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
c. Share data between networked controllers.
d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
e. Utilize real-time clock for scheduling.
f. Continuously check processor status and memory circuits for abnormal operation.
g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
h. Communication with other network devices to be based on assigned protocol.

2. Communication:
   a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
   b. Perform routing when connected to a network of custom application and application specific controllers.
   c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
3. Anticipated Environmental Ambient Conditions:
   a. Outdoors and/or in Wet Ambient Conditions:
      1) Mount within waterproof enclosures.
      2) Rated for operation at 40 to 150 degrees F.
   b. Conditioned Space:
      1) Mount within dustproof enclosures.
      2) Rated for operation at 32 to 120 degrees F.
4. Provisions for Serviceability:
   a. Diagnostic LEDs for power, communication, and processor.
   b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
   a. Maintain operation at 90 to 110 percent of nominal voltage rating.
   b. Perform orderly shutdown below 80 percent of nominal voltage.
   c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet.

B. Input/Output Interface:

1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
2. All Input/Output Points:
    a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
    b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
3. Binary Inputs:
    a. Allow monitoring of On/Off signals from remote devices.
    b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
    c. Sense dry contact closure with power provided only by the controller.
4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
5. Analog Inputs:
    a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
    b. Compatible with and field configurable to commonly available sensing devices.
6. Binary Outputs:
    a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.
    b. Outputs provided with three position (On/Off/Auto) override switches.
    c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
7. Analog Outputs:
    a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
    b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
    c. Drift to not exceed 0.4 percent of range per year.
8. Tri State Outputs:
    a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
    b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
    c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

9. System Object Capacity:
    a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
    b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

**2.05 POWER SUPPLIES AND LINE FILTERING**

A. Power Supplies:
    1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
    2. Limit connected loads to 80 percent of rated capacity.
    3. Match DC power supply to current output and voltage requirements.
    4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
    5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
    6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
    7. Operational Ambient Conditions: 32 to 120 degrees F.
    8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
    9. Line voltage units UL recognized and CSA approved.
B. Power Line Filtering:
    1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.
    2. Minimum surge protection attributes:
        a. Dielectric strength of 1000 volts minimum.
        b. Response time of 10 nanoseconds or less.
        c. Transverse mode noise attenuation of 65 dB or greater.
        d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

**2.06 LOCAL AREA NETWORK (LAN)**

A. Provide communication between control units over local area network (LAN).
B. LAN Capacity: Not less than 60 stations or nodes.
C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
D. LAN Data Speed: Minimum 19.2 Kb.
E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.

G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

**2.07 SYSTEM SOFTWARE**

A. Operating System:
   1. Concurrent, multi-tasking capability.
      a. Common Software Applications Supported: Microsoft Excel.
      b. Acceptable Operating Systems: _____.
   2. System Graphics:
      a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
      b. Animation displayed by shifting image files based on object status.
      c. Provide method for operator with password to perform the following:
         1) Move between, change size, and change location of graphic displays.
         2) Modify on-line.
         3) Add, delete, or change dynamic objects consisting of:
            (a) Analog and binary values.
            (b) Dynamic text.
            (c) Static text.
            (d) Animation files.
   3. Custom Graphics Generation Package:
      a. Create, modify, and save graphic files and visio format graphics in PCX formats.
      b. HTML graphics to support web browser compatible formats.
      c. Capture or convert graphics from AutoCAD.
   4. Standard HVAC Graphics Library:
      a. HVAC Equipment:
      b. Ancillary Equipment:

B. Workstation System Applications:
   1. Automatic System Database Save and Restore Functions:
      a. Current database copy of each Building Controller is automatically stored on hard disk.
      b. Automatic update occurs upon change in any system panel.
      c. In the event of database loss in any system panel, the first workstation to detect the loss automatically restores the database for that panel unless disabled by the operator.
   2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
      a. Save database from any system panel.

b. Clear a panel database.
c. Initiate a download of a specified database to any system panel.

3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
4. On-line Help:
   a. Context-sensitive system assists operator in operation and editing.
   b. Available for all applications.
   c. Relevant screen data provided for particular screen display.
   d. Additional help available via hypertext.
5. Security:
   a. Operator log-on requires user name and password to view, edit, add, or delete data.
   b. System security selectable for each operator.
   c. System supervisor sets passwords and security levels for all other operators.
   d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
   e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
   f. All system security data stored in encrypted format.
6. System Diagnostics:
   a. Operations Automatically Monitored:
      1) Workstations.
      2) Printers.
      3) Modems.
      4) Network connections.
      5) Building management panels.
      6) Controllers.
   b. Device failure is annunciated to the operator.
7. Alarm Processing:
   a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
   b. Configurable Objects:
      1) Alarm limits.
      2) Alarm limit differentials.
      3) States.
      4) Reactions for each object.
8. Alarm Messages:
   a. Descriptor:  English language.
   b. Recognizable Features:
      1) Source.

2) Location.
3) Nature.

9. Configurable Alarm Reactions by Workstation and Time of Day:
    a. Logging.
    b. Printing.
    c. Starting programs.
    d. Displaying messages.
    e. Dialing out to remote locations.
    f. Paging.
    g. Providing audible annunciation.
    h. Displaying specific system graphics.
10. Custom Trend Logs:
    a. Definable for any data object in the system including interval, start time, and stop time.
    b. Trend Data:
        1) Sampled and stored on the building controller panel.
        2) Archivable on hard disk.
        3) Retrievable for use in reports, spreadsheets and standard database programs.
        4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
        5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
11. Alarm and Event Log:
    a. View all system alarms and change of states from any system location.
    b. Events listed chronologically.
    c. Operator with proper security acknowledges and clears alarms.
    d. Alarms not cleared by operator are archived to the workstation hard disk.
12. Object, Property Status and Control:
    a. Provide a method to view, edit if applicable, the status of any object and property in the system.
    b. Status Available by the Following Methods:
        1) Menu.
        2) Graphics.
        3) Custom Programs.
13. Reports and Logs:
    a. Reporting Package:
        1) Allows operator to select, modify, or create reports.
        2) Definable as to data content, format, interval, and date.
        3) Archivable to hard disk.

b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
d. Set to be printed on operator command or specific time(s).

14. Reports:
    a. Standard:
        1) Objects with current values.
        2) Current alarms not locked out.
        3) Disabled and overridden objects, points and SNVTs.
        4) Objects in manual or automatic alarm lockout.
        5) Objects in alarm lockout currently in alarm.
        6) Logs:
            (a) Alarm History.
            (b) System messages.
            (c) System events.
            (d) Trends.
    b. Custom:
        1) Daily.
        2) Weekly.
        3) Monthly.
        4) Annual.
        5) Time and date stamped.
        6) Title.
        7) Facility name.
    c. Tenant Override:
        1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
        2) Annual report showing override usage on a monthly basis.
    d. Electrical, Fuel, and Weather:
        1) Electrical Meter(s):
            (a) Monthly showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
            (b) Annual summary showing monthly electrical consumption and peak demand with time and date stamp for each meter.
        2) Fuel Meter(s):
            (a) Monthly showing daily natural gas consumption for each meter.
            (b) Annual summary showing monthly consumption for each meter.
        3) Weather:

(a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.

C. Workstation Applications Editors:
   1. Provide editing software for each system application at PC workstation.
   2. Downloaded application is executed at controller panel.
   3. Full screen editor for each application allows operator to view and change:
      a. Configuration.
      b. Name.
      c. Control parameters.
      d. Set-points.
   4. Scheduling:
      a. Monthly calendar indicates schedules, holidays, and exceptions.
      b. Allows several related objects to be scheduled and copied to other objects or dates.
      c. Start and stop times adjustable from master schedule.
   5. Custom Application Programming:
      a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
      b. Programming Features:
         1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
         2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
         3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
         4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
         5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
         6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
         7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
         8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values cab be used in IF/THEN comparisons, calculations, programming statement logic, etc.

9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

**2.08 CONTROLLER SOFTWARE**

A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.

B. System Security:
   1. User access secured via user passwords and user names.
   2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
   3. User Log On/Log Off attempts are recorded.
   4. Automatic Log Off occurs following the last keystroke after a user defined delay time.

C. Object or Object Group Scheduling:
   1. Weekly Schedules Based on Separate, Daily Schedules:
      a. Include start, stop, optimal stop, and night economizer.
      b. 10 events maximum per schedule.
      c. Start/stop times adjustable for each group object.

D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.

E. Alarms:
   1. Binary object is set to alarm based on the operator specified state.
   2. Analog object to have high/low alarm limits.
   3. All alarming is capable of being automatically and manually disabled.
   4. Alarm Reporting:
      a. Operator determines action to be taken for alarm event.
      b. Alarms to be routed to appropriate workstation.
      c. Reporting Options:

F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.

G. Sequencing: Application software based upon specified sequences of operation in Section 23-09-93.

H. PID Control Characteristics:
   1. Direct or reverse action.
   2. Anti-windup.
   3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
   4. User selectable controlled variable, set-point, and PED gains.

I. Staggered Start Application:
   1. Prevents all controlled equipment from simultaneously restarting after power outage.
   2. Order of equipment startup is user selectable.

J. Energy Calculations:
   1. Accumulated instantaneous power or flow rates are converted to energy use data.
   2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.
   3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.

K. Anti-Short Cycling:
   1. All binary output objects protected from short-cycling.
   2. Allows minimum on-time and off-time to be selected.

L. On-Off Control with Differential:
   1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
   2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.

M. Run-Time Totalization:
   1. Totalize run-times for all binary input objects.
   2. Provides operator with capability to assign high run-time alarm.

**2.09 HVAC CONTROL PROGRAMS**

**2.10 CHILLER CONTROL PROGRAMS**

**PART 3 EXECUTION**

**3.01 EXAMINATION**

**3.02 INSTALLATION**

A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.

B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23-09-93.

C. Provide conduit and electrical wiring in accordance with Section 26-05-83. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

**3.03 MANUFACTURER'S FIELD SERVICES**

A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

**3.04 DEMONSTRATION AND INSTRUCTIONS**

A. Demonstrate complete and operating system to Owner.

**3.05 MAINTENANCE**

A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.

B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

C. Provide complete service of systems, including call backs. Make minimum of ____ complete normal inspections of approximately ____ hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

**END OF SECTION**

## 23-09-93 SEQUENCES OF OPERATION

1.1 EXHAUST FAN - ON / OFF

A. Run Conditions - Scheduled: The fan shall run according to a user definable schedule.

B. Fan: The fan shall have a user definable (adj.) minimum runtime.

C. Exhaust Air Damper: The exhaust air damper shall open anytime the unit runs and shall close anytime the unit stops. The exhaust air damper shall close 30 sec (adj.) after the fan stops.

1. Alarms shall be provided as follows:

a. Damper Failure: Commanded open, but the status is closed.
b. Damper in Hand: Commanded closed, but the status is open.

D. Damper Status: The fan shall be enabled after the damper status has proven.

1. Alarms shall be provided as follows:

a. Damper Failure: Commanded open, but the status is closed.
b. Damper in Hand: Commanded closed, but the status is open.

E. Fan Status: The controller shall monitor the fan status.

1. Alarms shall be provided as follows:

a. Fan Failure: Commanded on, but the status is off.
b. Fan in Hand: Commanded off, but the status is on.

| | Hardware Points | | | | Software Points | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Point Name** | **AI** | **AO** | **BI** | **BO** | **AV** | **BV** | **Loop** | **Sched** | **Trend** | **Alarm** | **Show On Graphic** |
| Fan Status | | | x | | | | | | x | | x |
| Fan Start/Stop | | | | x | | | | | x | | x |
| Schedule | | | | | | | | x | | | |
| Fan Failure | | | | | | | | | | x | |
| Fan in Hand | | | | | | | | | | x | |
| **Totals** | **0** | **0** | **2** | **2** | **0** | **0** | **0** | **1** | **4** | **4** | **4** |

**Total Hardware (2)** **Total Software (5)**

1.2 VAV ROOFTOP UNIT

A. Run Conditions - Scheduled: The unit shall run according to a user definable time schedule in the following modes:

1. Occupied Mode: The unit shall maintain

a. A 74°F (adj.) cooling setpoint

b. A 70°F (adj.) heating setpoint.

2. Unoccupied Mode (night setback): The unit shall maintain

   a. A 85°F (adj.) cooling setpoint.
   b. A 55°F (adj.) heating setpoint.

3. Alarms shall be provided as follows:

   a. High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
   b. Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

4. Zone Setpoint Adjust: The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.
5. Zone Optimal Start: The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.
6. Zone Unoccupied Override: A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.
7. Supply Air Smoke Detection: The unit shall shut down and generate an alarm upon receiving a supply air smoke detector status.

   a. Supply Fan: The supply fan shall run anytime the space is occupied or commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.
   b. Alarms shall be provided as follows:

      1) Supply Fan Failure: Commanded on, but the status is off.
      2) Supply Fan in Hand: Commanded off, but the status is on.

B. Zone Temperature Control: The controller shall measure the zone temperature and shall modulate the supply fan VFD speed to maintain zone temperature setpoint. The fan speed shall increase as the zone temperature rises above cooling setpoint, or as the zone temperature drops below heating setpoint. The supply fan VFD speed shall not drop below 30% (adj.) during cooling mode and 50% (adj.) during heating mode.

C. Cooling/Heating Control: The unit shall receive a signal from the unit discharge air temperature sensor and shall run on it's own internal controls to maintain the leaving air temperature to 55ºF until space has met the cooling setpoint. As space temperature continues to drop below cooling setpoint discharge air temperature shall be reset from 55ºF to 85ºF at heating setpoint temperature. (adj.).

1. The cooling shall be enabled whenever:

   a. The economizer (if present) is disabled or fully open.
   b. AND the supply fan status is on.
   c. AND the heating is not active.

2. The heating shall be enabled whenever:

   a. The zone temperature is below heating setpoint.

b. AND the supply fan status is on.
c. AND the cooling is not active.

D. Economizer: The controller shall measure the discharge air temperature and modulate the economizer dampers in sequence to supply air temperature setpoint. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.

1. The economizer shall be enabled whenever:

a. Outside air temperature is less than 65°F (adj.).
b. AND the outside air enthalpy is less than 22 btu/lb (adj.).
c. AND the outside air temperature is less than the return air temperature.
d. AND the outside air enthalpy is less than the return air enthalpy.
e. AND the supply fan status is on.

2. The economizer shall close whenever:

a. Mixed air temperature drops from 55°F to 50°F (adj.).
b. OR on loss of supply fan status.
c. OR freezestat (if present) is on.

3. The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

E. Minimum Outside Air Ventilation - Fixed Percentage: The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

F. Mixed Air Temperature: The controller shall monitor the mixed air temperature and use as required for economizer control (if present).

1. Alarms shall be provided as follows:

a. Low Mixed Air Temp: If the mixed air temperature is less than 45°F (adj.).

G. Return Air Temperature: The controller shall monitor the return air temperature and use as required for economizer control (if present).

1. Alarms shall be provided as follows:

a. High Return Air Temp: If the return air temperature is greater than 90°F (adj.).
b. Low Return Air Temp: If the return air temperature is less than 45°F (adj.).

| | Hardware Points | | | | Software Points | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Point Name** | **AI** | **AO** | **BI** | **BO** | **AV** | **BV** | **Loop** | **Sched** | **Trend** | **Alarm** | **Show On Graphic** |
| Zone Temp | x | | | | | | | | x | | x |
| Zone Setpoint Adjust | x | | | | | | | | | | x |
| Outside Air Humidity | x | | | | | | | | x | | x |
| Outside Air Temp | x | | | | | | | | x | | x |
| Mixed Air Temp | x | | | | | | | | x | | x |
| Return Air Humidity | x | | | | | | | | x | | x |

| | Hardware Points | | | | Software Points | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Point Name** | **AI** | **AO** | **BI** | **BO** | **AV** | **BV** | **Loop** | **Sched** | **Trend** | **Alarm** | **Show On Graphic** |
| Return Air Temp | x | | | | | | | | x | | x |
| Supply Fan VFD Speed | | x | | | | | | | x | | x |
| Mixed Air Dampers | | x | | | | | | | x | | x |
| Zone Override | | | x | | | | | | x | | x |
| Supply Fan VFD Fault | | | x | | | | | | x | | x |
| Supply Fan Status | | | x | | | | | | x | | x |
| Supply Fan Start/Stop | | | | x | | | | | x | | x |
| Cooling Stage 1 | | | | | | | | | x | | x |
| Cooling Stage 2 | | | | | | | | | x | | x |
| Cooling Stage 3 | | | | | | | | | x | | x |
| Cooling Stage 4 | | | | | | | | | x | | x |
| Reversing Valve | | | | | | | | | x | | x |
| Heating Stage 1 | | | | | | | | | x | | x |
| Heating Stage 2 | | | | | | | | | x | | x |
| Heating Stage 3 | | | | | | | | | x | | x |
| Heating Stage 4 | | | | | | | | | x | | x |
| Economizer Zone Temp Setpoint | | | | | x | | | | x | | x |
| Schedule | | | | | | | | x | | | |
| Heating Setpoint | | | | | | | | | x | | x |
| Cooling Setpoint | | | | | | | | | x | | x |
| High Zone Temp | | | | | | | | | | x | |
| Low Zone Temp | | | | | | | | | | x | |
| Supply Fan Failure | | | | | | | | | | x | |
| Supply Fan in Hand | | | | | | | | | | x | |
| Low Mixed Air Temp | | | | | | | | | | x | |
| High Return Air Temp | | | | | | | | | | x | |
| Low Return Air Temp | | | | | | | | | | x | |
| **Totals** | **7** | **2** | **3** | **1** | **1** | **0** | **0** | **1** | **24** | **7** | **25** |

**Total Hardware (13)** **Total Software (33)**

1.3 VARIABLE AIR VOLUME - TERMINAL UNIT WITH REHEAT

A. Run Conditions - Scheduled:

1. The unit shall run according to a user definable time schedule in the following modes:

a. Occupied Mode: The unit shall maintain

1) A 74°F (adj.) cooling setpoint
2) A 70°F (adj.) heating setpoint.

b. Unoccupied Mode (night setback): The unit shall maintain

1) A 85°F (adj.) cooling setpoint.
2) A 55°F (adj.) heating setpoint.

c. Alarms shall be provided as follows:

1) High Zone Temp: If the zone temperature is greater than the cooling setpoint by a user definable amount (adj.).
2) Low Zone Temp: If the zone temperature is less than the heating setpoint by a user definable amount (adj.).

2. Minimum Ventilation on Carbon Dioxide (CO2) Concentration: When in the occupied mode, the controller shall measure the zone CO2 levels and modulate the zone damper open on rising CO2 concentrations, overriding normal damper operation to maintain a CO2 setpoint of:

a. VAV-001 – 1500 PPM (adj.)
b. Alarms shall be provided as follows:

1) High Zone Carbon Dioxide Concentration: If the zone CO2 concentration is greater than the following:

a) VAV-001 – 1650 PPM (adj.)

3. Zone Setpoint Adjust: The occupant shall be able to adjust the zone temperature heating and cooling setpoints at the zone sensor.
4. Zone Optimal Start: The unit shall use an optimal start algorithm for morning start-up. This algorithm shall minimize the unoccupied warm-up or cool-down period while still achieving comfort conditions by the start of scheduled occupied period.
5. Zone Unoccupied Override: A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for an adjustable period of time. At the expiration of this time, control of the unit shall automatically return to the schedule.
6. Reversing Variable Volume Terminal Unit - Flow Control: The unit shall maintain zone setpoints by controlling the airflow through one of the following:

a. Occupied:

1) When zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
2) When the zone temperature is between the cooling setpoint and the heating setpoint, the zone damper shall maintain the minimum required zone ventilation (adj.).
3) When zone temperature is less than its heating setpoint, the controller shall enable heating to maintain the zone temperature at its heating setpoint. Additionally, the zone damper shall modulate between the minimum occupied airflow (adj.) and the maximum heating airflow (adj.) until the zone is satisfied.

b. Unoccupied:

1) When the zone is unoccupied the zone damper shall control to its minimum unoccupied airflow (adj.).

2) When the zone temperature is greater than its cooling setpoint, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the maximum cooling airflow (adj.) until the zone is satisfied.
3) When zone temperature is less than its unoccupied heating setpoint, the controller shall enable heating to maintain the zone temperature at the setpoint. Additionally, the zone damper shall modulate between the minimum unoccupied airflow (adj.) and the auxiliary heating airflow (adj.) until the zone is satisfied.

B. Reheating Coil Valve: The controller shall measure the zone temperature and modulate the reheating coil valve open on dropping temperature to maintain its heating setpoint.

C. Discharge Air Temperature: The controller shall monitor the discharge air temperature.

1. Alarms shall be provided as follows:

a. High Discharge Air Temp: If the discharge air temperature is greater than 120°F (adj.).

| | Hardware Points | | | | Software Points | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Point Name** | **AI** | **AO** | **BI** | **BO** | **AV** | **BV** | **Loop** | **Sched** | **Trend** | **Alarm** | **Show On Graphic** |
| Zone Temp | x | | | | | | | | x | | x |
| Zone Setpoint Adjust | x | | | | | | | | | | x |
| Airflow | x | | | | | | | | x | | x |
| Discharge Air Temp | x | | | | | | | | x | | x |
| Zone Damper | | x | | | | | | | | | x |
| Reheating Valve | | x | | | | | | | x | | x |
| Zone Override | | | x | | | | | | x | | x |
| Airflow Setpoint | | | | | x | | | | x | | x |
| Heating Mode | | | | | | x | | | x | | |
| Schedule | | | | | | | | x | | | |
| Heating Setpoint | | | | | | | | | x | | x |
| Cooling Setpoint | | | | | | | | | x | | x |
| High Zone Temp | | | | | | | | | | x | |
| Low Zone Temp | | | | | | | | | | x | |
| High Discharge Air Temp | | | | | | | | | | x | |
| **Totals** | **4** | **2** | **1** | **0** | **1** | **1** | **0** | **1** | **9** | **3** | **10** |

**Total Hardware (7)** **Total Software (15)**

1.4 HOT WATER LOOP PUMPS

A. Hot Water Pump System - Run Conditions:

1. The hot water pumps shall be enabled whenever:

a. A definable number of hot water coils need cooling.

