

**PROJECT MANUAL for**

# **RENOVATIONS TO THE STANTON MIDDLE SCHOOL**

**1800 LIMESTONE ROAD, WILMINGTON, DE 19804**

EIA Project No. PP7651

**for the**

# **RED CLAY CONSOLIDATED SCHOOL DISTRICT**

**1502 SPRUCE AVENUE, WILMINGTON, NEW CASTLE COUNTY, DELAWARE 19805**

**April 20, 2015**

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**VOLUME 2**

**SPECIFICATIONS: DIVISIONS 02 to 26**

SECTION 02 4119 - SELECTIVE DEMOLITIONPART-1 GENERAL1.01 Summary:

- A. This Section includes, but is not limited to, the removal or demolition of certain parts of existing construction, such as site amenities, utilities, building structures, finishes, equipment, materials, HVAC systems, plumbing systems, sprinkler systems, and electrical systems, and the provision of incidental and related repairs thereto, as called for in the Drawings and Specifications or as required to accommodate the installation of new work of each Contract.
1. In areas to be demolished, Owner will, unless indicated otherwise, remove or relocate to a protected area existing furnishings and equipment that are not fixed or attached to the building or its systems.
  2. Prior to start of demolition operations, review materials and equipment to be removed with Owner to identify or verify all items that are to be salvaged and remain the property of Owner, either for reinstallation or transfer to storage.
  3. "Systems" shall be understood to include the contents thereof or attachments thereto, such as water, steam, glycol, refrigerant, insulation, fittings, tags, controls, etc.
- B. Demolition work indicated or called for in the Drawings and Specifications is intended for general location and description only, and shall not be construed as a limit or extent of the work required. Each Contractor shall demolish, dismantle, or otherwise remove, as indicated, existing structures, systems, equipment, materials or appurtenant parts in their entirety or to such minimum extent as is required to accommodate the new work.
- C. Demolition Repair Responsibility: Unless otherwise indicated, the patching and repair of existing construction from which existing components, equipment or assemblies are being removed, and which is otherwise intended to remain undisturbed, shall be the responsibility of the Contractor performing the demolition work. Refer also to Division 01 Section "Execution,".
- D. Cutting and patching of openings into existing work required for installation of new mechanical, plumbing, and electrical equipment is generally included in the work of those various separate contracts. Refer to Division 01 Section "Execution."
- E. Except as indicated otherwise, removal of existing plumbing, HVAC, and electrical system components is included in the work of those various separate contracts.
1. The General Contractor shall determine, to his satisfaction, that such utilities serving the areas of general demolition are properly shut-off, removed or terminated as necessary before proceeding with his own demolition work.
- F. Related Sections:
1. Division 01 Sections "Summary," "Summary of Multiple Contracts" and "Temporary Facilities and Controls" for general requirements regarding work restrictions, existing utilities, temporary protection measures, warnings, and barriers.
  2. Sections in other Divisions for specific demolition requirements applicable to particular parts of the Work.
- G. Asbestos-Content Materials: Upon written request, the Owner will make a copy of the current asbestos report available to the Contractor. If any Contractor encounters materials designated for

demolition or removal that he suspects contain asbestos and that are not identified in the Contract Documents as asbestos-containing materials, said Contractor shall notify the Owner, in writing, and Owner will have material tested. If said material contains asbestos, Owner shall have material removed at no cost to the Contractor.

1. Unless indicated otherwise, a separate contract for abatement or removal of asbestos-containing materials on this Project, prepared by another design professional than the Architect, will be awarded by the Owner.

## PART-2 PRODUCTS

### 2.01 Materials:

- A. New materials required for repairs incidental to the performance of demolition work shall be as specified in other Sections of the Specifications.