2. To prevent short cycling, the hot water pump system shall run for and be off for minimum adjustable times (both user definable).

3. If a freezestat is tripped on any unit, the hot water pumps shall run at minimum 50% (adj.) speed if not already engaged.

B. Hot Water Pump Lead/Standby Operation: The two variable speed hot water pumps shall operate in a lead/lag fashion.

1. The lead pump shall run first.

a. On failure of the lead pump, the standby pump shall run and the lead pump shall turn off.
b. The designated lead pump shall rotate upon one of the following conditions (user selectable):

1) manually through a software switch
2) daily
3) weekly
4) monthly

2. Alarms shall be provided as follows:

a. Hot Water Pump 1:

1) Failure: Commanded on, but the status is off.
2) Running in Hand: Commanded off, but the status is on.
3) VFD Fault.

b. Hot Water Pump 2:

1) Failure: Commanded on, but the status is off.
2) Running in Hand: Commanded off, but the status is on.
3) VFD Fault.

C. Hot Water Differential Pressure Control: The controller shall measure hot water differential pressure and modulate the hot water pump VFD to maintain its hot water differential pressure setpoint. The following setpoints are recommended values. All setpoints shall be field adjusted during the commissioning period to meet the requirements of actual field conditions. If the pump is at minimum speed and differential pressure continues to rise, the control system shall modulate the bypass valve to maintain differential pressure.

1. The controller shall modulate hot water pump speeds to maintain a hot water differential pressure of 12lbf/in2 (adj.). The VFD minimum speed shall not drop below 20% (adj.).
2. On dropping hot water differential pressure, the VFD shall stage on and run to maintain setpoint as follows:

a. The controller shall modulate the lead VFD to maintain setpoint.

3. Alarms shall be provided as follows:

a. High Hot Water Differential Pressure: If the chilled water differential pressure is 25% (adj.) greater than setpoint.
b. Low Hot Water Differential Pressure: If the chilled water differential pressure is 25% (adj.) less than setpoint.

| | Hardware Points | | | | Software Points | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Point Name** | **AI** | **AO** | **BI** | **BO** | **AV** | **BV** | **Loop** | **Sched** | **Trend** | **Alarm** | **Show On Graphic** |
| Hot Water Differential Pressure | x | | | | | | | | x | | x |
| Hot Water Pump 1 VFD Speed | | x | | | | | | | x | | x |
| Hot Water Pump 2 VFD Speed | | x | | | | | | | x | | x |
| Hot Water Pump 1 Status | | | x | | | | | | x | | x |
| Hot Water Pump 2 Status | | | x | | | | | | x | | x |
| Hot Water Pump 1 VFD Fault | | | x | | | | | | | x | x |
| Hot Water Pump 2 VFD Fault | | | x | | | | | | | x | x |
| Hot Water Pump 1 Start/Stop | | | | x | | | | | x | | x |
| Hot Water Pump 2 Start/Stop | | | | x | | | | | x | | x |
| Outside Air Temp | | | | | x | | | | | | x |
| Hot Water Bypass Valve | | x | | | | | | | x | | x |
| Hot Water Differential Pressure Set-point | | | | | x | | | | | | x |
| Hot Water Pump 1 Failure | | | | | | | | | | x | |
| Hot Water Pump 2 Failure | | | | | | | | | | x | |
| Hot Water Pump 1 Running in Hand | | | | | | | | | | x | |
| Hot Water Pump 2 Running in Hand | | | | | | | | | | x | |
| High Hot Water Differential Pressure | | | | | | | | | | x | |
| Low Hot Water Differential Pressure | | | | | | | | | | x | |
| **Totals** | **1** | **3** | **4** | **2** | **2** | **0** | **0** | **0** | **8** | **8** | **12** |

**Total Hardware (10)** **Total Software (18)**

## SECTION 23-11-23 - FACILITY NATURAL-GAS PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.

#### 1.03 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### PART 2 PRODUCTS

#### 2.01 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
2. Joints: Threaded or welded to ASME B31.1.

B. Appliance Flexible Gas Connectors:

1. Corrugated Stainless Steel Tubing with Polymer Coating: Comply with ANSI Z21.24.
2. Fittings: Provide with threaded ends.
3. Operating Pressure rating: 0.5 psig (3.45 kPa).

#### 2.02 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous Pipe: Class 150 malleable iron threaded unions.

B. Flanges for Pipe Size Over 1 Inch:

1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

## 2.03 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.
   5. Rooftop Supports for EXISTING Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
      a. Bases: High density polypropylene.
      b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
      c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
      d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
      e. Height: Provide minimum clearance of 6 inches under pipe to top of roofing.

## 2.04 BALL VALVES

A. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 600 psi CWP, bronze body, chrome plated brass or bronze ball, full port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle, threaded ends with union.

## 2.05 STRAINERS

A. Size 2 inch and Under:
   1. Threaded brass body for 125 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen, threaded ends.

B. Size 2-1/2 inch and Larger:
   1. Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen, flanged ends

## 2.06 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

A. Compliance Requirements:
   1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
   2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.

B. Construction:
   1. Body and Diaphram Case: Cast iron or die-cast alumnium.
   2. Springs: Zinc plated steel.
   3. Diaphram: Zinc plated steel.
   4. Seals: NBR-based rubber.

5. Orifice: Alumniun: Interchangeable.

C. Maximum Inlet Operating Pressure: 10 psi.
   1. Appliance Regulator: 1 psi.
   2. Line Pressure Regulator: 2 psi.

D. Maximum Body Pressure: 10 psi.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

### 3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

### 3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom, conserve space, and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23-05-16.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed.

H. Provide support for utility meters in accordance with requirements of utility companies.

I. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

J. Install valves with stems upright or horizontal, not inverted.

K. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

L. Sleeve pipes passing through partitions, walls and floors.

M. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9.
   2. Support horizontal piping as indicated.
   3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
   4. Place hangers within 12 inches of each horizontal elbow.
   5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
   6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

**3.04 APPLICATION**

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

**END OF SECTION**

## SECTION 23-21-13 - HYDRONIC PIPING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water piping, above grade.

C. Equipment drains and overflows.

D. Pipe hangers and supports.

E. Unions, flanges, mechanical couplings, and dielectric connections.

F. Valves:

#### 1.02 ADMINISTRATIVE REQUIREMENTS

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data:

C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.

#### 1.04 QUALITY ASSURANCE

#### 1.05 DELIVERY, STORAGE, AND HANDLING

#### 1.06 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

### PART 2 PRODUCTS

#### 2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
3. Grooved mechanical joints may be used in accessible locations only.
    a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
    b. Grooved mechanical connections and joints comply with AWWA C606.
    c. Use rigid joints unless otherwise indicated.
    d. Depending on pipe size, three or four flexible joints may be used in lieu of a flexible connector.
4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:

1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
3. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.

**2.02 HEATING WATER PIPING, ABOVE GRADE**

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:

1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
2. Threaded Joints: ASME B16.3, malleable iron fittings.
3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
   a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

**2.03 EQUIPMENT DRAINS AND OVERFLOWS**

A. PVC Pipe: ASTM D1785, Schedule 40, or ASTM D2241, SDR 21 or 26.

1. Fittings: ASTM D2466 or D2467, PVC.
2. Joints: Solvent welded in accordance with ASTM D2855.

**2.04 PIPE HANGERS AND SUPPORTS**

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
3. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Vertical Support: Steel riser clamp.
6. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

7. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

### 2.05 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:

B. Flanges for Pipe 2 Inches and Greater:

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Mechanical Couplings: Comply with ASTM F1476.
   3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections:
   1. Flanges:
      a. Dielectric flanges with same pressure ratings as standard flanges.
      b. Water impervious insulation barrier capable of limiting galvanic current to 1 percent of short circuit current in a corresponding bimetallic joint.
      c. Dry insulation barrier able to withstand 600-volt breakdown test.
      d. Construct of galvanized steel with threaded end connections to match connecting piping.
      e. Suitable for the required operating pressures and temperatures.
   2. Unions:
      a. 1/2 to 1 Inches: Brass solder to galvanized FPT.
      b. 1/2 to 2 Inches: Brass solder to galvanized FPT.
      c. 1/2 to 1 Inches: Brass to galvanized FPT or FIP (Female Iron Pipe).
      d. 3/4 to 1/2 Inch Reducer: Brass solder to galvanized FPT.
      e. Service: 250 psi, minus 20 to 180 deg F.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. See Section 23-25-00 for additional requirements.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
D. Install piping to conserve building space and to avoid interference with use of space.
E. Group piping whenever practical at common elevations.
F. Sleeve pipe passing through partitions, walls, and floors.
G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified _____.
H. Slope piping and arrange to drain at low points.
I. Grooved Joints:
J. Pipe Hangers and Supports:
K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23-07-19.
L. Use eccentric reducers to maintain top of pipe level.

**END OF SECTION**

## SECTION 23-21-14 - HYDRONIC SPECIALTIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Hydraulic separators.

D. Strainers.

E. Automatic flow control valves.

F. Relief valves.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of _____ with size, location and installation of service utilities.

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - Product Requirements for additional provisions.
2. Extra Glycol Solution: One container, 1 gallon size.

#### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### PART 2 PRODUCTS

#### 2.01 EXPANSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM diaphragm or bladder seal factory precharged to 12 psi, and steel support stand.

B. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

#### 2.02 AIR VENTS

A. Manual Air Vent: Short vertical sections of 2-inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Air Vent:

C. Maximum Fluid Pressure: 150 psi.

D. Maximum Fluid Temperature: 250 degrees F.

**2.03 HYDRAULIC SEPARATORS**

A. Coalescing Hydraulic Separators:

1. Carbon-steel based, primer-base coated, vertical-mounted buffer tank with internal coalescing media basket, flanged inlet-outlet pipe connections, and ASME BPVC-VIII-1 tested and stamped for maximum allowed operating pressure of 150 psi.
2. Flow Rate Capacity and Pipe Connections: 40 gpm and 2 inch.
3. Threaded Connections: Aquastat, drain/blow down, and air vent. Provide aquastat, ball type drain valve, and air vent for field-installation.

**2.04 STRAINERS**

A. Size 2 inch and Under:

1. Provide threaded, grooved, or sweat brass or iron body for up to 175 psi working pressure, Y-pattern strainer with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:

1. Provide flanged or grooved iron body for up to 175 psi working pressure, up to 250 degrees F working temperature, Y-pattern strainer with 1/16 inch or 3/64 inch stainless steel perforated screen.

**2.05 PUMP CONNECTORS**

A. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.

1. Maximum Operating Service: 150 psi at 120 degrees F.
2. Accommodate the Following:
    a. Axial Deflection in Compression and Expansion: _____ inch.
    b. Lateral Movement: _____ inch.
    c. Angular Rotation: 15 degrees.
    d. Force developed by 1.5 times specified maximum allowable operating pressure.
3. End Connections: Same as specified for pipe jointing.
4. Provide necessary accessories including, but not limited to, swivel joints.

**2.06 AUTOMATIC FLOW CONTROL VALVES**

A. Manufacturers:

B. Construction:

1. Brass, bronze, or iron body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain.
2. Built-in lug-type outlet butterfly valve with 2-position handle.

C. Calibration: Control flow within 10 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, minimum pressure 2 psi.

D. Control Mechanism: Provide stainless steel or nickel-plated, brass piston or regulator cup, operating against stainless steel helical or wave formed spring or elastomeric diaphragm and polyphenylsulfone orifice plate.

### 2.07 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Provide manual air vents at system high points and as indicated.

C. Provide valved drain and hose connection on strainer blowdown connection.

D. Support pump fittings with floor-mounted pipe and flange supports.

E. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.

F. Pipe relief valve outlet to nearest floor drain.

**END OF SECTION**

## SECTION 23-21-23 - HYDRONIC PUMPS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Circulators.

B. In-line pumps.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Armstrong Fluid Technology, Inc: www.armstrongfluidtechnology.com/#sle.

B. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com/#sle.

C. SIHI Group: www.sterlingsihi.com/#sle.

D. [Grundfos pumps Corporation.].

E. [ITT Corporation; Bell & Gossett.].

F. [PACO Pumps.].

G. [TACO Incorporated.].

H. [Thrush Company Inc.].

I. [Little Giant Pump Co.].

J. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

#### 2.02 GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Electrical Requirements:

1. Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.

2. Variable Frequency Drives (VFDs): Provide in accordance with Section 23-09-34, except for integral-VFDs.

3. Enclosures: Provide unspecified product(s) required to fit motor:

#### 2.03 CIRCULATORS

A. Horizontal shaft, single-stage pump with direct connected, resilient-mount, oil lubricated motor for discharge pressures of up to 125 psi.
B. Casing: Cast iron, with flanged pump connections.
C. Impeller: Non-ferrous keyed to shaft.
D. Bearings: Oil-lubricated bronze sleeve.
E. Shaft: Alloy steel with bronze sleeve, integral thrust collar.
F. Drive: Flexible coupling.

**2.04 IN-LINE PUMPS**

A. Casing: Cast iron with seal flush connection, flanged suction, and discharge ports with gauge port and drain plug.
B. Impeller: Stainless steel, fully enclosed, keyed directly to motor shaft or extension.
C. Shaft: Stainless steel with stainless steel impeller cap screw or nut and bronze sleeve.
D. Seal: Mechanical seal, 225 degrees F maximum continuous duty temperature.
E. Electrical:
    1. Motor: 1,750 rpm, open drip-proof (ODP); see Section 23-05-13.
    2. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
    3. Integral Controls:
        a. Variable Frequency Drive (VFD): Factory-fitted and tested with dedicated terminal box for power, instrumentation and related control wiring.
        b. DDC Controller: VFD-integrated or external controller module with visual-tactile interface and minimum of 2 analog inputs, 2 digital inputs, and real-time clock. Provide differential pressure sensor and temperature sensor with thermowell and thermal grease.
        c. BAS, SCADA, or Other Integrated Automation Link: Wi-Fi in accordance with IEEE 802.11.

**PART 3 EXECUTION**

**3.01 PREPARATION**

A. Verify that electric power is available and of the correct characteristics.

**3.02 INSTALLATION**

A. Install in accordance with manufacturer's instructions.
B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

E. Check, align, and certify alignment of base-mounted pumps prior to start-up.

F. Lubricate pumps before start-up.

G. Controls: Interface each pump starter or VFD with HVAC controller; see Section 23-09-23.

**END OF SECTION**

## SECTION 23-31-00 - HVAC DUCTS AND CASINGS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Metal ducts.

B. Flexible ducts.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Shop Drawings: Indicate duct fitting types, gauges, sizes, welds, and configuration.

#### 1.03 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

### PART 2 PRODUCTS

#### 2.01 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Provide metal duct unless otherwise indicated.

C. Acoustical Treatment: Provide sound-absorbing liners and sectional silencers for metal-based ducts in compliance with Section 23-33-19 and where indicated on plans.

D. Duct Shape and Material in accordance with Allowed Static Pressure Range:

1. Round: Plus or minus 2 in-wc of galvanized steel.
2. Rectangular: Plus or minus 1/2 in-wc of galvanized steel.
3. Flexible Duct (Fabric and wire): Plus or minus 1/2 in-wc; see Section 23-37-00.

E. Duct Sealing and Leakage in accordance with Static Pressure Class:

1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
    a. Supply Air: 1/2 in-wc pressure class, galvanized steel.
    b. Return and Relief Air: 1/2 in-wc pressure class, galvanized steel.
    c. General Exhaust Air: 1/2 in-wc pressure class, galvanized steel.
2. Low Pressure Service: Up to 2 in-wc:
    a. Seal: Class C, apply to seal off transverse joints.
    b. Leakage:
        1) Rectangular: Class 24 or 24 cfm/100 sq ft.
        2) Round: Class 12 or 12 cfm/100 sq ft.
3. Low Pressure Service: From 2 in-wc to 3 in-wc:
    a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
    b. Leakage:
        1) Rectangular: Class 12 or 12 cfm/100 sq ft.
        2) Round: Class 6 or 6 cfm/100 sq ft.

F. Duct Fabrication Requirements:

1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
3. Construct tee's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

**2.02 METAL DUCTS**

A. Material Requirements:
   1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Round Metal Ducts:
   1. Round Connection System: Interlocking duct connection system per SMACNA (DCS).

C. Round Spiral Duct:
   1. Round spiral lock seam duct with galvanized steel outer wall.

D. Connectors, Fittings, Sealants, and Miscellaneous:
   1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
   2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
   3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
      a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
      b. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
   4. Gasket Tape:
      a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.

E. Flexible Ducts: UL 181, Class 1, polyethylene film, mechanically fastened and rolled using galvanized steel to form a spiral helix.
   1. Pressure Rating: 10 in-wc positive and 5 in-wc negative.
   2. Maximum Velocity: 5500 fpm.
   3. Temperature Range: Minus 20 degrees F to 250 degrees F.

**2.03 FLEXIBLE DUCTS**

A. Flexible Air Ducts:
   1. UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound spring steel wire.
   2. Insulation: Fiberglass insulation with aluminized vapor barrier film.
   3. Pressure Rating: From 10 in-wc positive to 1 in-wc negative.
   4. Maximum Velocity: 4,000 fpm.
   5. Temperature Range: Minus 20 to 210 degrees F.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

A. Install, support, and seal ducts in accordance with SMACNA (DCS).
B. Install products following the manufacturer's instructions.
C. Comply with safety standards NFPA 90A and NFPA 90B.
D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
F. Flexible Ducts: Connect to metal ducts with adhesive.
G. Flexible ducts to be used for final connection to air terminals and not to exceed 5'-0" in length and not exceed 45 degrees for chnage in direction. If chnage in direction exceeds 45 degrees, a sheetmetal elbow to be used.
H. Duct sizes indicated are inside precise dimensions. For lined ducts, maintain sizes inside lining.
I. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
J. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
K. Connect terminal units to supply ducts directly with no flexible duct used.
L. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.
M. Duct Insulation: Provide duct insulation in compliance with Section 23-07-13.

**END OF SECTION**

## SECTION 23-33-00 - AIR DUCT ACCESSORIES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Duct test holes.

B. Flexible duct connectors.

C. Volume control dampers.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS for additional provisions.
2. Extra Fusible Links: One of each type and size.

#### 1.03 QUALITY ASSURANCE

### PART 2 PRODUCTS

#### 2.01 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

#### 2.02 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.

#### 2.03 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Single Blade Dampers:

1. Fabricate for duct sizes up to 6 by 30 inch.
2. Blade: 24 gauge, 0.0239 inch, minimum.

C. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 by 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

1. Blade: 18 gauge, 0.0478 inch, minimum.

D. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

E. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches provide regulator at both ends.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23-31-00 for duct construction and pressure class.

B. Provide duct test holes where indicated and required for testing and balancing purposes.

C. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

D. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

F. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

**END OF SECTION**

## SECTION 23-34-23 - HVAC POWER VENTILATORS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Roof exhausters.

B. Cabinet exhaust fans.

C. Ceiling exhaust fans.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate fan roof curbs and service utilities installation according to fan size.

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.

### PART 2 PRODUCTS

#### 2.01 POWER VENTILATORS - GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, but not limited to :

1. Greenheck Fan Corporation.
2. PennBarry, Division of Air System Components.
3. Twin City Fan Company.
4. Loren Cook.
5. CaptiveAire.
6. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Static and Dynamically Balanced: Comply with AMCA 204.

C. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.

D. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.

E. Fabrication: Comply with AMCA 99.

F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

#### 2.02 ROOF EXHAUSTERS

A. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

B. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor and wall mounted multiple speed switch.

C. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.

D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

E. Performance Ratings: As indicated on drawings.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Provide sheaves required for final air balance.

E. Install backdraft dampers on inlet to roof and wall exhausters.

F. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

**END OF SECTION**

## SECTION 23-36-00 - AIR TERMINAL UNITS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Single-duct terminal units.
   1. Variable-volume units.
B. Controls for terminal units.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Sequencing: Completion utility connections in an orderly and expeditious manner.

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01-60-00 - PRODUCT REQUIREMENTS for additional provisions.

#### 1.04 QUALITY ASSURANCE

#### 1.05 WARRANTY

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS for additional warranty requirements.
B. Provide five year manufacturer warranty for air terminal units.

### PART 2 PRODUCTS

#### 2.01 SINGLE-DUCT, VARIABLE-VOLUME UNITS

A. Basis of Design: Krueger-HVAC: www.krueger-hvac.com/#sle.
   1. Single-Duct Terminal Unit: LMHS.
B. General:
   1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
   2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
C. Unit Casing:

1. Minimum 22 gauge, 0.0299 inch galvanized steel.
2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
3. Unit Discharge: Rectangular, with slip-and-drive connections.
4. Acceptable Liners:
    a. 3/4 inch thick polyurethane foam adhesive complying with UL 181 erosion requirements in accordance with ASHRAE Std 62.1, and having a maximum smoke developed index of 50 for both insulation and adhesive, when tested in accordance with ASTM E84.
    b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

D. Damper Assembly:
1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
3. Incorporate low leak damper blades for tight airflow shutoff.

E. Hot Water Heating Coil:
1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
3. Coil leak tested to minimum 350 psig.
4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.

F. Controls:
1. Terminal Unit Controls:
    a. Provide accessories for field interfaced controller including ball valve and thermostat.
    b. Factory ship DDC controller including airflow sensor, integral airflow transmitter, integral damper actuator, and duct-mounted temperature sensor.
    c. Sequence of Operation: Zone temperature control with airflow and coil discharge monitoring.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that conditions are suitable for installation.
B. Verify that field measurements are as indicated on drawings.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

C. Provide ceiling access doors or locate units above easily removable ceiling components.

D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.

E. Do not support from ductwork.

F. Connect to ductwork in accordance with Section 23-31-00.

**3.03 ADJUSTING**

**3.04 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.

**3.05 CLOSEOUT ACTIVITIES**

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS for closeout submittals.

B. See Section 01-79-00 - DEMONSTRATION AND TRAINING for additional requirements.

**END OF SECTION**

## SECTION 23-37-00 - AIR OUTLETS AND INLETS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Diffusers:

B. Rectangular ceiling diffusers.

C. Registers/grilles:

1. Ceiling-mounted, egg crate exhaust and return register/grilles.
2. Ceiling-mounted, exhaust and return register/grilles.
3. Ceiling-mounted, supply register/grilles.
4. Wall-mounted, supply register/grilles.
5. Wall-mounted, exhaust and return register/grilles.

D. Duct-mounted supply and return registers/louvers.

E. Louvers:

F. Goosenecks.

G. Gravity ventilators.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Krueger-HVAC.

B. Price Industries.

C. Titus, a brand of Air Distribution Technologies.

D. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

#### 2.02 RECTANGULAR CEILING DIFFUSERS

A. Type: Provide square formed backpan stamped ceiling diffusers constructed to maintain 360 degree discharge air pattern.

B. Connections: Round; size as indicated on plans

#### 2.03 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS

A. Type: Duct-mounted, rectangular louver for round-spiral duct with adjustable pivot-ended blades, end caps, built-in volume damper, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.

B. Color: As indicated on drawings.

#### 2.04 CEILING SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.

B. Color: _____.

C. Damper: Opposed blade damper with operator accessible through face of grille.

**2.05 CEILING EXHAUST AND RETURN REGISTERS/GRILLES**

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with blades set at 22.5 degrees, vertical face.

**2.06 CEILING EGG CRATE EXHAUST AND RETURN GRILLES**

A. Type: Egg crate style face consisting of 1 by 1 by 1 inch grid core. .

B. Fabrication: Grid core consists of aluminum frame with alumnium core.

**2.07 WALL SUPPLY REGISTERS/GRILLES**

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, double deflection.

**2.08 WALL EXHAUST AND RETURN REGISTERS/GRILLES**

A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.

**2.09 LOUVERS**

A. Manufacturers:

1. Ruskin Company:.
2. Greenheck.
3. Nailor.
4. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Type: 6 inch deep frame with drainable brades, heavy channel frame, 1/2 inch square mesh screen over intake or exhaust end.

C. Color: As indicated on the drawings.

**2.10 GOOSENECKS**

A. Fabricate in accordance with of minimum 18 gauge, 0.0598 inch galvanized steel.

B. Mount on minimum 12 inch high curb base where size exceeds 9 by 9 inch.

C. Provide 1/2" galvanized mesh screen at opening.

**2.11 GRAVITY VENTILATORS**

A. Hood Intake and Relief Gravity Ventilator:

1. Manufacturers:
   a. Greenheck Fan Corporation.
   b. Loren Cook Company.
   c. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.
2. General:
   a. Low silhouette for intake and relief applications with natural gravity or negative pressure system(s).
   b. Performance ratings and factory testing to be in accordance with AMCA 511 and AMCA 550.
   c. Suitable for non-ducted applications.

d. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.

3. Hood and Base:
   a. Material: Aluminum.
   b. Hood Construction: Precision formed, arched panels with interlocking seams.
   c. Vertical End Panels: Fully locked into hood end panels.
   d. Curb Cap: Pre-punched mounting holes for installation.
4. Birdscreen:
   a. Fabricate in accordance with ASTM B221 (ASTM B221M).
   b. Construction: 1/2 inch Galvanized mesh.
   c. Horizontally mounted across hood intake area.
5. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
         (a) Welded curb with 45 degree cant and wood nailer.
      2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
      3) Insulation Thickness: 1 inch.
   b. Curb Seal: Rubber seal between fan and roof curb.
   c. Dampers:
      1) Type: Gravity.
      2) Factory designed to prevents outside air from entering back into building when fan is off.
      3) Balanced for minimal resistance to flow.

B. Spun Aluminum Intake and Relief Gravity Ventilator:
1. Manufacturers:
   a. Greenheck Fan Corporation.
   b. Loren Cook Company.
   c. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.
2. General:
   a. Provide low silhouette configuration for intake and relief applications with natural gravity or negative pressure system.
   b. Suitable for non-ducted applications.
   c. Equipment to bear permanently affixed manufacturer's nameplate listing model and serial number.
3. Hood:
   a. Material: Aluminum.
   b. Internal structure constructed of galvanized steel.
4. Birdscreen:

a. Fabricate in accordance with ASTM B221 (ASTM B221M).
b. Construction: 1/2 inch galvanized mesh.
c. Horizontally mounted across hood intake area.

5. Housing:
   a. Curb Cap:
      1) Type: No Hinged.
      2) Construction: Aluminum.
      3) Integral deep spun inlet venturi with pre-punched mounting holes to ensure correct attachment to roof.
6. Options/Accessories:
   a. Roof Curbs:
      1) Flat Roofs:
         (a) Welded curb with 45 degree cant and wood nailer.
      2) Pitched Roofs: Welded, straight side curb with flashing flange and wood nailer.
      3) Insulation Thickness: 1 inch.
   b. Curb Seal: Rubber seal between fan and roof curb.
   c. Dampers:
      1) Type: Gravity.
      2) Factory designed to prevent outside air from entering back into building when fan is off.
      3) Balanced for minimal resistance to flow.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
C. Install diffusers to ductwork with air tight connection.
D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
E. Paint ductwork visible behind air outlets and inlets matte black, see Section 09-91-23.

**END OF SECTION**

## SECTION 23-74-16 - PACKAGED ROOFTOP AIR-CONDITIONING UNITS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Packaged, large-capacity, rooftop air-conditioning units.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS for additional provisions.
2. Extra Filters: One set for each unit.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site until roof mounting curbs are in place and ready for immediate installation of units.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Carrier Corporation.

B. Daikin.

C. Lennox.

D. York.

E. Trane.

#### 2.02 PACKAGED, LARGE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS

A. General: Roof mounted units having gas burner and electric refrigeration that are 25 tons and larger in capacity.

B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.

C. Electrical Characteristics:

D. Disconnect Switch: Factory mount disconnect switch in control panel.

E. Convenience Outlet: Powered GFCI, 120V 2 plug outlet, with service receptacle disconnect.

F. Smoke Detector: Return plenum smoke detectorto shutdown unit.

#### 2.03 CASING

A. Cabinet: Galvanized steel with baked enamel finish, including access doors with piano hinges and locking handle. Structural members to be minimum 18 gauge, 0.0478 inch, with access doors or panels of minimum 20 gauge, 0.0359 inch.

B. Insulation: One-inch thick, foil-faced glass fiber with edges protected from erosion.

**2.04 FANS**

A. Supply Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch pulley, and rubber isolated hinge mounted. Provide with high efficiency motor or direct drive as indicated. Isolate complete fan assembly. See Section 23-05-48.

**2.05 BURNERS**

A. Gas Burner: Forced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame-sensing device, and automatic 100 percent shutoff pilot.

B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

**2.06 EVAPORATOR COIL**

A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.

B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

**2.07 CONDENSER COIL**

A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil hail guard.

B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Provide high efficiency fan motors.

**2.08 COMPRESSORS**

A. Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

**2.09 MIXED AIR CASING**

A. Economizer Damper: Low leakage, fully modulating Dry-Bulb economizer damper with high enthalpy limit and Powered Exhaust .

B. Damper Operator, Units 7.5 Ton Cooling Capacity and Larger: 24 volt with gear train sealed in oil with spring return on.

**2.10 AIR FILTERS:**

A. 2-inch thick, MERV 11 filter.

**2.11 OPERATING CONTROLS**

A. Provide low voltage, adjustable room thermostat to control burner operation, compressor and condenser fan, and supply fan to maintain temperature setting.

1. Include system selector switch heat-off-cool and auto-on fan control switch.
2. Locate thermostat in room as indicated on drawings.

B. Provide remote-mounted auto-on fan control switch.

**2.12 OPERATING CONTROLS - VARIABLE VOLUME UNITS**

A. Temperature transmitter located in supply air to signal electronic logic panel to control mixing dampers and cooling in sequence. Mixing section to operate as first stage of cooling and revert to minimum outside air above approximately 75 degrees F as determined by enthalpy of return and outdoor air.

B. Control cooling by cycling compressors, cylinder unloading, and hot gas bypass.

C. Provide two stage morning warm-up thermostat to hold outdoor dampers closed and energize heat until return air temperature reaches setpoint.

### 2.13 ROOF CURBS

A. Roof Mounting Curb: 14 inches high, galvanized steel, channel frame with gaskets, nailer strips.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that roof is ready to receive work and opening dimensions are as required by manufacturer.

B. Verify that proper power supply is available.

### 3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 90A.

C. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

### 3.03 SYSTEM STARTUP

A. Prepare and start equipment. Adjust for proper operation.

### 3.04 MAINTENANCE

A. See Section 01-70-00 - EXECUTION AND CLOSEOUT REQUIREMENTS for additional requirements relating to maintenance service.

B. Provide service and maintenance of packaged rooftop units for one year from Date of Substantial Completion.

C. Provide routine maintenance service with a two-month interval as maximum time period between calls.

D. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.

E. After each service call, submit copy of service call work order or report that includes description of work performed.

**END OF SECTION**

## SECTION 23-81-26.13 - SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Forced air furnaces.

B. Air cooled condensing units.

C. Indoor air handling (fan and coil) units for ducted systems.

D. Controls.

#### 1.02 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

E. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.
2. Extra Filters: One for each unit.
3. Extra Pilot Thermocouples: One for each unit.

#### 1.03 QUALITY ASSURANCE

#### 1.04 WARRANTY

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS, for additional warranty requirements.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

A. Carrier Corporation: www.carrier.com/#sle.

B. Trane Inc: www.trane.com/#sle.

C. York International Corporation / Johnson Controls: www.york.com/#sle.

D. Coleman Company Inc. (The)..

E. [Lennox International Inc.].

F. [Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.].

G. [SANYO North America Corporation; SANYO Fisher Company.].

H. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

#### 2.02 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.

1. Heating: Natural gas fired.

2. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
3. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.

**2.03 INDOOR AIR HANDLING UNITS FOR DUCTED SYSTEMS**

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating and cooling element(s), controls, and accessories; wired for single power connection with control transformer.
1. Air Flow Configuration: Upflow.
2. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

B. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.
1. Motor: NEMA MG 1; 1750 rpm single speed, permanently lubricated, hinge mounted.
2. Motor Electrical Characteristics:

C. Air Filters: 2 inch thick MERV 11 filter type arranged for easy replacement.

D. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
2. Manufacturers: System manufacturer.

**2.04 OUTDOOR UNITS**

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
1. Comply with AHRI 210/240.
2. Refrigerant: R-454B or R-32.
3. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1 and UL 207.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
1. Provide thermostatic expansion valves.
2. Provide heat pump reversing valves.

D. Operating Controls:
1. Control by room thermostat to maintain room temperature setting.

**2.05 GAS FURNACE COMPONENTS**

A. Burner: Atmospheric type with adjustable combustion air supply,

1. Gas valve, single or two stage as indicated on drawings provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.
2. Combustion air damper with synchronous spring return damper motor.
3. Non-corrosive combustion air blower with permanently lubricated motor.

B. Burner Safety Controls:
1. Thermocouple Sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.
2. Flame Rollout Switch: Installed on burner box and prevents operation.
3. Vent Safety Shutoff Sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.
4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.

C. Operating Controls:
1. Cycle burner by room thermostat to maintain room temperature setting.
2. Supply fan energized from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation.

D. Flue Termination: Concentric roof kit.

**2.06 ACCESSORY EQUIPMENT**

A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:
1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from setpoint.
3. Thermostat Display:
a. Actual room temperature.
b. Programmed temperature.
c. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.
B. Verify that proper power supply is available and in correct location.
C. Verify that proper fuel supply is available for connection.

**3.02 INSTALLATION**

A. Install in accordance with NFPA 90A and NFPA 90B.
B. Install gas fired furnaces in accordance with NFPA 54.
C. Provide vent connections in accordance with NFPA 211.
D. Install refrigeration systems in accordance with ASHRAE Std 15.

**END OF SECTION**

## SECTION 26-05-05 - SELECTIVE DEMOLITION FOR ELECTRICAL

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Electrical demolition.

### PART 2 PRODUCTS

#### 2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Architect before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

#### 3.02 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

#### 3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:

1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
2. PCB- and DEHP-containing lighting ballasts.
3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

G. Repair adjacent construction and finishes damaged during demolition and extension work.

H. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

**3.04 CLEANING AND REPAIR**

A. See Section 01-74-19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL for additional requirements.

B. Clean and repair existing materials and equipment that remain or that are to be reused.

C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

**END OF SECTION**

## SECTION 26-05-19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Single conductor building wire.
B. Wiring connectors.
C. Electrical tape.
D. Heat shrink tubing.
E. Oxide inhibiting compound.
F. Wire pulling lubricant.
G. Cable ties.
H. Firestop sleeves.

#### 1.02 RELATED REQUIREMENTS

A. Section 07-84-00 - FIRESTOPPING.
B. Section 26-05-05 - SELECTIVE DEMOLITION FOR ELECTRICAL: Disconnection, removal, and/or extension of existing electrical conductors and cables.
C. Section 26-05-19.13 - Undercarpet Electrical Power Cables: Flat conductor cable and fittings for undercarpet power distribution.
D. Section 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Additional requirements for grounding conductors and grounding connectors.
E. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.
F. Section 28-46-00 - FIRE DETECTION AND ALARM: Fire alarm system conductors and cables.

#### 1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire.
B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.
E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.
F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes.
G. NECA 1 - Standard for Good Workmanship in Electrical Construction.
H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
I. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.

J. NFPA 70 - National Electrical Code.
K. UL 44 - Thermoset-Insulated Wires and Cables.
L. UL 83 - Thermoplastic-Insulated Wires and Cables.
M. UL 267 - Outline of Investigation for Wire-Pulling Compounds.
N. UL 486A-486B - Wire Connectors.
O. UL 486C - Splicing Wire Connectors.
P. UL 486D - Sealed Wire Connector Systems.
Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

**1.04 ADMINISTRATIVE REQUIREMENTS**

A. Coordination:
   1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
   2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
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.

**1.06 QUALITY ASSURANCE**

A. Comply with requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

**1.08 FIELD CONDITIONS**

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation

below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

## PART 2 PRODUCTS

### 2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is not permitted.

H. Manufactured wiring systems are not permitted.

### 2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

G. Conductors for Grounding and Bonding: Also comply with Section 26-05-26.

H. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

I. Conductor Material:

1. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
2. Tinned Copper Conductors: Comply with ASTM B33.

J. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
3. Color Code:
   a. 480Y/277 V, 3 Phase, 4 Wire System:
      1) Phase A: Brown.
      2) Phase B: Orange.

3) Phase C: Yellow.
4) Neutral/Grounded: Gray.

b. 208Y/120 V, 3 Phase, 4 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.

c. Equipment Ground, All Systems: Green.

**2.03 SINGLE CONDUCTOR BUILDING WIRE**

A. Description: Single conductor insulated wire.

B. Conductor Stranding:
1. Feeders and Branch Circuits:
a. Size 10 AWG and Smaller: Solid.
b. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation:
1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

**2.04 WIRING CONNECTORS**

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26-05-26.

C. Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
6. Conductors for Control Circuits: Use crimped terminals for all connections.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

G. Mechanical Connectors: Provide bolted type or set-screw type.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

**2.05 ACCESSORIES**

A. Electrical Tape:

1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil; suitable for continuous temperature environment up to 221 degrees F.
6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

D. Wire Pulling Lubricant:

1. Listed and labeled as complying with UL 267.
2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
3. Suitable for use at installation temperature.

E. Cable Ties: Material and tensile strength rating suitable for application.

F. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

### 3.03 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
2. When circuit destination is indicated without specific routing, determine exact routing required.
3. Include circuit lengths required to install connected devices within 10 ft of location indicated.
4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
2. Pull all conductors and cables together into raceway at same time.
3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

G. Install conductors with a minimum of 12 inches of slack at each outlet.

H. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

I. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

J. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

K. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
   1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
      a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
      b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
   2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.

a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.

3. Wet Locations: Use heat shrink tubing.

L. Insulate ends of spare conductors using vinyl insulating electrical tape.

M. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

N. Identify conductors and cables in accordance with Section 26-05-53.

O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07-84-00.

P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

**3.04 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Correct deficiencies and replace damaged or defective conductors and cables.

**END OF SECTION**

## SECTION 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

#### 1.02 RELATED REQUIREMENTS

A. Section 26-05-19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Additional requirements for conductors for grounding and bonding, including conductor color coding.

1. Includes oxide inhibiting compound.

B. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

#### 1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.

C. NFPA 70 - National Electrical Code.

D. UL 467 - Grounding and Bonding Equipment.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittals procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Manufacturer's 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.

#### 1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal air ducts.

### 2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26-05-26:

1. Use insulated copper conductors unless otherwise indicated.
    a. Exceptions:
        1) Use bare copper conductors where installed underground in direct contact with earth.
        2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:
    1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
    2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
    3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
        a. Exceptions:
            1) Use exothermic welded connections for connections to metal building frame.
D. Oxide Inhibiting Compound: Comply with Section 26-05-19.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.
B. Verify that field measurements are as indicated.
C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Make grounding and bonding connections using specified connectors.
    1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
    2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
    3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
    4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
    5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
D. Identify grounding and bonding system components in accordance with Section 26-05-53.

### 3.03 FIELD QUALITY CONTROL

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.
B. Inspect and test in accordance with NETA ATS except Section 4.
C. Perform inspections and tests listed in NETA ATS, Section 7.13.
D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

**END OF SECTION**

## SECTION 26-05-29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

#### 1.02 RELATED REQUIREMENTS

A. Section 03-30-00 - CAST-IN-PLACE CONCRETE: Concrete equipment pads.

B. Section 26-05-33.13 - CONDUIT FOR ELECTRICAL SYSTEMS: Additional support and attachment requirements for conduits.

C. Section 26-05-33.16 - BOXES FOR ELECTRICAL SYSTEMS: Additional support and attachment requirements for boxes.

D. Section 26-51-00 - INTERIOR LIGHTING: Additional support and attachment requirements for interior luminaires.

#### 1.03 REFERENCE STANDARDS

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

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

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. MFMA-4 - Metal Framing Standards Publication.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction.

F. NFPA 70 - National Electrical Code.

G. NFPA 101 - Life Safety Code.

H. UL 5B - Strut-Type Channel Raceways and Fittings.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
2. Coordinate work to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03-30-00.

## 1.05 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

D. Manufacturer's 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.

## 1.06 QUALITY ASSURANCE

A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## 1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

# PART 2 PRODUCTS

## 2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.
    a. NFPA 70.
    b. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported with minimum safety factor of _____. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.

c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:
1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
2. Comply with MFMA-4.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
a. Equipment Supports: 1/2-inch diameter.
b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.
e. Outlet Boxes: 1/4-inch diameter.
f. Luminaires: 1/4-inch diameter.

F. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Powder-actuated fasteners are not permitted.
3. Hammer-driven anchors and fasteners are not permitted.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: See Section 26-05-33.13 for additional requirements.

I. Box Support and Attachment: See Section 26-05-33.16 for additional requirements.

J. Interior Luminaire Support and Attachment: See Section 26-51-00 for additional requirements.

K. Secure fasteners in accordance with manufacturer's recommended torque settings.

L. Remove temporary supports.

M. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

**3.03 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**

## SECTION 26-05-33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Galvanized steel rigid metal conduit (RMC).

B. Galvanized steel electrical metallic tubing (EMT).

#### 1.02 RELATED REQUIREMENTS

A. Section 07-84-00 - FIRESTOPPING.

B. Section 26-05-19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cable assemblies consisting of conductors protected by integral metal armor.

C. Section 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

D. Section 26-05-29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

E. Section 26-05-33.16 - BOXES FOR ELECTRICAL SYSTEMS.

F. Section 26-05-33.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS.

G. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

#### 1.03 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC).

B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT).

E. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

F. NFPA 70 - National Electrical Code.

G. UL 6 - Electrical Rigid Metal Conduit-Steel.

H. UL 514B - Conduit, Tubing, and Cable Fittings.

I. UL 797 - Electrical Metallic Tubing-Steel.

J. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

**1.05 SUBMITTALS**

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
C. Shop Drawings:
   1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.

**1.06 QUALITY ASSURANCE**

A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

**PART 2 PRODUCTS**

**2.01 CONDUIT APPLICATIONS**

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.
B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

**2.02 CONDUIT - GENERAL REQUIREMENTS**

A. Comply with NFPA 70.
B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.
C. Provide conduit, fittings, supports, and accessories required for complete raceway system.
D. Provide products listed, classified, and labeled as suitable for purpose intended.
E. Minimum Conduit Size, Unless Otherwise Indicated:
   1. Branch Circuits: 3/4-inch trade size.
   2. Branch Circuit Homeruns: 3/4-inch trade size.
   3. Control Circuits: 1/2-inch trade size.
   4. Flexible Connections to Luminaires: 3/8-inch trade size.
F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

**2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)**

A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:

1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

**2.04 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)**

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.
3. Connectors and Couplings: Use compression/gland or set-screw type.
    a. Do not use indenter type connectors and couplings.
4. Damp or Wet Locations, Where Permitted: Use fittings listed for use in wet locations.

**2.05 ACCESSORIES**

A. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

B. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

C. Foam Conduit Sealant:

1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
3. Rated to hold minimum of 10 ft water head pressure.

D. Conduit Mechanical Seals:

1. Listed as complying with UL 514B.
2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.
3. Suitable for sealing around conductors/cables to be installed.

E. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

F. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

G. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.

D. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.
2. When conduit destination is indicated without specific routing, determine exact routing required.
3. Conceal conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
    a. Electrical rooms.
    b. Mechanical equipment rooms.
    c. Within joists in areas with no ceiling.
5. Unless otherwise approved, do not route exposed conduits:
    a. Across floors.
    b. Across roofs.
    c. Across top of parapet walls.
6. Arrange conduit to maintain adequate headroom, clearances, and access.
7. Arrange conduit to provide no more than equivalent of three 90-degree bends between pull points.
8. Arrange conduit to provide no more than 150 feet between pull points.
9. Route conduits above water and drain piping where possible.
10. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
11. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
    a. Heaters.
    b. Hot water piping.
    c. Flues.

12. Group parallel conduits in same area on common rack.

E. Conduit Support:
   1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26-05-29.
   2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
   3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
   4. Use conduit strap to support single surface-mounted conduit.
      a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
   5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
   6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
   7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
   8. Use of spring steel conduit clips for support of conduits is not permitted.
   9. Use of wire for support of conduits is not permitted.
   10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

F. Connections and Terminations:
   1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
   2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
   3. Use suitable adapters where required to transition from one type of conduit to another.
   4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
   5. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
   6. Secure joints and connections to provide mechanical strength and electrical continuity.

G. Penetrations:
   1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
   2. Make penetrations perpendicular to surfaces unless otherwise indicated.
   3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
   4. Conceal bends for conduit risers emerging above ground.

5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
7. Provide metal escutcheon plates for conduit penetrations exposed to public view.
8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07-84-00.

H. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
2. Where conduits are subject to earth movement by settlement or frost.

I. Conduit Sealing:
1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
a. Where conduits enter building from outside.
b. Where service conduits enter building from underground distribution system.
c. Where conduits enter building from underground.
d. Where conduits may transport moisture to contact live parts.
2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
a. Where conduits pass from outdoors into conditioned interior spaces.
b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

J. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

K. Provide grounding and bonding; see Section 26-05-26.

L. Identify conduits; see Section 26-05-53.

**3.03 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective conduits.

**3.04 CLEANING**

A. Clean interior of conduits to remove moisture and foreign matter.

**3.05 PROTECTION**

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

**END OF SECTION**

## SECTION 26-05-33.16 - BOXES FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Floor boxes.

D. Accessories.

#### 1.02 RELATED REQUIREMENTS

A. Section 07-84-00 - FIRESTOPPING.

B. Section 08-31-00 - ACCESS DOORS AND PANELS: Panels for maintaining access to concealed boxes.

C. Section 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

D. Section 26-05-29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

E. Section 26-05-33.13 - CONDUIT FOR ELECTRICAL SYSTEMS:

1. Conduit bodies and other fittings.
2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

F. Section 26-05-33.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS:

G. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

H. Section 26-27-26 - WIRING DEVICES:

1. Wall plates.
2. Floor box service fittings.
3. Poke-through assemblies.
4. Additional requirements for locating boxes for wiring devices.

I. Section 26-28-13 - FUSES: Spare fuse cabinets.

J. Section 27-10-00 - STRUCTURED CABLING: Additional requirements for communications systems outlet boxes.

#### 1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable.

E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

F. NFPA 70 - National Electrical Code.

G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

I. UL 508A - Industrial Control Panels.

J. UL 514A - Metallic Outlet Boxes.

**1.04 ADMINISTRATIVE REQUIREMENTS**

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

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. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.
2. Keys for Lockable Enclosures: Two of each different key.

**1.06 QUALITY ASSURANCE**

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.01 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
3. Use suitable concrete type boxes where flush-mounted in concrete.
4. Use suitable masonry type boxes where flush-mounted in masonry walls.
5. Use raised covers suitable for the type of wall construction and device configuration where required.
6. Use shallow boxes where required by the type of wall construction.
7. Do not use "through-wall" boxes designed for access from both sides of wall.
8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
12. Minimum Box Size, Unless Otherwise Indicated:
    a. Communications Systems Outlets: Comply with Section 27-10-00.
    b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
13. Wall Plates: Comply with Section 26-27-26.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
    a. Indoor Clean, Dry Locations: Type 1, painted steel.
    b. Outdoor Locations: Type 3R, painted steel.
3. Junction and Pull Boxes Larger Than 100 cubic inches:
    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
    b. Boxes 6 square feet and Larger: Provide sectionalized screw-cover or hinged-cover enclosures.
4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:
    a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
    b. Back Panels: Painted steel, removable.
    c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

D. Floor Boxes:
1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26-27-26; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
2. Metallic Floor Boxes: Fully adjustable (with integral means for leveling adjustment prior to and after concrete pour).
3. Manufacturer: Same as manufacturer of floor box service fittings.

**2.02 ACCESSORIES**

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for boxes and facade materials to be installed.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive boxes.
C. Verify that conditions are satisfactory for installation prior to starting work.

**3.02 INSTALLATION**

A. Install products in accordance with manufacturer's instructions.
B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with Section 08-31-00 as required where approved by the Architect.
2. Unless dimensioned, box locations indicated are approximate.
3. Locate boxes as required for devices installed under other sections or by others.
    a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26-27-26.
    b. Communications Systems Outlets: Comply with Section 27-10-00.
4. Locate boxes so that wall plates do not span different building finishes.
5. Locate boxes so that wall plates do not cross masonry joints.
6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
    a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
    b. Do not install flush-mounted boxes with area larger than 16 square inches or such that the total aggregate area of openings exceeds 100 square inches for any 100 square feet of wall area.
10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26-05-33.13.
11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
    a. Concealed above accessible suspended ceilings.
    b. Within joists in areas with no ceiling.
    c. Electrical rooms.
    d. Mechanical equipment rooms.

I. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26-05-29 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
4. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.

N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07-84-00.

P. Close unused box openings.

Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

R. Provide grounding and bonding in accordance with Section 26-05-26.

S. Identify boxes in accordance with Section 26-05-53.

**3.03 CLEANING**

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

**3.04 PROTECTION**

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

**END OF SECTION**

## SECTION 26-05-33.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Surface raceway systems.

B. Wireways.

C. Wall duct.

#### 1.02 RELATED REQUIREMENTS

A. Section 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. Section 26-05-29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

C. Section 26-05-33.13 - CONDUIT FOR ELECTRICAL SYSTEMS.

D. Section 26-05-33.16 - BOXES FOR ELECTRICAL SYSTEMS.

E. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

F. Section 26-27-26 - WIRING DEVICES: Receptacles.

G. Section 27-10-00 - STRUCTURED CABLING: Voice and data jacks.

#### 1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NFPA 70 - National Electrical Code.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. UL 5 - Surface Metal Raceways and Fittings.

E. UL 111 - Outline of Investigation for Multioutlet Assemblies.

F. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of raceways with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate rough-in locations of outlet boxes provided under Section 26-05-33.16 and conduit provided under Section 26-05-33.13 as required for installation of raceways provided under this section.
3. Verify minimum sizes of raceways with the actual conductors and components to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install raceways until final surface finishes and painting are complete.
2. Do not begin installation of conductors and cables until installation of raceways is complete between outlet, junction and splicing points.

#### 1.05 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including dimensions, knockout sizes and locations, materials, fabrication details, finishes, service condition requirements, and accessories.

1. Surface Raceway Systems: Include information on fill capacities for conductors and cables.

C. Shop Drawings:

1. Pre-wired Surface Raceway Systems: Provide plan and elevation views including dimensioned locations of wiring devices and circuiting arrangements.
2. Wireways: Provide dimensioned plan and elevation views including adjacent equipment with all required clearances indicated.

D. Manufacturer's 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.

**1.06 QUALITY ASSURANCE**

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

**PART 2 PRODUCTS**

**2.01 RACEWAY REQUIREMENTS**

A. Provide all components, fittings, supports, and accessories required for a complete raceway system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Do not use raceways for applications other than as permitted by NFPA 70 and product listing.

**2.02 SURFACE RACEWAY SYSTEMS**

A. Manufacturers:

1. Hubbell Incorporated: www.hubbell.com/#sle.
2. MonoSystems, Inc: www.monosystems.com/#sle.
3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
4. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Surface Metal Raceways: Listed and labeled as complying with UL 5.

C. Multioutlet Assemblies: Listed and labeled as complying with UL 111.

**2.03 WIREWAYS**

A. Manufacturers:

1. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com/#sle.
2. Enduro Composites: www.endurocomposites.com/#sle.
3. Hoffman, a brand of Pentair Technical Products: www.hoffmanonline.com/#sle.
4. Schneider Electric; Square D Products: www.schneider-electric.us/#sle.
5. Substitutions: See Section 01-60-00 - PRODUCT REQUIREMENTS.

B. Description: Lay-in wireways and wiring troughs with removable covers; listed and labeled as complying with UL 870.

C. Wireway Type, Unless Otherwise Indicated:
1. Indoor Clean, Dry Locations: NEMA EN 10250, Type 1, painted steel with screw-cover.

D. Finish for Painted Steel Wireways: Manufacturer's standard grey unless otherwise indicated.

E. Minimum Wireway Size: 4 by 4 inches unless otherwise indicated.

F. Where wireway size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

### 2.04 SOURCE QUALITY CONTROL

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes and conduit terminations are installed in proper locations and are properly sized in accordance with NFPA 70 to accommodate raceways.

C. Verify that mounting surfaces are ready to receive raceways and that final surface finishes are complete, including painting.

D. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install raceways plumb and level.

D. Arrange wireways and associated raceway connections to comply with NFPA 70, including but not limited to requirements for deflected conductors and wireways used as pullboxes. Increase size of wireway where necessary.

E. Secure and support raceways in accordance with Section 26-05-29 at intervals complying with NFPA 70 and manufacturer's requirements.

F. Close unused raceway openings.

G. Provide grounding and bonding in accordance with Section 26-05-26.

H. Identify raceways in accordance with Section 26-05-53.

### 3.03 FIELD QUALITY CONTROL

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Inspect raceways for damage and defects.

C. Surface Raceway Systems with Integrated Devices: Test each wiring device to verify operation and proper polarity.

D. Correct wiring deficiencies and replace damaged or defective raceways.

**3.04 CLEANING**

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

**3.05 PROTECTION**

A. Protect installed raceways from subsequent construction operations.

**END OF SECTION**

## SECTION 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Electrical identification requirements.
B. Identification nameplates and labels.
C. Wire and cable markers.
D. Voltage markers.
E. Warning signs and labels.

#### 1.02 RELATED REQUIREMENTS

A. Section 09-91-13 - EXTERIOR PAINTING.
B. Section 09-91-23 - INTERIOR PAINTING.
C. Section 26-05-19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
D. Section 26-05-36 - CABLE TRAYS FOR ELECTRICAL SYSTEMS: Additional identification requirements for cable tray systems.
E. Section 26-05-73 - POWER SYSTEM STUDIES: Arc flash hazard warning labels.
F. Section 26-27-26 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.
G. Section 27-10-00 - STRUCTURED CABLING: Identification for communications cabling and devices.

#### 1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs.
B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels.
C. NFPA 70 - National Electrical Code.
D. NFPA 70E - Standard for Electrical Safety in the Workplace.
E. UL 969 - Marking and Labeling Systems.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
B. Sequencing:
   1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
   2. Do not install identification products until final surface finishes and painting are complete.

#### 1.05 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittals procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

C. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

D. Manufacturer's 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.

### 1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

### 1.07 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

## PART 2 PRODUCTS

### 2.01 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    a. Panelboards:
        1) Identify ampere rating.
        2) Identify voltage and phase.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
        5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
        6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
    b. Transformers:
        1) Identify kVA rating.
        2) Identify voltage and phase for primary and secondary.
        3) Identify power source and circuit number. Include location when not within sight of equipment.
        4) Identify load(s) served. Include location when not within sight of equipment.
    c. Enclosed switches, circuit breakers, and motor controllers:
        1) Identify voltage and phase.
        2) Identify power source and circuit number. Include location when not within sight of equipment.

3) Identify load(s) served. Include location when not within sight of equipment.

d. Time Switches:

1) Identify load(s) served and associated circuits controlled. Include location.

2. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
3. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
4. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
5. Use identification label on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
6. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
7. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
   a. Service equipment.
   b. Industrial control panels.
   c. Motor control centers.
   d. Elevator control panels.
   e. Industrial machinery.
8. Arc Flash Hazard Warning Labels: Comply with Section 26-05-73.
9. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
10. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26-05-19.
2. Identification for Communications Conductors and Cables: Comply with Section 27-10-00.
3. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
4. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:

a. Within boxes when more than one circuit is present.

D. Identification for Raceways:
   1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.
   2. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.
      a. Maximum Intervals: 20 feet.
      b. Color-Coded Bands: Use field-painting or vinyl color coding electrical tape to mark bands 3 inches wide.
         1) Field-Painting: Comply with Section 09-91-23 and 09-91-13.
         2) Vinyl Color Coding Electrical Tape: Comply with Section 26-05-19.
      c. Color Code:
         1) Emergency Power System: Red.
         2) Fire Alarm System: Red.
   3. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.

E. Identification for Boxes:
   1. Use voltage markers to identify highest voltage present.
   2. Use voltage markers or color coded boxes to identify systems other than normal power system.
      a. Color-Coded Boxes: Field-painted in accordance with Section 09-91-23 and 09-91-13 per the same color code used for raceways.
         1) Emergency Power System: Red.
         2) Fire Alarm System: Red.

F. Identification for Devices:
   1. Identification for Communications Devices: Comply with Section 27-10-00.
   2. Wiring Device and Wallplate Finishes: Comply with Section 26-27-26.
   3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.

**2.02 IDENTIFICATION NAMEPLATES AND LABELS**

A. Identification Nameplates:
   1. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
      b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
   2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
   3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.

4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:
1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
   a. System designation where applicable:
   b. Equipment designation or other approved description.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height:
   a. System Designation: 1 inch.
   b. Equipment Designation: 1/2 inch.
   c. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
5. Color:
   a. Normal Power System: White text on black background.
   b. Fire Alarm System: White text on red background.

D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/4 inch.
5. Color: Black text on white background unless otherwise indicated.

E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 1/2 inch.
5. Color: Black text on yellow background unless otherwise indicated.

F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.

2. Legend: Power source and circuit number or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

G. Format for Control Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Load controlled or other designation indicated.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Black text on clear background.

H. Format for Fire Alarm Device Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
2. Legend: Designation indicated and device zone or address.
3. Text: All capitalized unless otherwise indicated.
4. Minimum Text Height: 3/16 inch.
5. Color: Red text on white background.

**2.03 WIRE AND CABLE MARKERS**

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

**2.04 VOLTAGE MARKERS**

A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

C. Minimum Size:
1. Markers for Equipment: 1 1/8 by 4 1/2 inches.
2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

D. Legend:
1. Markers for Voltage Identification: Highest voltage present.
2. Markers for System Identification:

E. Color: Black text on orange background unless otherwise indicated.

**2.05 WARNING SIGNS AND LABELS**

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:

1. Materials:
    a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
    b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
3. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size: 2 by 4 inches unless otherwise indicated.

**PART 3 EXECUTION**

**3.01 PREPARATION**

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

**3.02 INSTALLATION**

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Secure rigid signs using stainless steel screws.

G. Mark all handwritten text, where permitted, to be neat and legible.

**3.03 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

**END OF SECTION**

## SECTION 26-05-83 - WIRING CONNECTIONS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Electrical connections to equipment.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
   2. Determine connection locations and requirements.

B. Sequencing:
   1. Install rough-in of electrical connections before installation of equipment is required.
   2. Make electrical connections before required start-up of equipment.

#### 1.03 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

C. Manufacturer's 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.

#### 1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

### PART 2 PRODUCTS

#### 2.01 MATERIALS

#### 2.02 EQUIPMENT CONNECTIONS

### PART 3 EXECUTION

#### 3.01 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

#### 3.02 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.
F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
H. Install terminal block jumpers to complete equipment wiring requirements.
I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

**END OF SECTION**

## SECTION 26-09-23 - LIGHTING CONTROL DEVICES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Occupancy sensors.

B. Daylighting controls.

#### 1.02 RELATED REQUIREMENTS

A. Section 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. Section 26-05-29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

C. Section 26-05-33.16 - BOXES FOR ELECTRICAL SYSTEMS.

D. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

E. Section 26-27-26 - WIRING DEVICES: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

F. Section 26-28-13 - FUSES.

G. Section 26-51-00 - INTERIOR LIGHTING.

#### 1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NFPA 70 - National Electrical Code.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
4. Coordinate the placement of photo sensors for daylighting controls with windows, skylights, and luminaires to achieve optimum operation. Coordinate placement with ductwork, piping, equipment, or other potential obstructions to light level measurement installed under other sections or by others.
5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

#### 1.05 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.
B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
    1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
C. Shop Drawings:
    1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
    2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
D. Field Quality Control Reports.
E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
F. Operation and Maintenance Data: Include detailed information on device programming and setup.
G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

**1.06 QUALITY ASSURANCE**

A. Comply with requirements of NFPA 70.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND PROTECTION**

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

**1.08 FIELD CONDITIONS**

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

**1.09 WARRANTY**

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS, for additional warranty requirements.
B. Provide five year manufacturer warranty for all occupancy sensors.
C. Provide two year manufacturer warranty for all daylighting controls.

**PART 2 PRODUCTS**

**2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS**

A. Provide products listed, classified, and labeled as suitable for the purpose intended.
B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

## 2.02 OCCUPANCY SENSORS

A. All Occupancy Sensors:
   1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
   2. Sensor Technology:
      a. Passive Infrared/Acoustic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and audible sound sensing technologies.
   3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
   4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
   5. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
   6. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.

B. Wall Switch Occupancy Sensors:
   1. All Wall Switch Occupancy Sensors:
      a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
      b. Finish: Match finishes specified for wiring devices in Section 26-27-26, unless otherwise indicated.
   2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet.

C. Ceiling Mounted Occupancy Sensors:
   1. All Ceiling Mounted Occupancy Sensors:
      a. Description: Low profile occupancy sensors designed for ceiling installation.
      b. Unless otherwise indicated or required to control the load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.
      c. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.

D. Power Packs for Low Voltage Occupancy Sensors:
   1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.

2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
3. Input Supply Voltage: Dual rated for 120/277 V ac.
4. Load Rating: As required to control the load indicated on drawings.

**2.03 DAYLIGHTING CONTROLS**

A. System Description: Control system consisting of photo sensors and compatible control modules and power packs, contactors, or relays as required for automatic control of load indicated according to available natural light; capable of integrating with occupancy sensors and manual override controls.

B. Daylighting Control Photo Sensors: Low voltage class 2 photo sensor units with output signal proportional to the measured light level and provision for zero or offset based signal.
1. Sensor Type: Filtered silicon photo diode.
2. Sensor Range:
a. Indoor Photo Sensors: 5 to 100 footcandles.
3. Finish: White unless otherwise indicated.

C. Daylighting Control Switching Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors, for switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, load to be turned on when light level is below selected low set point and load to be turned off when light level is above selected high set point, with a no switching dead band between set points to prevent unwanted cycling.
2. Input Delay: To prevent unwanted cycling due to intermittent light level fluctuations.
3. Control Capability:

D. Daylighting Control Dimming Modules for Low Voltage Sensors: Low voltage class 2 control unit compatible with specified photo sensors and with specified dimming ballasts, for both continuous dimming of compatible dimming ballasts and switching of compatible power packs, contactors, or relays in response to changes in measured light levels according to selected settings.
1. Operation: Unless otherwise indicated, specified load to be continuously brightened as not enough daylight becomes available and continuously dimmed as enough daylight becomes available.
2. Control Capability: Capable of controlling up to three separately programmable channels, with up to 50 ballasts per channel.
3. Dimming and Fade Rates: Adjustable from 5 to 60 seconds.
4. Cut-Off Delay: Selectable and adjustable from 0 to 20 minutes.

E. Power Packs for Low Voltage Daylighting Control Modules:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage daylighting control modules for switching of line

voltage loads. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.

2. Input Supply Voltage: Dual rated for 120/277 V ac.
3. Load Ratings: As required to control the load indicated on drawings.

F. Accessories:

1. Where indicated, provide compatible accessory wall switches for manual override control.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

**3.02 PREPARATION**

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

**3.03 INSTALLATION**

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26-05-33.16 as required for installation of lighting control devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:
    a. Wall Switch Occupancy Sensors: 48 inches above finished floor.
2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.
3. Locate wall switch occupancy sensors on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.

C. Install lighting control devices in accordance with manufacturer's instructions.

D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

E. Install lighting control devices plumb and level, and held securely in place.

F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26-27-26.

G. Provide required supports in accordance with Section 26-05-29.

H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

I. Identify lighting control devices in accordance with Section 26-05-53.

J. Occupancy Sensor Locations:

1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect.
2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

K. Daylighting Control Photo Sensor Locations:

1. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for proper control of respective room or area based on manufacturer's recommendations for installed devices.
2. Unless otherwise indicated, locate photo sensors for closed loop systems to accurately measure the light level controlled at the designated task location, while minimizing the measured amount of direct light from natural or artificial sources such as windows or pendant luminaires.
3. Unless otherwise indicated, locate photo sensors for open loop systems to accurately measure the level of daylight coming into the space, while minimizing the measured amount of lighting from artificial sources.

L. Lamp Burn-In: Operate lamps at full output for minimum of 100 hours or prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

M. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near the sensor location.

N. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

O. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

**3.04 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Inspect each lighting control device for damage and defects.

C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

D. Test daylighting controls to verify proper operation, including light level measurements and time delays where applicable. Record test results in written report to be included with submittals.

E. Correct wiring deficiencies and replace damaged or defective lighting control devices.

**3.05 ADJUSTING**

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on passive infrared (PIR) and dual technology occupancy sensor lenses to block undesired motion detection.

D. Adjust daylighting controls under optimum lighting conditions after all room finishes, furniture, and window treatments have been installed to achieve desired operation as indicated or as directed by Architect. Record settings in written report to be included with submittals. Readjust controls calibrated prior to installation of final room finishes, furniture, and window treatments that do not function properly as determined by Architect.

**3.06 CLEANING**

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

**3.07 CLOSEOUT ACTIVITIES**

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS, for closeout submittals.