## PART-3 EXECUTION

### 3.01 Performance of Removal and Demolition Work:

- A. The means, methods and procedures employed in the execution of demolition work shall be at the Contractor's discretion and risk.
  1. The Contractor shall be responsible for all damage or injury resulting from such means, methods or procedures, including, but not limited to, those caused by the fall or collapse of any part or portion of the structure resulting from his operations or failure to provide proper protections.
  2. If such means, methods or procedures are, in the Architect's or Owner's opinion, causing excessive residual damage to other parts of the building, the Owner may cause such operations to cease until other suitable methods are employed and maintained.
  3. Contractor shall immediately notify the Architect of the questionable stability of any part of the structure and shall not proceed with that part of the work.
- B. Each Contractor is responsible to establish a schedule, coordinated with all other Contractors and satisfactory to the Owner, for performance of his demolition work, and shall obtain all approvals and permits required for such work, and, unless otherwise stipulated elsewhere, shall pay all related costs.
- C. Demolition operations shall be confined to the Owner's property. Each Contractor shall be responsible for any intrusion on, or damage to, adjacent properties due to his operations.
- D. Each Contractor shall provide and maintain such temporary barriers or enclosures as may be required to confine residual dust and debris within the area of his demolition work. Debris may be water sprinkled to lay the dust.
- E. Each Contractor shall erect and maintain all bracing, shoring, needles, and other supports necessary to prevent collapse or displacement of any part of the structure or site during performance of his demolition work, until the permanent construction has been repaired or otherwise reinforced.
- F. Existing materials and equipment to be removed and reinstalled as part of the Project or transferred to Owner's storage shall be salvaged, handled and retained as Owner's property as

specified in Article 3.02. Existing materials and equipment to be removed but not designated to be retained as Owner's property shall become the property of the Contractor and shall be promptly removed from the site to a legal, off-site location of Contractor's selection and convenience at no increase in Contract Sum or Time.

- G. Existing materials, equipment, and casework indicated for removal or demolition shall, unless otherwise indicated, have all plumbing, heating, ventilating, and electrical work pertinent to the existing installation disconnected and removed by the respective Contractor for said trades. Such services and connections shall be removed to the point required to permit removal of the indicated construction and installation of new work.
- H. Existing materials, structures, equipment and other portions of the existing property to be demolished or otherwise removed shall be removed to the extent indicated, or if not specifically indicated, to the minimum extent required to permit proper placement and installation of new work.
- I. Combustible materials that are removed and not retained as Owner's property shall be taken out of the building as demolition progresses. Do not allow such materials to accumulate inside overnight.
- J. No on-site burning is permitted.
- K. Demolished materials shall not be permitted to accumulate on site unless otherwise indicated or allowed by Owner/Architect.

### 3.02 Salvaging Existing Materials, Equipment and Components:

- A. Existing materials, equipment and components designated to be retained as Owner's property, either for reinstallation as part of the Project or transfer to Owner's storage, shall be removed in a careful, workmanlike manner to minimize damage to functional parts, assemblies or finishes and to prevent defects or damage which will detract from or impair their usefulness. Additional salvage requirements apply when specified elsewhere in the Specifications or Drawings.
- B. Items to be Reinstalled as Part of the Project:
  - 1. Remove and protectively store items prior to reinstallation. Rehabilitate items where indicated elsewhere in the Drawings or Specifications. Reinstall where indicated on Drawings. Protect, clean and otherwise treat reinstalled items as if new, prior to Owner's acceptance and occupancy.
  - 2. Remove and reinstall as part of Project the items (if any) indicated elsewhere in the Drawings or Specifications.
- C. Items to be Transferred to Owner's Storage:
  - 1. Remove, deliver and place items in a storage location designated by Owner or in location designated by the Drawings or Specifications.
  - 2. Remove and transfer to Owner's storage the items (if any) indicated elsewhere in the Drawings or Specifications or designated by Owner during pre-demolition review.

END OF SECTION



SECTION 04 2000 - UNIT MASONRY ASSEMBLIESPART-1 GENERAL1.01 Summary:

- A. This Section includes unit masonry assemblies consisting of the following:
  - 1. Concrete masonry units (CMU), including but not limited to the following:
    - a. Standard, matte-face gray units.
  - 2. Mortar and grout.
  - 3. Joint reinforcement and reinforcing steel.
  - 4. Miscellaneous masonry accessories.
- B. Related work specified in other Sections:
  - 1. Divisions 05, 08, 10, 22, 23, and 26 for furnishing of miscellaneous items built into masonry assemblies under the work of this Section.
- C. Cutting through or into existing masonry construction for openings and chases required in the demolition and installation work of the various mechanical and electrical trades, and the subsequent repair and restoration thereto, is the responsibility and a part of the work of those various separate mechanical and electrical contracts.