**END OF SECTION**

## SECTION 26-27-26 - WIRING DEVICES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Wall switches.

B. Wall dimmers.

C. Receptacles.

D. Wall plates.

E. Poke-through assemblies.

#### 1.02 RELATED REQUIREMENTS

A. Section 26-05-19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.

B. Section 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

C. Section 26-05-33.16 - BOXES FOR ELECTRICAL SYSTEMS.

D. Section 26-05-33.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS: Surface raceway systems, including multioutlet assemblies.

E. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

F. Section 26-05-83 - WIRING CONNECTIONS: Cords and plugs for equipment.

G. Section 26-09-23 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

H. Section 27-10-00 - STRUCTURED CABLING: Voice and data jacks.

#### 1.03 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices.

E. NEMA WD 1 - General Color Requirements for Wiring Devices.

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications.

G. NFPA 70 - National Electrical Code.

H. UL 20 - General-Use Snap Switches.

I. UL 498 - Attachment Plugs and Receptacles.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.

K. UL 943 - Ground-Fault Circuit-Interrupters.

L. UL 1310 - Class 2 Power Units.

M. UL 1449 - Standard for Surge Protective Devices.

N. UL 1472 - Solid-State Dimming Controls.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
   4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
   6. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install wiring devices until final surface finishes and painting are complete.

**1.05 SUBMITTALS**

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

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. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.
   2. Extra Wall Plates: One of each style, size, and finish.

**1.06 QUALITY ASSURANCE**

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND PROTECTION**

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

**PART 2 PRODUCTS**

**2.01 WIRING DEVICE APPLICATIONS**

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
D. Provide tamper resistant receptacles for all receptacles installed in public spaces.
E. Provide GFCI protection for receptacles where required by the NEC.
F. Unless noted otherwise, do not use combination switch/receptacle devices.
G. For flush floor service fittings, use tile rings for installations in tile floors.
H. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

**2.02 WIRING DEVICE FINISHES**

A. Provide wiring device finishes as described below unless otherwise indicated.
B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
D. Wiring Devices Installed in Wet or Damp Locations: White with specified weatherproof cover.
E. Flush Floor Box Service Fittings: Gray wiring devices with aluminum cover and ring/flange.
F. Flush Poke-Through Service Fittings: Gray wiring devices with aluminum cover and aluminum flange.

**2.03 WALL SWITCHES**

A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
    1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

**2.04 WALL DIMMERS**

A. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.
B. Power Rating, Unless Otherwise Indicated or Required to Control the Load Indicated on the Drawings:
C. Provide accessory wall switches to match dimmer appearance when installed adjacent to each other.

**2.05 RECEPTACLES**

A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
   2. NEMA configurations specified are according to NEMA WD 6.

B. Convenience Receptacles:
   1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
   2. Automatically Controlled Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; controlled receptacle marking on device face per NFPA 70; single or duplex as indicated on the drawings.
   3. Tamper Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.

C. GFCI Receptacles:
   1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
   2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
   3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
   4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.

**2.06 WALL PLATES**

A. Wall Plates: Comply with UL 514D.
   1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
   2. Size: Standard; _____.
   3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.

C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

D. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

**2.07 POKE-THROUGH ASSEMBLIES**

A. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

B. Flush Floor Service Fittings:

1. Dual Service Flush Combination Outlets:

a. Cover: Hinged door(s).

b. Configuration:

1) Power: One standard convenience duplex receptacle(s).

2) Communications: _____.

3) Voice and Data Jacks: As specified in Section 27-10-00.

2. Dual Service Flush Furniture Feed:

a. Configuration:

1) Power: One 3/4 inch threaded opening(s).

2) Communications: Two 1/2 inch threaded opening(s).

3. Accessories:

a. Closure Plugs: Size and fire rating as required to seal unused core hole and maintain fire rating of floor.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that core drilled holes for poke-through assemblies are in proper locations.

G. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

### 3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26-05-33.16 as required for installation of wiring devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:

a. Wall Switches: 48 inches above finished floor.

b. Wall Dimmers: 48 inches above finished floor.

c. Receptacles: 18 inches above finished floor or 6 inches above counter.

2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect to obtain direction prior to proceeding with work.
5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.

L. Do not share neutral conductor on branch circuits utilizing wall dimmers.

M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

N. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

P. Identify wiring devices in accordance with Section 26-05-53.

Q. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

**3.04 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

D. Test each receptacle to verify operation and proper polarity.

E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

F. Correct wiring deficiencies and replace damaged or defective wiring devices.

**3.05 ADJUSTING**

A. Adjust devices and wall plates to be flush and level.

B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Architect.

**3.06 CLEANING**

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

**END OF SECTION**

## SECTION 26-28-13 - FUSES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Fuses.

#### 1.02 RELATED REQUIREMENTS

A. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

B. Section 26-28-16.16 - ENCLOSED SWITCHES: Fusible switches.

#### 1.03 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses.

B. NFPA 70 - National Electrical Code.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses.

E. UL 248-8 - Low-Voltage Fuses - Part 8: Class J Fuses.

F. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses.

G. UL 248-15 - Low-Voltage Fuses - Part 15: Class T Fuses.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
    a. Fusible Enclosed Switches: See Section 26-28-16.16.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.
2. Extra Fuses: One set(s) of three for each type and size installed.
3. Fuse Pullers: One set(s) compatible with each type and size installed.

#### 1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.01 APPLICATIONS

A. Feeders:
   1. Fusible Switches up to 600 Amperes: Class RK1, time-delay.
B. General Purpose Branch Circuits: Class RK1, time-delay.
C. Individual Motor Branch Circuits: Class RK1, time-delay.
D. Primary Protection for Control Transformers: Class CC, time-delay.

### 2.02 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.
B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
C. Provide fuses of the same type, rating, and manufacturer within the same switch.
D. Comply with UL 248-1.
E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
F. Voltage Rating: Suitable for circuit voltage.
G. Class R Fuses: Comply with UL 248-12.
H. Class CC Fuses: Comply with UL 248-4.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
B. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.
B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

**END OF SECTION**

## SECTION 26-28-16.16 - ENCLOSED SWITCHES

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Enclosed safety switches.

#### 1.02 RELATED REQUIREMENTS

A. Section 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.

B. Section 26-05-29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

C. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

D. Section 26-28-13 - FUSES.

#### 1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction.

B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA BS 31047 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).

D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems.

E. NFPA 70 - National Electrical Code.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.

H. UL 98 - Enclosed and Dead-Front Switches.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### 1.05 SUBMITTALS

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

D. Manufacturer's Installation Instructions: 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.

E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01-60-00 - PRODUCT REQUIREMENTS, for additional provisions.
2. See Section 26-28-13 for requirements for spare fuses and spare fuse cabinets.

**1.06 QUALITY ASSURANCE**

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

**1.08 FIELD CONDITIONS**

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

**PART 2 PRODUCTS**

**2.01 ENCLOSED SAFETY SWITCHES**

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.
2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
2. Minimum Ratings:

a. Switches Protected by Class H Fuses: 10,000 rms symmetrical amperes.
b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Provide with switch blade contact position that is visible when the cover is open.

H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

I. Conductor Terminations: Suitable for use with the conductors to be installed.

J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

L. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
a. Indoor Clean, Dry Locations: Type 1.
b. Outdoor Locations: Type 3R.
2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

N. Heavy Duty Switches:
1. Comply with NEMA BS 31047.
2. Conductor Terminations:
a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

O. Provide the following features and accessories where indicated or where required to complete installation:
1. Hubs: As required for environment type; sized to accept conduits to be installed.
2. Integral fuse pullers.
3. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

## 3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26-05-29.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26-05-26.

H. Provide fuses complying with Section 26-28-13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Identify enclosed switches in accordance with Section 26-05-53.

## 3.03 FIELD QUALITY CONTROL

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

## 3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

## 3.05 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

**END OF SECTION**

## SECTION 26-51-00 - INTERIOR LIGHTING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. LED drivers.

E. Fluorescent emergency power supply units.

F. Lamps.

G. Accessories.

#### 1.02 RELATED REQUIREMENTS

A. Section 26-05-29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

B. Section 26-05-33.16 - BOXES FOR ELECTRICAL SYSTEMS.

C. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

D. Section 26-09-23 - LIGHTING CONTROL DEVICES.

E. Section 26-27-26 - WIRING DEVICES: Manual wall switches and wall dimmers.

#### 1.03 REFERENCE STANDARDS

A. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information.

B. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.

C. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction.

E. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems.

F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems.

G. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

H. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility.

I. NFPA 70 - National Electrical Code.

J. NFPA 101 - Life Safety Code.

K. UL 924 - Emergency Lighting and Power Equipment.

L. UL 1598 - Luminaires.

M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

**1.05 SUBMITTALS**

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
   1. LED Luminaires:
      a. Include estimated useful life, calculated based on IES LM-80 test data.
      b. Include IES LM-79 test report upon request.
   2. Provide electronic files of photometric data certified by a National Voluntary Laboratory Accreditation Program (NVLAP) lab or independent testing agency in IES LM-63 standard format upon request.

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. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

**1.06 QUALITY ASSURANCE**

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND PROTECTION**

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

**1.08 FIELD CONDITIONS**

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

**1.09 WARRANTY**

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS, for additional warranty requirements.

B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.

C. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

**PART 2 PRODUCTS**

**2.01 LUMINAIRE TYPES**

A. Furnish products as indicated in luminaire schedule included on the drawings.

**2.02 LUMINAIRES**

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.
2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

H. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.
2. Tested in accordance with IES LM-79 and IES LM-80.
3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

I. Track Lighting Systems: Provide track compatible with specified track heads, with all connectors, power feed fittings, dead ends, hangers and canopies as necessary to complete installation.

J. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

## 2.03 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:
   1. Sealed maintenance-free lead calcium unless otherwise indicated.
   2. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

G. Accessories:
   1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
   2. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

## 2.04 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
   1. Number of Faces: Single- or double-face as indicated or as required for installed location.
   2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.
   1. Self-Powered Exit Signs:
      a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
      b. Battery: Sealed, maintenance-free, nickel cadmium unless otherwise indicated.
      c. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
      d. Provide low-voltage disconnect to prevent battery damage from deep discharge.

e. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

**2.05 BALLASTS AND DRIVERS**

A. Ballasts/Drivers - General Requirements:
   1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
   2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
   3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

B. Dimmable LED Drivers:
   1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
   2. Control Compatibility: Fully compatible with the dimming controls to be installed.
      a. Wall Dimmers: See Section 26-27-26.
      b. Daylighting Controls: See Section 26-09-23.
      c. Network Lighting Controls: See Section _____.

**2.06 ACCESSORIES**

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that field measurements are as indicated.
B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
C. Verify that suitable support frames are installed where required.
D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
E. Verify that conditions are satisfactory for installation prior to starting work.

**3.02 PREPARATION**

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

**3.03 INSTALLATION**

A. Coordinate locations of outlet boxes provided under Section 26-05-33.16 as required for installation of luminaires provided under this section.
B. Perform work in accordance with NECA 1 (general workmanship).
C. Install products in accordance with manufacturer's instructions.
D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

E. Provide required support and attachment in accordance with Section 26-05-29.

F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

G. Suspended Ceiling Mounted Luminaires:

1. Do not use ceiling tiles to bear weight of luminaires.
2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
4. Secure pendant-mounted luminaires to building structure.
5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.
7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.

H. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

I. Suspended Luminaires:

1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
4. Unless otherwise indicated, support pendants from swivel hangers.

J. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

K. Install accessories furnished with each luminaire.

L. Bond products and metal accessories to branch circuit equipment grounding conductor.

M. Emergency Lighting Units:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
2. Install lock-on device on branch circuit breaker serving units.

N. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

O. Install lamps in each luminaire.

**3.04 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Inspect each product for damage and defects.

C. Operate each luminaire after installation and connection to verify proper operation.

D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.

E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

**3.05 ADJUSTING**

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

**3.06 CLEANING**

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

**3.07 CLOSEOUT ACTIVITIES**

**3.08 PROTECTION**

A. Protect installed luminaires from subsequent construction operations.

**END OF SECTION**

## SECTION 27-05-29 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

#### 1.02 RELATED REQUIREMENTS

A. Section 03-30-00 - CAST-IN-PLACE CONCRETE.

B. Section 26-05-29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS.

C. Section 27-10-00 - STRUCTURED CABLING.

#### 1.03 REFERENCE STANDARDS

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

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

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

E. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition.

F. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition.

G. MFMA-4 - Metal Framing Standards Publication.

H. NECA 1 - Standard for Good Workmanship in Electrical Construction.

I. NFPA 70 - National Electrical Code.

J. NFPA 101 - Life Safety Code.

K. TIA-569 - Telecommunications Pathways and Spaces.

L. UL 5B - Strut-Type Channel Raceways and Fittings.

M. UL 2024 - Standard for Cable Routing Assemblies and Communications Raceways.

N. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
2. Coordinate work to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.

4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has cured; see Section 03-30-00.

**1.05 SUBMITTALS**

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable supports, channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

C. Manufacturer's 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.

**1.06 QUALITY ASSURANCE**

A. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

**PART 2 PRODUCTS**

**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

A. General Requirements:
1. Comply with the following. Where requirements differ, comply with most stringent.
a. TIA-569.
b. NFPA 70.
c. Requirements of authorities having jurisdiction.
2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit Supports: Straps and clamps suitable for conduit to be supported.
    1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
    2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Noncontinuous Cable Supports: Suitable for cables to be supported, including but not limited to J-hooks, bridle rings, drive rings, and flexible harnesses/slings.
    1. Applications:
        a. Do not exceed 5 feet between cable supports.
        b. Maximum Number of Cables per Cable Support:
            1) J-Hooks: 50, regardless of capacity.
        c. Allowable Cable Types:
            1) J-Hooks: Category 3, Category 5e, and Category 6.
            2) Bridle Rings without Saddle: Category 3.
            3) Bridle Rings with Saddle: Category 3, Category 5e, and Category 6.
    2. J-Hooks: Noncontinuous cabling support with removable top retainer clip.
        a. Material: Use galvanized steel, factory-painted steel, or stainless steel.
        b. Provide support surfaces with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.
        c. Provide multitiered J-hooks where required to support multiple cabling systems.
        d. Color coding to be visible from below after installation.
    3. Bridle Rings: Noncontinuous circular cabling support.
        a. Material: Use galvanized steel, painted steel, or stainless steel.
        b. Provide integral saddle with smooth, beveled edges and radius not less than minimum allowable bend radius of cables supported.

D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

E. Metal Channel/Strut Framing Systems:
    1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
    2. Comply with MFMA-4.

F. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
    1. Minimum Size, Unless Otherwise Indicated or Required:

a. Equipment Supports: 1/2-inch diameter.
b. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.
c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.
d. Trapeze Support for Multiple Conduits: 3/8-inch diameter.

G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
2. Powder-actuated fasteners are not permitted.
3. Hammer-driven anchors and fasteners are not permitted.
4. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that mounting surfaces are ready to receive support and attachment components.
C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.
C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
E. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
F. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
G. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
H. Equipment Support and Attachment:
1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
I. Secure fasteners in accordance with manufacturer's recommended torque settings.
J. Remove temporary supports.

K. Identify independent communications component support wires above accessible ceilings, where permitted, with color distinguishable from other support wires in accordance with NFPA 70.

**3.03 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION**

## SECTION 27-05-36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Metal cable tray systems:

1. Metal wire mesh/basket cable tray.

#### 1.02 RELATED REQUIREMENTS

A. Section 07-84-00 - FIRESTOPPING.

B. Section 27-05-29 - Hangers and Supports for Communications Systems.

C. Section 27-10-00 - STRUCTURED CABLING: General structured cabling system requirements.

#### 1.03 REFERENCE STANDARDS

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

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

E. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition.

F. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition.

G. BICSI N3 - Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure.

H. BICSI TDMM - Telecommunications Distribution Methods Manual, 14th Edition.

I. NECA 1 - Standard for Good Workmanship in Electrical Construction.

J. NECA/BICSI 607 - Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings.

K. NEMA BI-50016 - Cable Tray Installation Guidelines.

L. NEMA VE 1 - Metal Cable Tray Systems.

M. NFPA 70 - National Electrical Code.

N. NFPA 101 - Life Safety Code.

O. TIA-569 - Telecommunications Pathways and Spaces.

P. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

Q. UL 2024 - Standard for Cable Routing Assemblies and Communications Raceways.

#### 1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate arrangement of cable tray with structural members, ductwork, piping, equipment and other potential conflicts. Coordinate work to avoid installation of obstructions within cable tray required clearances.
2. Coordinate arrangement of cable tray with dimensions and clearance requirements of actual products to be installed.
3. Coordinate work with placement of supports and anchors required for mounting.
4. Notify  of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
1. Do not begin installation of cables until installation of associated cable tray run is complete.

**1.05 SUBMITTALS**

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS for submittal procedures.
B. See Section 27-10-00 for additional submittal requirements.
C. Product Data:  Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.
D. Manufacturer's 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.

**1.06 QUALITY ASSURANCE**

A. Comply with NFPA 70.
B. Manufacturer Qualifications:  Company specializing in manufacturing products specified in this section with minimum three years documented experience.
C. Product Evaluation and Listing Organization Qualifications:  Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions and NEMA BI-50016, except do not store cable tray outdoors without cover as permitted in NEMA BI-50016.
B. Handle products carefully to avoid damage to finish.

**PART 2 PRODUCTS**

**2.01 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS**

A. Provide new cable tray system consisting of required components, fittings, supports, and accessories, as necessary for complete system.
B. Provide products listed, classified, and labeled as suitable for purpose intended.
C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.

D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under service conditions at installed location.

E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (i.e., no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA VE 1.

F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with NEMA VE 1 including applicable allowable tolerances.

G. See Section 27-10-00 for additional requirements for communications systems design and pathways.

**2.02 METAL CABLE TRAY SYSTEMS**

A. Comply with NEMA VE 1.

B. Material/Finishes:

1. Zinc Electroplated Steel: Comply with ASTM B633.
2. Mill-Galvanized Before Fabrication (Pre-Galvanized) Steel: Comply with ASTM A653/A653M, G90 coating.
3. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel: Comply with ASTM A123/A123M.
4. Stainless Steel: Type 304 or Type 316.

C. Metal Wire Mesh/Basket Cable Tray:

1. Material: Zinc-electroplated steel or mill-galvanized before fabrication (pre-galvanized) steel.
2. Tray Depth: As indicated on drawings.
3. Span/Load Rating: As indicated on drawings.
4. Mesh Spacing: 2 by 4 inches.
5. Tray Width: As indicated on drawings.

**2.03 SOURCE QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.

B. Metal Cable Tray: Perform factory design tests in accordance with NEMA VE 1, including electrical continuity and load testing.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

A. Verify that work likely to damage cable tray system has been completed.

B. Verify field measurements.

C. Verify dimensions and span/load ratings of cable tray system components.

D. Verify that mounting surfaces are ready to receive cable tray and associated supports.

E. Verify that conditions are satisfactory for installation prior to starting work.

**3.02 INSTALLATION**

A. Install products in accordance with manufacturer's instructions.

B. Install cable tray system in accordance with the following. Where requirements differ, comply with most stringent.
    1. BICSI ITSIMM (technology systems).
    2. BICSI N1 (cabling infrastructure).
    3. NECA 1 (general workmanship).
    4. NEMA BI-50016 (cable tray).
C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
D. Arrange cable tray to provide required clearances and maintain cable access.
    1. Maintain minimum clearance of 3 inches between bottom of cable tray and top of suspended ceilings, unless otherwise indicated or required by authorities having jurisdiction.
    2. Minimum Clearance Above and Adjacent to Cable Tray: 12 inches.
    3. Maintain recommended separation from sources of electromagnetic interference (EMI) greater than 5 kVA in accordance with BICSI ITSIMM and BICSI TDMM.
E. Install cable tray plumb and level, with sections aligned and with horizontal runs at specified elevation.
F. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
    1. Inside Radius of Fittings: 12 inches.
G. Hot-Dip Galvanized After Fabrication (H.D.G.A.F.) Steel Cable Tray: After cutting, drilling, or deburring, use approved zinc-rich paint to repair finish in accordance with ASTM A780/A780M.
H. Cable Tray Movement Provisions:
    1. Provide expansion fittings where cable tray is subject to movement, including but not limited to:
        a. Where cable tray crosses structural joints intended for expansion.
        b. Long straight cable tray runs in accordance with NEMA BI-50016.
    2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA BI-50016.
    3. Set gaps for expansion fittings in accordance with NEMA BI-50016.
I. Cable Provisions:
    1. Use fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
    2. Use drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
    3. Use cable support fittings for long vertical cable tray runs with heavy cables.
J. Provide end closures at unconnected ends of cable tray runs.
K. Cable Tray Support:
    1. See Section 27-05-29 for additional requirements.
    2. Use manufacturer's recommended hangers and supports, located in accordance with NEMA BI-50016, BICSI ITSIMM, and manufacturer's requirements, but not exceeding

specified span unless otherwise approved by Engineer. Provide required support and attachment where not furnished by cable tray manufacturer.

3. Provide support within 24 inches of each side of connection to a bend, tee, or cross in accordance with TIA-569, unless otherwise approved by Engineer.
4. Provide smooth nonscratching covers for abrasive supports installed within cable fill area in accordance with TIA-569.
5. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

L. Grounding and Bonding Requirements:

1. Install cable tray grounding in accordance with the following. Where requirements differ, comply with the most stringent.
   a. BICSI ITSIMM (technology systems).
   b. BICSI N3 (cabling infrastructure).
   c. BICSI TDMM (telecommunications distribution methods).
   d. NECA/BICSI 607 (telecommunications bonding and grounding).
   e. NEMA BI-50016 (cable tray).
2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified cable tray connectors to provide electrical continuity. Do not use classified cable tray connectors where cable tray sections have been modified, such as being bent, cut, or reshaped.
3. Provide suitable bonding conductor in each metal cable tray. Do not use cable tray as sole bonding conductor.
   a. Bonding Conductor for Galvanized Steel Cable Tray: Use bare or insulated copper conductor.
   b. Bonding Conductor for Aluminum Cable Tray: Use insulated copper conductor only; do not use bare copper conductor.
   c. Minimum Bonding Conductor Size:
      1) Conductor Lengths up to Up to 100 ft: 6 AWG.
      2) Conductor lengths greater than 100 ft: Size in accordance with BICSI TDMM.
   d. Do not decrease bonding conductor size as bonding path moves closer to intersystem bonding termination device/busbar.
   e. Bond cable tray bonding conductor to each metal cable tray section using suitable listed ground clamps. Separate bonding jumpers are not required where properly bonded cable tray bonding conductor provides equivalent continuity.

M. Conduit Termination:

1. Use listed cable tray conduit clamps (evaluated for bonding connection) to terminate conduits at cable tray.
2. Provide insulating bushing at conduit termination to protect cables.
3. Provide independent support for conduit.

N. Cable Installation:

1. Install cables in accordance with the following. Where requirements differ, comply with most stringent.
    a. BICSI ITSIMM (technology systems).
    b. BICSI N1 (cabling infrastructure).
    c. NEMA BI-50016 (cable tray).
2. Use appropriate cable pulling tools, applied to prevent excessive force on cable tray system and maintain minimum cable bending radius.
3. Use cable clamps or cable ties to fasten conductors/cables to vertical and horizontal runs of cable tray.
    a. Distance Between Fastening Points for Vertical Runs: 18 inches.
    b. Distance Between Fastening Points for Horizontal Runs: As required to maintain spacing and confine conductor/cable within cable fill area.

O. Penetrations: Install firestopping to preserve fire resistance rating of building elements.
1. See Section 07-84-00 for additional requirements.

P. Identification Requirements:
1. Use warning labels to identify cable tray with word message "WARNING! Do Not Use As A Walkway, Ladder, Or Support For Personnel. Use Only As A Mechanical Support For Cables, Tubing and Raceways." at maximum intervals of 20 ft.

**3.03 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS for additional requirements.
B. Inspect cable tray system for damage and defects.
C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
D. Correct deficiencies and replace damaged or defective cable tray system components.

**3.04 ADJUSTING**

A. Adjust tightness of mechanical connections to manufacturer's recommended torque settings.

**3.05 CLEANING**

A. Remove dirt and debris from cable tray.
B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

**3.06 PROTECTION**

A. Protect cable tray system from subsequent construction operations.

**END OF SECTION**

## SECTION 27-10-00 - STRUCTURED CABLING

### PART 1 GENERAL

#### 1.01 SECTION INCLUDES

A. Communications system design requirements.
B. Communications pathways.
C. Copper cable and terminations.
D. Fiber optic cable and interconnecting devices.
E. Communications equipment room fittings.
F. Communications outlets.
G. Communications grounding and bonding.
H. Communications identification.

#### 1.02 RELATED REQUIREMENTS

A. Section 07-84-00 - FIRESTOPPING.
B. Section 26-05-19.13 - Undercarpet Electrical Power Cables: Flat cable and fittings for undercarpet communications distribution.
C. Section 26-05-26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
D. Section 26-05-33.16 - BOXES FOR ELECTRICAL SYSTEMS.
E. Section 26-05-53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products.
F. Section 26-27-26 - WIRING DEVICES.

#### 1.03 REFERENCE STANDARDS

A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition.
B. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment.
C. ICEA S-83-596 - Indoor Optical Fiber Cable.
D. NFPA 70 - National Electrical Code.
E. TIA-455-21 - FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices.
F. TIA-492AAAC - Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers.
G. TIA-526-14 - Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; IEC 61280-4.1 Edition 3.1, Fiber Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement.
H. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set.
I. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
J. TIA-568.3 - Optical Fiber Cabling and Components Standard.
K. TIA-569 - Telecommunications Pathways and Spaces.
L. TIA-598 - Optical Fiber Cable Color Coding.
M. TIA-606 - Administration Standard for Telecommunications Infrastructure.

N. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
O. UL 444 - Communications Cables.
P. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
Q. UL 1651 - Fiber Optic Cable.
R. UL 1863 - Communications-Circuit Accessories.

**1.04 ADMINISTRATIVE REQUIREMENTS**

A. Coordination:
   1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
   2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
   3. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

A. See Section 01-30-00 - ADMINISTRATIVE REQUIREMENTS, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
C. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
D. Evidence of qualifications for installer.
E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
F. Test Plan: Complete and detailed plan, with list of test equipment, procedures for inspection and testing, and intended test date; submit at least 60 days prior to intended test date.
G. Field Test Reports.
H. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
   1. Record actual locations of outlet boxes and distribution frames.
   2. Show as-installed color coding, pair assignment, polarization, and cross-connect layout.
   3. Identify distribution frames and equipment rooms by room number on drawings.
I. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

**1.06 QUALITY ASSURANCE**

A. Manufacturer Qualifications: At least 3 years experience manufacturing products of the type specified.

B. Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:
   1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
   2. Supervisors and installers factory certified by manufacturers of products to be installed.
   3. Employing BICSI Registered Cabling Installation Technicians (RCIT) for supervision of all work.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Keep stored products clean and dry.

**1.08 WARRANTY**

A. See Section 01-78-00 - CLOSEOUT SUBMITTALS, for additional warranty requirements.

B. Correct defective Work within a 2 year period after Date of Substantial Completion.

**PART 2 PRODUCTS**

**2.01 SYSTEM DESIGN**

A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
   1. Comply with TIA-568 (SET) (cabling) and TIA-569 (pathways) (commercial standards).
   2. Comply with Communications Service Provider requirements.
   3. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
   4. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
   5. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
   1. Locate main distribution frame as indicated on the drawings.
   2. Capacity: As required to terminate all cables required by design criteria plus minimum 25 percent spare space.

C. Intermediate Distribution Frames (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.

1. Locate intermediate distribution frames as indicated on the drawings.

D. Backbone Cabling: Cabling, pathways, and terminal hardware connecting intermediate distribution frames (IDF's) with main distribution frame (MDF), wired in star topology with main distribution frame at center hub of star.

E. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

**2.02 COPPER CABLE AND TERMINATIONS**

A. Copper Horizontal Cable:

1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
2. Cable Type - Voice and Data: TIA-568.2 Category 6 UTP (unshielded twisted pair); 23 AWG.
3. Cable Capacity: 4-pair.
4. Cable Applications: Use listed NFPA 70 Type CMP plenum cable unless otherwise indicated.
5. Cable Jacket Color - Voice and Data Cable: Blue.

B. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.

C. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.

1. Performance: 500 mating cycles.
2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.

D. Copper Patch Cords:

1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.
2. Patch Cords for Patch Panels:
   a. Quantity: One for each pair of patch panel ports.

**2.03 FIBER OPTIC CABLE AND INTERCONNECTING DEVICES**

A. Fiber Optic Backbone Cable:

1. Description: Tight buffered, non-conductive fiber optic cable complying with TIA-568.3, TIA-598, ICEA S-83-596 and listed as complying with UL 444 and UL 1651.
2. Cable Type: Multimode, laser-optimized 50/125 um (OM3) complying with TIA-492AAAC.
3. Cable Capacity: Quantity of fibers as indicated on drawings.
4. Cable Applications:
   a. Plenum Applications: Use listed NFPA 70 Type OFNP plenum cable.
5. Cable Jacket Color:
   a. Laser-Optimized Multimode Fiber (OM3/OM4): Aqua.

B. Fiber Optic Horizontal Cable:
   1. Description: Tight buffered, non-conductive fiber optic cable complying with TIA-568.3, ICEA S-83-596 and listed as complying with UL 444 and UL 1651.
   2. Cable Type: Multimode, laser-optimized 50/125 um (OM3) complying with TIA-492AAAC.
   3. Cable Capacity: 2-fiber.
   4. Cable Applications: Use listed NFPA 70 Type OFNP plenum cable unless otherwise indicated.
   5. Cable Jacket Color:
      a. Laser-Optimized Multimode Fiber (OM3/OM4): Aqua.

C. Fiber Optic Interconnecting Devices:
   1. Connector Type: Type LC.
   2. Connector Performance: 500 mating cycles, when tested in accordance with TIA-455-21.
   3. Maximum Attenuation/Insertion Loss: 0.3 dB.

D. Fiber Optic Patch Cords:
   1. Description: Factory-fabricated 2-fiber cable assemblies with suitable connectors at each end.
   2. Patch Cords for Patch Panels:
      a. Quantity: One for each pair of patch panel ports.

**2.04 COMMUNICATIONS EQUIPMENT ROOM FITTINGS**

A. Copper Cross-Connection Equipment:
   1. Connector Blocks for Category 5e and Up Cabling: Type 110 insulation displacement connectors; capacity sufficient for cables to be terminated plus 25 percent spare.
   2. Patch Panels for Copper Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum; cabling terminated on Type 110 insulation displacement connectors; printed circuit board interface.
      a. Jacks: Non-keyed RJ-45, suitable for and complying with same standard as cable to be terminated; maximum 48 ports per standard width panel.
      b. Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.
      c. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.
      d. Provide incoming cable strain relief and routing guides on back of panel.

B. Fiber Optic Cross-Connection Equipment:
   1. Patch Panels for Fiber Optic Cabling: Sized to fit EIA/ECA-310 standard 19 inch wide equipment racks; 0.09 inch thick aluminum.
      a. Adapters: As specified above under FIBER OPTIC CABLE AND INTERCONNECTING DEVICES; maximum of 24 duplex adaptors per standard panel width.
      b. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA-606.

c. Provide incoming cable strain relief and routing guides on back of panel.
d. Provide rear cable management tray at least 8 inches deep with removable cover.
e. Provide dust covers for unused adapters.

C. Backboards: Interior grade plywood without voids, 3/4 inch thick; UL-labeled fire-retardant.
1. Do not paint over UL label.

D. Equipment Frames, Racks and Cabinets:
1. Component Racks: EIA/ECA-310 standard 19 inch wide.
2. Wall Mounted Racks: Steel construction, hinged to allow access to back of installed components.
3. Floor Mounted Racks: Aluminum or steel construction with corrosion resistant finish; vertical and horizontal cable management channels, top and bottom cable troughs, and grounding lug.
4. Freestanding Cabinets: Front and rear doors with locks; removable side panels with locks; vented top and rear door; adjustable leveling feet; cable access in roof and base; grounding bar.
5. Wall Mounted Cabinets: Front doors with locks, louvered side panels, top and bottom cable access, and ground lug.
6. Cabinets: Steel construction with corrosion resistant finish.
7. Locks: Keyed alike.

E. Cable Management:
1. Product(s):
a. CommScope Cable Runway: www.commscope.com/#sle.
b. CommScope Horizontal/Vertical Cable Managers; HCM-SS-XX-XX/VCM-DS-XX-XX Series: www.commscope.com/#sle.
c. CommScope FiberGuide Raceway: www.commscope.com/#sle.

**2.05 COMMUNICATIONS OUTLETS**

A. Outlet Boxes: Comply with Section 26-05-33.16.
1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
2. Minimum Size, Unless Otherwise Indicated:
a. Data or Combination Voice/Data Outlets: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.

B. Wall Plates:
1. Comply with system design standards and UL 514C.
2. Accepts modular jacks/inserts.
3. Capacity:
a. Data or Combination Voice/Data Outlets: 4 ports.
4. Wall Plate Material/Finish - Flush-Mounted Outlets: Match wiring device and wall plate finishes specified in Section 26-27-26.

### 2.06 GROUNDING AND BONDING COMPONENTS

A. Comply with TIA-607.

B. Comply with Section 26-05-26.

### 2.07 IDENTIFICATION PRODUCTS

A. Comply with TIA-606.

B. Comply with Section 26-05-53.

### 2.08 SOURCE QUALITY CONTROL

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Factory test cables according to TIA-568 (SET).

## PART 3 EXECUTION

### 3.01 INSTALLATION - GENERAL

A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), BICSI N1, NFPA 70, and SYSTEM DESIGN as specified in PART 2.

B. Comply with Communication Service Provider requirements.

C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.

D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07-84-00.

### 3.02 INSTALLATION OF PATHWAYS

A. Install pathways with the following minimum clearances:

1. 48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
2. 12 inches from power conduits and cables and panelboards.
3. 5 inches from fluorescent and high frequency lighting fixtures.
4. 6 inches from flues, hot water pipes, and steam pipes.

B. Outlet Boxes:

1. Coordinate locations of outlet boxes provided under Section 26-05-33.16 as required for installation of telecommunications outlets provided under this section.
    a. Mounting Heights: Unless otherwise indicated, as follows:
        1) Telephone and Data Outlets: 18 inches above finished floor.
    b. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
    c. Provide minimum of 24 inches horizontal separation between flush mounted outlet boxes installed on opposite sides of fire rated walls.
    d. Unless otherwise indicated, provide separate outlet boxes for line voltage and low voltage devices.
    e. Locate outlet boxes so that wall plate does not span different building finishes.
    f. Locate outlet boxes so that wall plate does not cross masonry joints.

### 3.03 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:
   1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
   2. Do not over-cinch or crush cables.
   3. Do not exceed manufacturer's recommended cable pull tension.
   4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
   1. At Distribution Frames: 120 inches.
   2. At Outlets - Copper: 12 inches.

C. Copper Cabling:
   1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.
   2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
   3. Use T568B wiring configuration.

D. Fiber Optic Cabling:
   1. Prepare for pulling by cutting outer jacket for 10 inches from end, leaving strength members exposed. Twist strength members together and attach to pulling eye.
   2. Support vertical cable at intervals as recommended by manufacturer.

E. Wall-Mounted Racks and Enclosures:
   1. Install to plywood backboards only, unless otherwise indicated.
   2. Mount so height of topmost panel does not exceed 78 inches above floor.

F. Floor-Mounted Racks and Enclosures: Permanently anchor to floor in accordance with manufacturer's recommendations.

G. Identification:
   1. Use wire and cable markers to identify cables at each end.
   2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.
   3. Use identification nameplate to identify cross-connection equipment, equipment racks, and cabinets.

**3.04 FIELD QUALITY CONTROL**

A. See Section 01-40-00 - QUALITY REQUIREMENTS, for additional requirements.

B. Comply with inspection and testing requirements of specified installation standards.

C. Visual Inspection:
   1. Inspect cable jackets for certification markings.
   2. Inspect cable terminations for color coded labels of proper type.
   3. Inspect outlet plates and patch panels for complete labels.
   4. Inspect patch cords for complete labels.

D. Testing - Copper Cabling and Associated Equipment:
   1. Test backbone cables after termination but before cross-connection.
   2. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.
   3. Test operation of shorting bars in connection blocks.
   4. Category 5e and Above Backbone: Perform near end cross talk (NEXT) and attenuation tests.
   5. Category 5e and Above Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.

E. Testing - Fiber Optic Cabling:
   1. Backbone: Perform optical fiber end-to-end attenuation test using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures; perform verification acceptance tests and factory reel tests.
   2. Multimode Backbone: Perform tests in accordance with TIA-526-14.
   3. Links: Perform optical fiber end-to-end attenuation tests and field reel tests.

F. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

**END OF SECTION**

## SECTION 28-13-00 - ACCESS CONTROL

### PART 1 GENERAL

#### 1.01 REFERENCE STANDARDS

A. UL 294 - Access Control System Units.

#### 1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.
   1. This section is inclusive to all Division 28 sections.

B. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27, as applicable.

#### 1.03 SUMMARY

A. This project consists of providing a complete, operational Access Control System (ACS) for the Project, as shown on the Drawings, and indicated in the Specifications. The scope of the project shall include all equipment, cabling, installation, software, programming and testing as required to support specified systems; removal of the existing ACS including panel, wiring, and devices; and to provide a complete and fully operational turn-key Access Control and Alarm Monitoring System.

B. The Access Control System shall be Lenel OnGuard and shall include access control and integrated alarm monitoring. Refer to page-7 within Part 2 Products for equipment specifications.

C. The Access Control System equipment for the Project shall be integrated into National Park Service (NPS) Midwest Region (MWR) Lenel OnGuard Enterprise Security Management and Access Control System (SMS).

D. Integrate new ACS equipment to the associated NPS MWR Regional Dispatch Center's Lenel OnGuard Enterprise regional server, or to NPS MWR Lenel regional sever as directed by Owner. NPS MWR Lenel regional servers are located at Mount Rushmore NP, Buffalo National River, Indiana Dunes NP, Gateway Arch NP, and Cuyahoga Valley NP.

E. New Lenel access control and alarm panels supplied for the project shall be connected to NPS network switches on site and shall communicate via dedicated security VLAN over the NPS MWR network to the associated Lenel SMS regional server.

F. The ACS shall be capable of customized Application Protocol Interface (API) soft integration with third party systems and equipment. The ACS shall be capable of soft integration with third party Video Management Systems (VMS).
   1. Permits, Inspections, Codes and Regulatory References
      a. General: Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Owner.

b. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable with electronic and electrical installations.

c. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

d. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

**1.04 GENERAL SYSTEMS INFORMATION**

A. Section includes requirements for an ACS for the Project and shall provide all of the functionality described within Division 28 specifications and shown on the project drawings.

a. ACS primary components include, but may not be limited to:

1) System Management Software
2) Related Software(s)
3) System Licensing

b. As required to complete the scope of the project, ACS peripheral components may include, but may not be limited to:

1) Intelligent Door Controllers
2) Input Output Controllers
3) Power Supplies
4) Access Control Devices
5) Cabling as required for each system
6) Category data cabling and patch cables as required
7) Capable of API integration with third party systems and equipment including security alarm and fire alarm panels.
8) Capable of API integration with third party Video Management Systems.
9) Monitoring alarms from field-installed hardware devices.
10) Managing alarm event information and notification.
11) Managing and regulating access control functionality.
12) Managing access credential holder database.
13) Issuing and enrolling multiple types of access credentials.
14) Identifying credential via industry standard access control devices.
15) Capable to produce identification access control credentials.
16) Access control anti-passback features.
17) Tracking and reporting system events.
18) Input and output linking through programming.
19) Surge and tamper protection.
20) Monitoring status of field-installed hardware devices.

21) RS-232, RS-485, and/or IP-based interface.
22) Interfaced with building UPS/generator.

B. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 8, Division 26, and Division 27, as applicable.

**1.05 QUALITY ASSURANCE**

1. Installation shall comply with all applicable codes and standards.

B. All equipment shall be new, in current production, the standard products of an acceptable manufacturer.

C. The manufacturer shall guarantee the availability of parts for a minimum of (5) years from date of shipment. All equipment and software shall be the latest version available from the manufacturer.

D. The manufacturer shall be able to demonstrate the features, functions, operating characteristics, and clarity of picture to the Owner.

1. The system shall be installed by a factory authorized, and trained, Security System Installer.

E. Maintenance and repair service shall be available locally and within (4) hours of notification for emergency conditions.

1. Design Verification and Acceptance

a. The contractor is responsible for verifying the accuracy of the system designs documented in the Specification and Drawings and acceptance of responsibility. Any issues, discrepancies substitutions, or exceptions to the contract documents by the Contractor shall be communicated to the Owner prior to the purchase of any equipment or materials by way of the Shop Drawings Submittal process. Upon approval of the Contractor’s Shop Drawing Submittal by the Owner's designated representative, or if the Contractor fails to submit Shop Drawings, the Contractor shall assume all responsibility for supplying such materials and taking such actions as to satisfy the full intentions of the contract documents without claim for additional compensation. This shall include providing any incidental equipment, Installation Materials and labor needed in order to result in a complete and operable system, even if such equipment, materials, or labor are not listed in this Specification. Exceptions include Owner-requested changes, unexpected field issues due to work by other trades, or schedule changes initiated by others.

F. Equipment and accessories furnished under the terms of this specification shall be the standard products of manufacturers regularly engaging in the manufacture of this type of product(s) for a period of at least three years.

G. All products within this bid, deemed by the manufacturer as “End of Life” at the time of installation shall be replaced with the next generation replacement in kind, at no additional cost to the owner.

**1.06 WARRANTY**

A. Provide complete written warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

B. Any material, equipment, or appurtenance whose operation or performance does not comply with the requirements of the Contract or any equipment which is damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

1. The system shall be warranted for a period of one year from date of owner acceptance.
2. Refer to Division 01 for additional warranty requirements.

**1.07 PROJECT DRAWINGS AND SPECIFICATIONS**

A. The Contractor shall carefully examine the Drawings and Specifications of all trades and report all discrepancies to the Owner in writing to obtain corrective action. No departures from the Contract Documents will be made without prior written approval from the Owner.

B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Owner. The Owner's interpretation is final and binding.

C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.

D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Owner.

E. If there is a conflict between contract documents, the document highest in precedence shall control. The precedence shall be: first; permits from agencies as required by law, second; special provisions, third; specifications, fourth; drawings, fifth; reference specifications and sixth; vendor submittals.

**1.08 COOPERATION AND COORDINATION WITH OTHER TRADES**

A. This contractor shall be responsible for all cross connecting and coordination with vendors and other trades to provide a complete operational system. Coordination shall include Division 8, Division 26, and Division 27 contractors, as applicable.

1. Coordination with Owner:
    a. Coordinate all work and technical requirements with owner during planning and pre-construction phases of the project.
    b. Coordinate all final equipment locations with owner prior to work.
    c. As required to facilitate Ethernet communications for new equipment, coordinate all networking requirements with owner IT prior to installation of equipment. All IT network switches or ports required for LAN/WAN connectivity shall be provided by owner. The system shall communicate via dedicated security VLAN as recommended by Lenel, coordinate all requirements with owner IT personnel.

d. As required, coordinate decommissioning or removal of any existing equipment with owner prior to work.
e. Existing equipment which is removed during construction shall be turned over to owner unless owner directs otherwise.