1.02 Definitions:

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.03 Performance Requirements:

- A. Provide unit masonry that develops indicated net-area compressive strengths ( $f'_m$ ) at 28 days.
- B. Determine net-area compressive strength ( $f'_m$ ) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.04 Submittals:

- A. Product Data: Manufacturer's technical descriptive information, standard construction details, dimensions of components, and specifications for each type of masonry unit, accessory and other product indicated.
- B. Material Certificates: Submit affidavits, executed by material suppliers and masonry unit manufacturers, certifying that materials and units for use in this Project comply with the requirements of the Specifications, including compliance with standards and type designations within standards. These affidavits shall contain the company name of the material supplier or unit manufacturer, the signature of an authorized company representative, the name of the project, and the type of materials or units. Provide for each type and size of the following:
  - 1. Masonry units.
    - a. Include material test reports from a qualified testing agency substantiating compliance with requirements.

- b. For masonry units used in structural masonry, include data establishing average net-area compressive strength of units.
  - 2. Cementitious materials. Include brand, type, and name of manufacturer.
  - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 4. Reinforcing bars.
  - 5. Joint reinforcement.
  - 6. Anchors, ties, and metal accessories.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
  - 1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
  - 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

#### 1.05 Quality Assurance:

- A. Installers' Qualifications: Masonry work shall be performed only by competent, skilled masonry mechanics of proven abilities, employing the latest accepted and recommended practices established by the National Concrete Masonry Association (NCMA), the Brick Institute of America (BIA), and the International Building Code (IBC).
- B. Manufacturers' Qualifications: Concrete masonry unit manufacturer shall be an established firm possessing the force and facilities required to manufacture high-quality units conforming to Specifications, and in quantities sufficient to meet construction schedules.
- C. Source Limitations for Materials:
  - 1. Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
  - 2. Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
  - 3. The accepted types, kinds, and supply sources of unit masonry and mortar materials shall remain the same throughout the work and shall not be changed without the Architect's review.
- D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
- E. Masonry Standards: Unless indicated otherwise, comply with ACI 530/ASCE 5/TMS 402, "Building Code Requirements for Masonry Structures," ACI 530.1/ASCE 6/TMS 602 "Specifications for Masonry Structures," and the published technical notes and recommended

practices of the National Concrete Masonry Association (NCMA), Brick Industry Association (BIA), and International Masonry Institute (IMI).

- F. **Testing Agency Qualifications:** An independent testing agency, acceptable to Owner, Architect and authorities having jurisdiction, qualified according to ASTM C 1093 to conduct the field quality control testing indicated, as documented according to ASTM E 548.
- G. **Masonry Unit Testing:** At the discretion of the Architect, randomly selected units, considered representative of the lot, shall be submitted to an independent testing laboratory, of the Architect's choice, for sampling and testing in accordance with ASTM C 67 or C 140, as applicable. In the event these test specimens fail to conform to the Specifications, the manufacturer may select new specimens from the same lot for a retest. Failure of this second set to conform to requirements shall be sufficient cause for rejection and removal from the site of the entire lot. Expense of original testing will be borne by the Owner; all subsequent retesting shall be at the expense of the Contractor.
- H. **Preinstallation Conference:**
1. At least 14 days prior to start of masonry construction, the Contractor shall hold a meeting at the Project site to determine the procedures for producing proper masonry construction. Coordinate meeting date and time with Construction Manager, Architect and Owner's Representative at least **ten (10) days** prior to conference so that they may attend if they so desire. Refer to requirements for such meetings in Division 01 Section "Project Management and Coordination."
  2. Contractor shall require responsible representatives of every party concerned with the masonry work to attend the conference including, but not limited to, the following:
    - a. Contractor's Superintendent
    - b. Masonry Subcontractor
    - c. Testing & Inspection Agency Responsible for Field Quality Control, including representatives of the Authorities Having Jurisdiction, as applicable.
  3. Minutes of the meeting shall be recorded, typed, and printed by the Contractor, and distributed by him to all parties concerned within five days of the meeting. The minutes shall also be transmitted, with the number of copies indicated, to the following for informational purposes:
    - a. Owner's Representative – one copy.
    - b. Architect and Construction Manager – two copies each.
  4. The minutes shall include a statement by the admixture manufacturer(s), as applicable, indicating that the proposed design mixes and placement procedures can produce the mortar and grout quality required by these Specifications.
  5. Review quality control procedures, including hot and cold weather procedures and testing and inspection requirements.
  6. Review fire-resistance rated wall construction.
  7. Review wall anchorage requirements and conditions.
  8. Review control joint and expansion joint locations.
  9. Review closure requirements at all non-mortar joint conditions such as control joints, expansion joints, head-of-wall joints, etc., including means for preventing water penetration.
  10. Review other topics of concern pertaining to masonry construction.