**1.09 ACS ACCESS CONTROL AND ALARM MONITORING PERFORMANCE REQUIREMENTS**

A. Distributed Processing: System must be a fully distributed processing system so that information, including time, date, valid codes, access levels, and similar data, is downloaded to Controllers so that each Controller makes access-control decisions for that Location. Do not use intermediate Controllers for access control. If communications to Master Control are lost, all Controllers must automatically buffer event transactions until communications are restored, at which time buffered events must be uploaded to the Master Control.
   1. System Capacity:
      a. 1,000 reader-controlled doors.
      b. 10,000 total access credentials.
      c. 10,000 supervised alarm inputs.
      d. 10,000 programmable outputs.
      e. 10,000 custom action messages.
   2. System Network Requirements:
      a. Provide for automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.
      b. Communication must not require operator initiation or response and must return to normal after partial or total network interruption such as power loss or transient upset.
      c. System must automatically annunciate communication failures to the operator and identify the communication link that has experienced a partial or total failure.

B. Environmental Capabilities: System must be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
   a. Control Station: Rated for continuous operation in ambient conditions of 60° to 85° F and a relative humidity of 20 to 80 percent, noncondensing.
   b. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments must be rated for continuous operation in ambient conditions of 36° to 122° F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosure.
   c. Interior, Uncontrolled Environment: System components installed in non-air-conditioned and non-temperature-controlled interior environments must be rated for continuous operation in ambient conditions of 0° to 122 ° F dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 12 enclosures.
   d. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

C. System must provide operator interface, interaction, display, control, and dynamic and real-time monitoring. System must control system networks to interconnect all system components, including workstations and field-installed Controllers.

D. Field equipment must include Controllers, sensors, and I/O devices. Controllers must serve as an interface between the system headend and sensors and controls. Data exchange between the System and the Controllers must include down-line transmission of commands, software, and databases to Controllers. The up-line data exchange from the Controller to the System must include status data such as intrusion alarms, status reports, and entry-control records. Controllers are classified as alarm-annunciation or entry-control type.

E. System Response to Alarms: Field device network must provide a system end-to-end response time of 1 second(s) or less for every device connected to the system. Alarms must be annunciated at the Monitoring workstation within 1 second of the alarm occurring at a Controller or device controlled by a local Controller. Alarm and status changes must be displayed within 100ms after receipt of data by the System. All graphics must be displayed, including graphics-generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console. This response time must be maintained during system heavy load.

F. False Alarm Reduction: The design of System and Controllers must contain features to reduce false alarms. Equipment and software must comply with SIA CP-01.

G. Data Line Supervision: System must initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

H. Door Hardware Interface: Coordinate with Division 8 Sections that specify door hardware required to be monitored or controlled by the security access system. The Controllers in this Section must have electrical characteristics that match the signal and power requirements of door hardware, including door monitors and latch detection where required. Integrate door hardware specified in Division 8 Sections to function with the controls and PC-based software and hardware in this Section.

I. Licensing: the system shall be bid to the owner as a “Turn-Key” system. It shall contain all and any necessary user licenses (at no additional cost) as required for a fully functioning system as specified.

J. Cyber Security: The system shall include provisions within its software designed to protect the various user data bases and control functions from attacks from the outside via cyber-space. System shall be configured, at the time when it is turned over to the owner, to protect against the most recent known threats.

**1.10 SUBMITTALS**

A. Floor plans showing the entire area with room numbers, locations for each device, riser diagram, point to point diagram, symbol of all devices being used. Indicate system components, location and provide full schematic of wiring system showing building, operation details.

B. Product Data: For each type of product supplied. Include operating characteristics, furnished specialties, and accessories. Reference each product to a location on Drawings or Specifications. Test and evaluation data presented in Product Data must comply with SIA BIO-01. Include submittals for, but not limited to the following:

a. System Management Software
b. Related Software(s)
c. System Licensing
d. Other peripheral equipment, as required
e. All associated cabling, as required

2. Shop Drawings:
a. Floor plan security device drawings with cable routing, as appliable.
b. Security signal-flow or one-line riser drawings, as applicable.
c. Diagrams for panel layouts in equipment rooms with cable management system.
d. Equipment schedules for head-end equipment, panels, and peripheral security devices.
e. System labeling schedules, including electronic copy of labeling schedules that are part of the cable.
f. Include typical wiring diagrams showing wiring schematics for each type of suppled panel:
1) Main control panel
2) Access control panels
3) Input output panels

C. Operation and Maintenance Manuals: Provide O&M Manuals and close-out information to include the following:
a. ACS O&M Manuals for all supplied software and equipment.
b. The Contractor will provide all software configuration files for any/all software utilized on the project.
c. Software must include system restore, emergency boot discs, and drivers for all installed hardware. Provide separately for each PC.
d. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
e. System installation and setup guides, with data forms to plan and record options and setup decisions.
f. Commissioning final test results.
g. Warranty information.
h. Contractor’s contact information for emergency service warranty work.

**1.11 DELIVERY, STORAGE, AND HANDLING**

1. Workstations, and Controllers:
a. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50° and 85° F, and not more than 80 percent relative humidity, noncondensing.

b. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
c. Mark packing list with appropriate designations assigned to materials and equipment for recording in a system labeling schedule.
d. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

**PART 2 - PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

1. Basis of Design listed manufacturer or product:
   a. The Basis of Design listed equipment shall serve as a “minimum standard” of functionality.
   b. Any product substitutions must meet all requirements of Prior Approval, as outlined in the contract documents. Substitutions that meet Prior Approval requirements must be listed as an Alternate by addendum.
2. Access Control System (ACS)
   a. The Basis of Design ACS solution shall be:
      1) Lenel OnGuard platform and shall utilize Mercury Security hardware.
      2) No substitutions

B. For ancillary devices, a “Basis of Design” product may be listed along with acceptable alternate manufacturers; in as much as that the alternate product meets all minimum criteria of the Basis of Design product.

**2.02 ACCESS CONTROL SYSTEM (ACS) HARDWARE**

1. Hardware controllers shall be Linux based platform.
2. Intelligent Controller (IC). The IC shall include the following capabilities:
   a. Multi-card & Multi-reader Technology support
      1) 8 active card formats per IC
      2) OSDP Reader Integration (V.2)
   b. AES 128- or 256-bit data encryption
   c. MSP1 Encryption
   d. HSPD-12/FIPS201 capable
   e. UL 294 recognized
   f. On-board memory to support:
      1) 2,000,000 user records
      2) 50,000 transactions (event buffer)
   g. 255 Access levels
   h. High Assurance Credential Authentication
   i. BACnet compliant for connection & control of building automation systems
   j. Basis of Design:
      1) Lenel LNL-X2220 Intelligent Dual Reader Controller (IDRC)

2) Lenel LNL-1320 Series 3 Dual Reader Interface (DRI)
3) Lenel LNL-1300 Series 3 Single Reader Interface (SRI)

3. Input Output (I/O) Controllers:
   a. Provide I/O devices as required to provide for all door requirements at each equipment room location.
      1) Provide 10% spare capacity at each central equipment location to allow growth without adding more panels.
   b. Provide in combination from the following devices to meet the door control and input device requirements for each equipment location.
      1) Lenel LNL-1000 Series 3 Input Control Module (ICM), 16 inputs
      2) Lenel LNL-1200 Series 3 Output Control Module (OCM), 16 outputs
4. Wall-Mount Cabinets:
   a. Contractor shall utilize the larger size cabinet for their controllers to allow better working space within.
   b. Provide cabinets as provided by or recommended by the ACS System manufacturer.
   c. All cabinets/boxes shall include tamper switches.
   d. Basis of Design Manufacturer:
      1) LifeSafety Enclosure Products, EM Series
      2) Approved equivalent
5. Card Reader:
   a. Provide wall mount and/or mullion mount card readers as shown on the drawings. Card readers shall be sized and selected to fit the available space and shall be approved in advance before purchase.
   b. Card reader shall be multi-tech 13.56MHz / 125kHz proximity technology and shall read encoded data from access cards and transmit the data to the ICs.
   c. Shall be compatible with multiple formats including Seos, iClass, iClass SE, MIFARE, DESFIRE, HID Prox, AWID, and EM Prox.
   d. A two-color LED on the face of the card reader and an audible tone shall indicate authorized and unauthorized reader uses.
   e. Shall be compatible with Owner’s existing credentials in use.
   f. Basis of Design Manufacturer:
      1) HID Signo Reader 40, standard reader
      2) HID Signo Reader 20, mullion mount reader
      3) HID Signo 40K, standard reader with keypad
6. Door Contact:
   a. Provide door contacts as shown on the drawings.
   b. Shall be connected to the ACS system.
   c. Basis of Design:
      1) Recessed Contact: Interlogix 1078C Series

2) Surface Mount Contact: Interlogix 1085T Series
3) Overhead Door Contact: Interlogix 2202AU Series
4) Approved equivalents

7. Request to Exit Motion Device
   a. Provide RTE Motion as shown on the drawings.
   b. Shall be connected to the ACS system.
   c. Basis of Design:
      1) Bosch DS160 Series
      2) Approved equivalent
8. Duress Alarm Button:
   a. Provide panic buttons as shown on the drawings.
   b. Shall be connected to the ACS system.
   c. Basis of Design:
      1) Honeywell 269R
      2) Approved equivalent
9. Power Supply:
   a. Provide centrally located power supplies as required to power security equipment, peripheral devices, and electrified door hardware.
   b. Locks and security devices shall be powered @ 24V DC.
   c. All power supplies shall be supervised through the ACS system.
   d. Basis of Design Manufacturer:
      1) Altronix 600 series or approved equal.
      2) Provide PD8CB's for all power supplies.

**2.03 APPLICATION SOFTWARE**

A. Contractor is responsible to provide, install, configure, and test any or all of the ACS System's capabilities, based on the project planning process described in Paragraph 3.2.

B. One of the ACS's primary purposes shall be to provide access control. The ACS shall be able to make access granted or denied decisions, define access levels, and set time zones and holidays. An input or output linkage feature shall allow linking of monitor zone points to output control points within Intelligent System Controllers (ISCs). The ACS shall support features such as area control (two- man control, hard, soft, and timed anti-passback), database segmentation, and Time zone or holiday overrides.

C. The ACS shall be capable of complete Credential Production and Management. The ACS shall offer seamlessly integrated credential management module. The credential management functionality should be configured to permit the enrollment of cardholders into the database, capturing of images from video, biometric data, and signatures, as well as the import or export of employee data. This functionality shall also allow the System Operator to assign and/or modify the access rights of a cardholder.

D. Alarm Monitoring: The main Alarm Monitoring window shall provide information about the time and location of the alarm, along with its priority. The main Alarm Monitoring window must be able to sort pending and/or insert new alarms based on any of the following attributes: priority, date or time, alarm description, Intelligent System Controller, Card Reader, Input Control Module, asset name, or cardholder. Date or time sorts must be System Operator selectable to be either ascending or descending and must have the option of displaying the seconds of the minute in which the alarm arrived at the ACS.

E. Digital Video Management: The ACS shall be seamlessly integrated to a digital video management module. It shall support real-time linkage of digital video clips to their associated alarms as well as those from linked devices in the ACS database, Access Control hardware for example. This linkage shall happen automatically as defined by the configuration.
    a. The SMS shall support API integrations with multiple, third party, industry standard VMS manufacturers.
    b. Where applicable, System Administrators shall define parameters for video segment creation by specifying pre-alarm and post-alarm durations. The system shall automatically associate alarms from linked hardware with the linked camera's pre and post-alarm durations.

F. Third-Party Interfaces: The ACS shall provide seamless integration with a variety of 3rd party systems. The ACS shall allow alarms and events from the third-party systems to report into the same main Alarm Monitoring window as access control alarms. Third-party interface hardware shall be configured in the ACS access control module. In some cases, System Operators shall be able to control third-party hardware devices from the Alarm Monitoring Workstation. Third-party hardware alarms and events shall be stored in the ACS database for audit trail and reporting purposes.

G. The ACS shall support a real time, bi-directional data interface to external databases such as Human Resources, Time and Attendance, Food Service Systems. The interface shall allow data to be imported into or exported out of the ACS in real-time or in a batch mode basis. Data used for import shall be retrieved directly from an external database or through an import file. Data provided for export shall be applied directly to an external database or through an export file. Any data shall
    1. be imported or exported including image data. The file used for import or created by export shall have the ability to be structured in a wide variety of ways but shall always be in ASCII text format.

H. The ACS shall also support a one-step download and distribution process of cardholder and security information from the external database to the ACS database, all the way down to the Intelligent System Controller (ISC) database. This shall be a guaranteed process, even if the communication path between the ACS database and the ISC is broken. If the communication path is broken, the data shall be stored in a temporary queue and shall be automatically downloaded once the communication path is restored.

I. API Development Toolkit: The ACS shall allow, through API toolkits, System Administrators to expose specific ACS data and events that are relevant to IT information or other third-party

systems. Conversely, the ACS shall allow, through these same API toolkits, System Administrators to accept and process information exposed from the IT information or other third-party systems. This shall permit System Administrators to develop scripts and applications that allow events in either the IT domain to cause appropriate actions in the Security domain, and vice versa.

a. Integrator shall utilize Lenel professional services to develop and write any new custom API integrations which are required and provided for the project.

J. Scheduling Utility: An integral Scheduling Utility shall be provided. The Scheduling Utility shall allow System Administrators to schedule actions to occur on a one-time or a recurring basis. Recurring schedules shall be configured to begin immediately, last indefinitely, or have optional start and end dates.

a. The Scheduling Utility shall maintain a history log in the database for actions that it executes.

K. The ACS shall import and support .pdf, .dxf, & .rvt file extensions (minimum) for use as graphical display format of building layouts. The system shall support map hierarchies or maps within maps. There shall be no limit to the number of maps that shall be nested hierarchically with each other. Multiple maps may be displayed simultaneously

L. Contractor shall install and configure Integrated Intrusion Detection Interface as required. Provide seamless integration with intrusion detection panels. This shall allow for the ability to monitor intrusion detection alarms in real time inside the ACS alarm monitoring module and allow for command and control of supported intrusion detection. Once alarms are brought into ACS, they shall have the ability to be linked to digital video and/or global I/O, and they shall be stored in the ACS database.

M. Access Control System (ACS) Hardware is required to receive alarms and administer all access granted or denied decisions. All field hardware must be designed to meet UL 294 requirements. The ACS must be able to retrieve device serial numbers from all field hardware, excluding card readers, biometric readers, and keypads.

N. ACS Third-party Devices: The ACS shall interface at the software level via pre-developed interface package with select devices from any 3rd party manufacturers.

**2.04 ACS SERVER**

A. Integrate new ACS equipment to the associated NPS MWR Regional Dispatch Center's Lenel OnGuard Enterprise regional server, or to NPS MWR Lenel regional sever as directed by Owner.

1. NPS MWR Lenel regional servers are located at Mount Rushmore NP, Buffalo National River, Indiana Dunes NP, Gateway Arch NP, and Cuyahoga Valley NP.

B. New Lenel access control and alarm panels supplied for the project shall be connected to NPS network switches on site and communicate via LAN/WAN to the associated Lenel SMS regional server. Coordinate network connectivity requirements with NPS MWR IT personnel prior to work.

**2.05 SURGE AND TAMPER PROTECTION**

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.
    a. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Division 26 Section "Transient-Voltage Suppression for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components must initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display must identify tamper alarms and indicate locations.

**2.06 CABLES**

1. Supply manufacturer-recommended cable types for all equipment including:
    a. Category data cabling
    b. LAN/WAN communications cabling
    c. System interface cabling
    d. Access Control Composite cabling
    e. Door contacts
    f. Alarm device cabling
        1) Electrified door hardware PART 3 - EXECUTION

**2.07 EXAMINATION**

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, Controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.
    1. Proceed with installation only after unsatisfactory conditions have been corrected.

**2.08 PREPARATION**

A. Comply with TIA/EIA-606, "Administration Standard for the Telecommunications Infrastructure of Commercial Buildings."

B. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project Drawings and Specifications and publish as Project planning documents for review and approval.
    a. Record setup data for control station and workstations.
    b. For each Location, record setup of Controller features and access requirements.
    c. Propose start and stop times for time zones and holidays and match up access levels for doors.
    d. Set up groups, facility codes, linking, and list inputs and outputs for each Controller.

e. Assign action message names and compose messages.
f. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.
g. Prepare and install alarm graphic maps on VGUI at Master Control Stations.
h. Complete system diagnostics and operation verification.
i. Prepare a specific plan for system testing, startup, and demonstration.
j. Develop acceptance test concept and, on approval, develop specifics of the test.
k. Develop cable and asset management system details, input data from construction documents. Include system schematics and Visio Technical Drawings.

C. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

**2.09 GROUNDING**

1. Provide any required grounding as recommended by equipment manufacturers.

**2.10 INSTALLATION**

1. Install all devices in strict accordance with manufacturer's instructions.
   a. Contractor will configure System Administration
   b. Contractor will perform Screen or Forms Creation
   c. Contractor will perform Graphical Map Creation
   d. Contractor will configure Application Programming Interfaces
   e. Contractor will perform Data Import
   f. Contractor will Configure Archiving
   g. Contractor will Configure Cardholder Database
2. Access Control Software:
   a. Contractor will configure Time zones
   b. Contractor will configure Access Levels
   c. Contractor will configure Access Groups
   d. Contractor will configure Holidays
   e. Contractor will implement First Card Unlock
   f. Contractor will configure Field Hardware Communications
   g. Contractor will configure Area Control
   h. Contractor will perform Field Hardware Configuration
   i. Contractor will configure Cardholder Use Limits
   j. Contractor will configure Extended Individual Strike Times
   k. Contractor will configure Extended Individual Door Held Open Times
   l. Contractor will configure Extended, on Demand, Door Held Open Times
   m. Contractor will configure Guard Tour
   n. Contractor will configure Security Clearance Levels
   o. Contractor will configure Elevator Control:

B. Conductor terminations in control panels and panels to be made on terminal strips with a separate point for each conductor. All such strips to be number identified as shown in wiring diagram attached to inside of door of control panel. Connect wiring neatly to terminals strips. Place wire neatly in Panduit type wire channels. Set up termination of cabling so that section of the system may be isolated for servicing.

1. Wiring
    a. Wiring shall run continuous from device to termination destination. No splices shall be permitted except at terminal blocks installed in termination cabinets. The use of wire nuts or crimp type connectors shall not be permitted unless specifically approve by the Owner.
    b. Exposed cabling is not permitted. Exposed cabling shall be installed within surface raceway in finished areas, or within conduit in unfinished areas.
    c. Wiring shall be rated for the environment in which it is installed.
    d. Within equipment rooms at head-end equipment locations, install wiring within Panduit finger duct. Within termination and control panels install wiring in Panduit wiring channels.
    e. All wiring shall be installed and dressed in a neat and professional looking manor.
    f. Where shielded wire is used it shall be connected to an earth ground at the main panel. If recommended by manufacturer, data and signal wiring shall be run with shielded wiring.
    g. Minimum wire size shall be as recommended by manufacturer.
    h. Wiring installation shall comply with the following standards:
        1) National Electric Code (NEC)
        2) National Electric Safety Code (NESC)
        3) National Electrical Manufacturer’s Association (NEMA)
        4) Institute of Electrical and Electronic Engineers (IEEE)
        5) Electronic Industry Association (EIA)
        6) Telecommunications Industry Association (TIA)
        7) Occupational Safety and Health Act (OSHA)
        8) Building Officials and Code Administrators (BOCA)
        9) Local codes and ordinances in effect and having jurisdiction
        10) Requirements of local ISP and Telephone utility companies
        11) Published instructions set forth by supplied equipment manufacturers
2. Termination Cabinets
    a. Where termination cabinets are used, they shall be installed on walls or in walls in finished areas. Each termination cabinet shall have a hinged cover with a lock installed flush with the cover. These locks shall be keyed alike. Install a white 3/4" plywood backboard inside. Each termination cabinet shall be marked with a sign with

the words "sec. termination cabinet" attached to the front cover. This sign shall be constructed from red laminated plastic with 1/4" white engraved letters.

## 2.11 SYSTEM SOFTWARE

A. Develop, install, and test software and databases for the complete and proper operation of systems involved. Assign software license to Owner.

B. The Contractor will provide all software configuration files for all and any software utilized on the project

   1. Access Control Reports: Configure any and all reports available and requested.

C. Contractor configured Alarm Attributes: The System Administrator shall have the ability to configure how the ACS handles the annunciation of alarms on an individual basis.

   a. Contractor will configure Alarm-Event Mappings
   b. Contractor will configure System Downloads:
   c. Contractor will configure Card Reader Options
   d. Contractor will configure Input Control Module (ICM) Options
   e. Contractor will configure Entry or Exit Delay
   f. Contractor will configure Intelligent System Controller Options
   g. Contractor will configure Basic Integrated Intrusion Functionality
   h. Contractor will configure Alarm Monitoring
   i. Contractor will perform Alarm Annunciation Configuration
   j. Contractor will configure Real-Time, Dynamic Graphical Maps:
      1) Support graphical maps that display device or group status, function lists and video cameras dynamically in real-time. The maps may be configured to appear on command or when specified alarms are selected for acknowledgment. Map device icons shall have the ability to dynamically change shape and/or color to reflect the current state of the device. The ACS shall indicate if the field hardware is not operating with the most current version of firmware.

## 2.12 FIELD QUALITY CONTROL

A. Contractor: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

   1. Perform the following field tests and inspections and prepare test reports:

      a. LAN Cable Procedures: If the Category cable is provided as a part of this bid, the contractor shall inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 6 or 6A tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-568-1, "Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA-568-B. Comply with Section 27 15 00 Horizontal Cable.

      b. Test each circuit and component of each system. Tests must include, but are not limited to, measurements of power supply output under maximum load, signal loop

resistance, and leakage to ground where applicable. System components with battery backup must be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.

c. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

2. Remove and replace malfunctioning devices and circuits and retest as specified above.

**2.13 CABLE PROTECTION**

A. Cables shall not be exposed to paint, paint remover, water, or any liquids which may degrade the performance of the cable, void the manufacturer's warranty, alter the flame and/or smoke characteristics of the cable, or obscure the flame rating designations printed on the jacket. Cables exposed to paint, paint remover, water, or any liquid shall be replaced by the Contractor.

**2.14 DEMONSTRATION**

A. Prior to contract completion, the contractor shall provide comprehensive demonstration of the fully function system to owner/architect.

a. Notify the Contractor, Architect and Owner in writing 30 days prior to scheduling the demonstration.

**2.15 TRAINING**

A. The contractor is required to perform a minimum of 20 hours of training, broken up into two eight- hour training sessions allowing for the different government branches to attend at their convenience. The final four hours will be reserved as a follow-up session to correct misunderstandings, or for those who were previously unable to attend. Training shall cover all system functions, including (at a minimum) the following:

a. System setup.

b. System operation.

c. Credential creation.

d. Records keeping.

**2.16 CLOSEOUT**

A. Provide an additional 40 hours of on-site training, reprogramming, adjustment, and setup after final acceptance at the direction of the Owner for adjustments to the system.

**END OF SECTION**

## SECTION 28-23-00 - VIDEO SURVEILLANCE SYSTEM

### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section and the other sections of Division 28.

B. This section is inclusive to all Division 28 sections.

C. All of Division 28 shall be performed in full coordination with the Architect, and all trades representing Division 26, and Division 27, as applicable.

#### 1.02 SUMMARY

A. This project consists of modifications to an existing, operational Video Management System (VMS) for the Project, as shown on the Drawings and indicated in the Specifications. The scope of the project shall include all equipment, cabling, installation, software, programming and testing as required to support additions to the specified systems. Not all paragraphs contained in this section are directly applicable and are included for reference only.

B. Integrated VMS Solution: The VMS shall incorporate local Network Video Recorders (NVRs) and IP PoE cameras, and shall be integrated into National Park Service (NPS) Midwest Region (MWR) standard Milestone XProtect VMS solution, which utilizes centralized management servers based in Denver CO. The video system NVRs shall be networked, and shall communicate via dedicated security VLAN, coordinate all requirements with owner IT personnel.

C. Stand-Alone Video System: The VMS shall incorporate local Network Video Recorders and IP PoE cameras, and shall operate as stand-alone for the project site, as NPS does not have LAN/WAN connectivity to the site. The stand-alone video system shall utilize the National Park Service (NPS) Midwest Region (MWR) standard Milestone XProtect VMS platform.

D. The VMS shall be capable of integration with NPS MWR Lenel OnGuard Enterprise Security Management System (SMS) events such as security and duress alarms, and invalid card read events. If required for project, integrate SMS alarm events with the Milestone VMS System.

E. Major raceway, outlet boxes and 120-volt power (including power to the outdoor cameras) shall be provided by Division 26 contractor.

F. Specifications include, but may not limited to the following:

1. System Management Software
2. Related Software(s)
3. System Licensing
4. Recording servers
5. Network video recorders
6. Client monitoring station
7. Security cameras and mounts
8. Power supplies

9. Peripheral devices
10. TVSS devices
11. All control wiring and power wiring

G. All equipment, wiring, and operation of the system shall comply with local and state ordinances and UL Standards for Safety.

H. Permits, Inspections, Codes and Regulatory References
1. General: Contractor shall obtain and pay for all permits and inspections required by laws, ordinances, rules, and regulations having jurisdiction for work included under this Contract and shall submit approval certificates to the Owner.
2. Codes: The cabling system installation shall comply fully with all local, county and state laws, ordinances, and regulations applicable with electronic and electrical installations.
3. If there is a conflict between applicable documents, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.
4. This document does not replace any code, either partially or wholly. The contractor must be aware of local codes that may impact this project.

**1.03 QUALITY ASSURANCE**

A. Installation shall comply with all applicable codes and standards.

B. All equipment shall be new, in current production, the standard products of an acceptable manufacturer.

C. The manufacturer shall guarantee the availability of parts for a minimum of (5) years from date of shipment. All equipment and software shall be the latest version available from the manufacturer.

D. The manufacturer shall be able to demonstrate the features, functions, operating characteristics, and clarity of picture to the Owner.

E. The system shall be installed by a factory authorized, and trained, Security System Installer.

F. Maintenance and repair service shall be available locally and within (4) hours of notification for emergency conditions.

G. Design Verification and Acceptance
1. The contractor is responsible for verifying the accuracy of the system designs documented in the Specification and Drawings and acceptance of responsibility. Any issues, discrepancies substitutions, or exceptions to the contract documents by the Contractor shall be communicated to the Owner prior to the purchase of any equipment or materials by way of the Shop Drawings Submittal process. Upon approval of the Contractor’s Shop Drawing Submittal by the Owner's designated representative, or if the Contractor fails to submit Shop Drawings, the Contractor shall assume all responsibility for supplying such materials and taking such actions as to satisfy the full intentions of the contract documents without claim for additional compensation. This shall include providing any incidental equipment,

a. Installation Materials and labor needed in order to result in a complete and operable system, even if such equipment, materials, or labor are not listed in this Specification. Exceptions include Owner-requested changes, unexpected field issues due to work by other trades, or schedule changes initiated by others.

H. Equipment and accessories furnished under the terms of this specification shall be the standard products of manufacturers regularly engaging in the manufacture of this type of product(s) for a period of at least three years.

I. All products within this bid, deemed by the manufacturer as “End of Life” at the time of installation shall be replaced with the next generation replacement in kind, at no additional cost to the owner.

**1.04 WARRANTY**

A. Provide complete written warranty information for each item to include date of beginning of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

B. Any material, equipment, or appurtenance whose operation or performance does not comply with the requirements of the Contract or any equipment which is damaged prior to acceptance will be held as defective and shall be removed and properly replaced at no additional cost to the Owner.

C. The system shall be warranted for a period of one year from date of owner acceptance.

D. Refer to Division 01 for additional warranty requirements.

**1.05 PROJECT DRAWINGS AND SPECIFICATIONS**

A. The Contractor shall carefully examine the Drawings and Specifications of all trades and report all discrepancies to the Owner in writing to obtain corrective action. No departures from the Contract Documents will be made without prior written approval from the Owner.

B. Questions or disputes regarding the intent or meaning of Contract Documents shall be resolved by the interpretation of the Owner. The Owner’s interpretation is final and binding.

C. The Drawings and Specifications are not intended to define all details, finish materials, and special construction, which may be required or necessary. The Contractor shall provide all installations complete and adequate as implied by the project documents.

D. Drawings are diagrammatic only and do not show exact routes and locations of equipment and associated wiring. The Contractor shall verify the work of all other trades and shall arrange his work to avoid conflicts. In the event of a conflict, the Contractor shall obtain corrective action from the Owner.

E. If there is a conflict between contract documents, the document highest in precedence shall control. The precedence shall be: first; permits from agencies as required by law, second; special provisions, third; specifications, fourth; drawings, fifth; reference specifications and sixth; vendor submittals.

**1.06 COOPERATION AND COORDINATION WITH OTHER TRADES**

A. This contractor shall be responsible for all cross connecting and coordination with vendors and other trades to provide a complete operational system. Coordination shall include Division 26 and Division 27 contractors, as applicable.

B. Coordination with Owner:
   1. Coordinate all work and technical requirements with owner during planning and pre-construction phases of the project.
   2. Coordinate all final equipment locations with owner prior to work.
   3. As required to facilitate Ethernet communications for new equipment, coordinate all networking requirements with owner IT prior to installation of equipment. All IT network switches or ports required for LAN/WAN connectivity shall be provided by owner. The system shall communicate via dedicated security VLAN, coordinate all requirements with owner IT personnel.
   4. As required, coordinate decommissioning or removal of any existing equipment with owner prior to work.
   5. Existing equipment which is removed during construction shall be turned over to owner unless owner directs otherwise.

**1.07 SUBMITTALS**

A. Floor plans showing the entire area with room numbers, locations for each device, riser diagram, point to point diagram, symbol of all devices being used. Indicate system components, location and provide full schematic of wiring system showing building, operation details.

B. Product Data: For each type of product supplied. Include operating characteristics, furnished specialties, and accessories. Reference each product to a location on Drawings or Specifications. Test and evaluation data presented in Product Data must comply with SIA BIO-01. Include submittals for equipment supplied, but not limited to the following:
   1. System Management Software
   2. Related Software(s)
   3. System Licensing
   4. Recording servers
   5. Network video recorders
   6. Client monitoring station
   7. Cameras and mounts
   8. Power supplies
   9. Peripheral devices, as required
   10. TVSS devices
   11. All associated cabling, as required

C. Shop Drawings:
   1. Floor plan security device drawings with cable routing, as appliable.
   2. Security signal-flow or one-line riser drawings, as applicable.
   3. Equipment schedules for head-end equipment and peripheral security devices.

4. System labeling schedules, including electronic copy of labeling schedules that are part of the cable.

D. Operation and Maintenance Manuals: Provide O&M Manuals and close-out information to include the following:
   1. SMS O&M Manuals for all supplied software and equipment.
   2. The Contractor will provide all software configuration files for any/all software utilized on the project.
   3. Software must include system restore, emergency boot discs, and drivers for all installed hardware. Provide separately for each PC.
   4. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.
   5. System installation and setup guides, with data forms to plan and record options and setup decisions.
   6. Commissioning final test results.
   7. Warranty information.
   8. Contractor’s contact information for emergency service warranty work.

**1.08 DELIVERY, STORAGE, AND HANDLING**

A. Workstations, and Controllers:
   1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50° and 85° F, and not more than 80 percent relative humidity, noncondensing.
   2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.
   3. Mark packing list with appropriate designations assigned to materials and equipment for recording in a system labeling schedule.
   4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

**PART 2 - PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

A. Basis of Design listed manufacturer or product:
   1. The Basis of Design listed equipment shall serve as a “minimum standard” of functionality.
   2. Any product substitutions must meet all requirements of Prior Approval, as outlined in the contract documents. Substitutions that meet Prior Approval requirements must be listed as an Alternate by addendum.

B. Video Management System (VMS)
   1. The Basis of Design VMS solution shall be:
      a. Milestone XProtect Professional+ VMS solution
      b. No substitutions

2. The Basis of Design Camera products shall be:
    a. Axis Communications
    b. Hanwha Techwin
    c. Pre-approved equivalent

C. For ancillary devices, a “Basis of Design” product may be listed along with acceptable alternate manufacturers; in as much as that the alternate product meets all minimum criteria of the Basis of Design product.

**2.02 EQUIPMENT**

A. Network Video Recorder (NVR)
1. Provide system recording server hardware and software to support the VMS database applications and camera recording as required. Provide all associated system licensing.
2. Locate NVR where coordinated with Owner.
3. NVR shall record and store video for all cameras indicated on the drawings. Video from each camera shall be stored and available for no less than 30 days. Provide recording server sized as required.
4. Provide recording server with enterprise level, video surveillance-grade SATA storage in minimum RAID 5 configuration.
5. Server hardware/software shall meet or exceed minimum technical requirements as recommended by the VMS manufacturer for the designed camera system.
6. NVR shall be capable of automatically transferring recorded video to alternative, centralized back-up storage devices for longer term storage, if required by Owner.
7. Provide all associated system licensing for camera and recording devices.
8. Basis of Design NVR:
    a. BCDVideo Professional Series BCD104-PVS Recording Server
    b. RAID 5 Configuration
9. Provide dedicated security UPS to support the NVR:
    a. Shall support the equipment load for 30-minute run time, plus 20% capacity.
    b. Basis of Design: APC Smart UPS, sized as needed.

B. Interior Fixed IP Dome Camera, Standard
1. Ceiling or surface-wall mounted camera
    a. Provide recessed ceiling mount kit where possible
2. 1080p resolution
3. Varifocal 3.0-10.5mm lens, f1.4
4. Remote zoom and focus
5. Wide Dynamic Range (WDR)
6. Day/Night
7. Low-light capable
8. ONVIF compliant
9. Up to 30fps image rate

10. PoE power
11. Tamper resistant housing
12. Manufacturer:
    a. Axis P3245-V
    b. Hanwha Techwin equivalent
    c. Approved equivalent
        1) Interior 360 Degree Dome Camera
        2) Ceiling mounted camera
    d. Provide recessed ceiling mount kit where possible
13. 12MP resolution
14. 1.65mm lens, f2.8
15. Wide Dynamic Range (WDR)
16. Low-light capable
17. ONVIF compliant
18. Up to 30fps image rate
19. PoE power
20. Tamper resistant housing
21. Manufacturer:
    a. Axis M3068-P
    b. Hanwha Techwin equivalent
    c. Approved equivalent

C. Exterior Fixed IP Dome Camera, Standard
1. Surface-wall or wall-arm mounted camera
2. 1080p resolution
3. Varifocal 3.0-01.5mm lens, f1.4
4. Remote zoom and fucus
5. Wide Dynamic Range (WDR)
6. Day/Night
7. Low-light capable
8. ONVIF compliant
9. Up to 30fps image rate
10. PoE power
11. Tamper resistant housing
12. Outdoor environmental dome
13. Manufacturer:
    a. Axis P3245-VE
    b. Hanwha Techwin equivalent
    c. Approved equivalent

D. Exterior 180˚ IP Camera
    1. Exterior surface-wall or wall-arm mount camera
    2. Multi-sensor dome camera, panoramic
    3. Minimum 8-megapixel resolution, total
    4. 180° field of view
    5. Remote Zoom & Focus
    6. Wide Dynamic Range (WDR)
    7. Day/Night
    8. Low-light capable
    9. ONVIF compliant
    10. Up to 30fps image rate
    11. PoE power
    12. Outdoor environmental dome
    13. Manufacturer:
        a. Axis P3807-PVE
        b. Hanwha Techwin equivalent
        c. Approved equivalent

E. Exterior 270˚ or 360˚ IP Camera with IR
    1. Exterior wall-arm mount camera
    2. Multi-sensor dome camera
    3. Minimum 8-megapixel resolution, total
    4. Up to 360° field of view
    5. Remote Zoom & Focus
    6. Wide Dynamic Range (WDR)
    7. IR illumination
    8. Day/Night
    9. Low-light capable
    10. ONVIF compliant
    11. Up to 30fps image rate
    12. PoE power
    13. Outdoor environmental dome
    14. Manufacturer:
        a. Axis P3717-PLE
        b. Hanwha Techwin equivalent
        c. Approved equivalent

F. Exterior PTZ IP Dome Cameras
    1. Exterior wall-arm mount camera
    2. 1080p resolution

3. Lens min 4.7-84.6mm, automatic focus
4. Minimum 18x optical zoom / 12x digital zoom
5. Remote Pan, Tilt, Zoom, & Focus
6. Wide Dynamic Range (Wide-D)
7. Day/Night
8. Low-light capable
9. ONVIF compliant
10. Up to 30fps image rate
11. PoE or higher, provide power injector if required
12. Outdoor environmental dome, for exterior locations
13. Manufacturer:
    a. Axis P5415-E PTZ Dome
    b. Hanwha Techwin equivalent
    c. Approved equivalent

G. Power over Ethernet Midspan Injector (PoE+/HPoE)
1. For camera models requiring PoE+ or HPoE power input, provide appropriate midspan power injector.
2. Power injector shall meet minimum requirements of associated camera models.
3. May be single channel unit or be multi-channel rack mount type for space efficiency.
4. Locate midspan power injectors in telecom equipment rooms within associated IT racks.
5. Coordinate location in IT racks with Owner.
6. Manufacturer:
    a. Axis T8133 30W Midspan
    b. Or as recommended by camera manufacturer

H. Client Monitoring Station Minimum Requirements:
1. Coordinate final equipment location with Owner.
2. Provide all hardware and software, as recommended by SMS Manufacturer.
3. Dell OptiPlex 3070 Small Form Factor
4. Intel Core i3-9100 (4 Cores, 6MB, 4TB, 3.6GHz to 4.2GHz)
5. Microsoft Windows 10 IoT Enterprise 2016 EMB
6. 4GB (1 x 4GB) RAM DDR4 2666MHz UDIMM Non-ECC
7. RJ45 Ethernet Port NIC
8. 8x DVD+/-RW 9.5mm Optical Drive
9. PERC H740 Integrated RAID Controller, 8GB NV Cache
10. Operating System Drives: 500GB 2.5in Serial ATA (7,200 Rpm)
11. Intel Integrated Graphics Card, OptiPlex, DisplayPort to DVI Single-Link
12. OptiPlex 3070 Small Form Factor with 200W Power Supply
13. Surge Suppressor

14. Internal Speaker
15. Mouse and Keyboard Support

I. Display Monitor Minimum Requirements:
   1. Provide (2) 24” monitors with each client station
   2. 1920 x 1200 @ 60Hz native resolution
   3. 16.7 million colors
   4. Contrast ratio 1000:1
   5. 1 x DP, 1 x HDMI, 1 x USB-C
   6. 120VAC operation
      a. Shall be Dell U2421E, or approved equivalent PART 3 - EXECUTION

**2.03 INSTALLATION**

A. The systems shall be installed and configured per the drawings and as specified herein.

B. The camera setup shall be setup, aimed, and focused in coordination with the Owner.
   1. Contractor shall configure the camera, transceiver (where required), and power supply to optimize the installation process. The power supply shall be selected and configured to accommodate all devices as required to meet the design requirements.
   2. Where cameras are installed such that the distance is too great to meet the Cat 6 100-meter limit, the contractor shall utilize a combination of twisted pair for power and Multimode fiber for connectivity.

C. Installation shall be accomplished in a professional manner by qualified personnel regularly engaging in and experienced in this type of work for a period of at least 5 years.
   1. Where applicable, all Category cabling shall be CAT6A, unless otherwise indicated. Confirm Category cabling criteria with Owner prior to bid.
   2. Where applicable, the successful bidder shall coordinate cable, patch panel, patch cords, etc. with the on-site Division 27 contractor for installation within the telecom rooms as required.

D. All control locations shall have complete full function control of each camera.

E. All fixed lens cameras to be adjusted to the satisfaction of the Owner.

F. Junction boxes to be provided as required to properly install cameras.

G. System shall be completely integrated with the existing VMS and configured for full operation. Confirm final requirements with Owner.

H. All custom software shall become the property of the Owner upon final payment with no special or hidden keys preventing updating of the software.

I. Licensing: the system shall be bid to the owner as a “Turn-Key” system. It shall contain all and any necessary user licenses (at no additional cost) as required for a fully functioning system as specified.

J. PC’s, monitors, power supplies, NVR etc. to be securely rack-mounted in monitoring locations.

K. Wiring

1. Wiring shall run continuous from device to termination destination. No splices shall be permitted except at terminal blocks installed in termination cabinets. The use of wire nuts or crimp type connectors shall not be permitted unless specifically approve by the Owner.
2. Exposed cabling is not permitted. Exposed cabling shall be installed within surface raceway in finished areas, or within conduit in unfinished areas.
3. Wiring shall be rated for the environment in which it is installed.
4. All wiring shall be installed and dressed in a neat and professional looking manor.
5. Minimum wire size shall be as recommended by manufacturer.
6. Wiring installation shall comply with the following standards:
    a. National Electrical Code (NEC)
    b. National Electric Safety Code (NESC)
    c. National Electrical Manufacturer's Association (NEMA)
    d. Institute of Electrical and Electronic Engineers (IEEE)
    e. Electronic Industry Association (EIA)
    f. Telecommunications Industry Association (TIA)
    g. Occupational Safety and Health Act (OSHA)
    h. Building Officials and Code Administrators (BOCA)
    i. Local codes and ordinances in effect and having jurisdiction
    j. Requirements of local ISP and Telephone utility companies
    k. Published instructions set forth by supplied equipment manufacturers

L. Labeling
1. Attach to the interior of each control panel a clear plastic holder in this holder place a typed list of the zone numbers and/or area for each camera, the type of camera and all accessories (make and model numbers) with any other information required for ordering replacements. This list shall be typed on 8-1/2" x 11" paper provide a copy of these list(s) on CD/DVD in Microsoft Word compatible format to the Owner.
2. Where junction boxes are installed in concealed areas in the ceiling the box shall have the words "sec. system" attached to the cover. At the access point to the junction box there shall be a sign with 1/4" letters attached to the T-bar grid, this sign shall state "sec. terminal" and shall be constructed from red laminated plastic with white engraved letters. Where the ceiling is solid, the sign shall be attached at the access door nearest to the junction box.

M. Conduits
1. Minimum conduit size for multiple conductor runs shall be 1".

**2.04 SYSTEM VERIFICATION**

A. The security equipment supplier shall make a thorough inspection of the complete installed system including all components to insure the following:
1. Complete and functional system.
2. Underwriters Laboratories requirements.

3. Installed in accordance with manufacturer's recommendations.
    a. Regulations covering supervision of components are adhered to.

**2.05 TESTING AND GUARANTEE**

A. Guarantee all wiring and equipment free from inherent mechanical and electrical defects for a period of one (1) year from the date of the installation and acceptance of the Owner. Upon notification of request for warranty service, respond within four hours. If the problem cannot be corrected at that time, present a written plan of correction to the Owner's Plant Operations and Maintenance personnel detailing the problem, the course of action, and a time schedule for correction.

B. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Submit prior to request for final payment.

C. Test each camera type for its specific capabilities and verify integration with the Milestone XProtect system.

D. Provide 4 hours of on-site instruction to the Owner with regard to proper use and operation of the system. Provide class syllabus as a submittal. Also provide video system operations and maintenance instructions.

E. Provide an additional 4 hours of on-site training, reprogramming, adjustment, and setup after final acceptance at the direction of the Owner for adjustments to the system.

F. Operations and Maintenance Manual: Shall include manufacturers data sheets; maintenance and operation information sheets; as-built drawings showing the final Owner's room numbers; a separate sheet listing all the zones, and other devices, their locations, and the exact and specific function of the device as to what it actually is monitoring or operating and any other information available that pertains to the system construction, operation, or maintenance. A copy of this listing of all the zones, or other devices and their functions shall be provided on a CD or DVD in Microsoft Word format. As-built drawings shall be provided on a CD or DVD.

**END OF SECTION**