1.06 Delivery, Storage, and Handling:

- A. Materials shall be stored above and clear of the ground on raised pallets or platforms, and adequately covered and protected from weather, moisture, and other damage.
- B. Cement or lime, partially set, caked, or otherwise deteriorated; masonry sand contaminated by the intrusion of foreign materials; or, cracked, broken, or dirt-encrusted masonry units will be rejected as unfit for use in the work and shall be removed from the site.
- C. Units shall be stored separately at the site according to their particular type or grade designations, and their use in the work.

PART-2 PRODUCTS2.01 Concrete Masonry Units:

- A. General: Provide shapes indicated and as follows:
  - 1. Unless otherwise indicated, provide bullnose corner units in all leading or outer corners of walls and partitions of which the masonry surface will be exposed in the finish work, receiving no applied finish material other than paint.
    - a. Where walls are indicated to receive ceramic tile wainscot, provide square corner masonry units full height of wall.
  - 2. Provide masonry units with bullnose exterior corners for stools and jambs of openings, except when one of the following conditions occurs:
    - a. Where openings are detailed with slate, marble, solid surface material or wood stools, provide square corner units for opening perimeter.
    - b. Where corners will be covered by trim, moldings, or ceramic tile.
    - c. Where noted on the Drawings.
    - d. Where special shapes are shown.
  - 3. Special Shape Units: Provide special shape solid concrete masonry units, manufactured or cut with obtuse corners and two finish faces, for use at the outer or leading edges of all oblique corners and returns of all walls which will be "exposed" in the finish work receiving painted finish only.
  - 4. Units used in exposed surfaces shall be free of chips, cracks, or other defects detrimental to appearance, and shall contain no slag or other aggregates having residual metallic substances causing rust bleed-through of paint finish. Surface texture and finish shall conform to that of the sample unit selected and accepted for use in exposed work.
  - 5. Solid Load-Bearing Units or Fully Grouted Load-Bearing Hollow Units:
    - a. Use for bearing under lintels, beams, and other structural wall bearing members.
    - b. Use for projecting concrete masonry units and for walls dividing certain areas as indicated on Drawings for enhanced sound-attenuating partition construction.

- B. Hollow and Solid Load-Bearing Concrete Masonry Units (CMU): ASTM C 90, Type 1, moisture-controlled modular-sized units of nominal 8 in. x 16 in. face dimension and of thickness called for on Drawings or required in the Work. Shall be used for all concrete masonry work, below and above grade, except where other types or grades are specified or otherwise permitted herein.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1,900 psi, unless indicated otherwise.
  2. Weight Classification: Normal weight, unless indicated otherwise.
    - a. Provide light weight units for masonry partitions at existing elevated slab locations.

#### 2.04 Mortar and Grout Materials and Mixes:

- A. General: Except where otherwise indicated, mortar and grout materials and mixes shall comply with the requirements of this Article.
- 1.
- B. Dry ingredients for mortar and grout shall conform to the following:
1. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.
  2. Hydrated Lime: ASTM C 207, Type S
  3. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
  4. Aggregate for Mortar: ASTM C 144
    - a. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
    - b. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
  5. Aggregate for Grout: ASTM C 404
- C. Water shall be clean, potable, and free from deleterious or organic materials.
- D. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, salts, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated or accepted in writing by the Architect prior to use.
1. Water-Repellent Admixture: For mortar in concrete masonry outer wythe of exterior walls directly exposed to the exterior, provide liquid water-repellent mortar admixture by same manufacturer as that accepted for use with the corresponding concrete masonry units.
  2. Add cold-weather admixture (if accepted by Architect for use) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

- E. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry:
1. Type M (2500 psi) – For masonry below grade or in contact with earth, including Ivany® block walls.
  2. Type S (1800 psi) – For load-bearing masonry construction other than foundation walls.
  3. Type N (750 psi) – For non-load bearing masonry construction, unless indicated otherwise.
- F. Grout for Unit Masonry: Comply with ASTM C 476, minimum 28-day compressive strength of 3,000 psi for all applications unless indicated otherwise.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
  2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143. Water-reducing admixtures are not permitted.

#### 2.05 Wall Reinforcement and Masonry Ties:

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one or more of the following:
1. Hohmann & Barnard
  2. Dur-O-Wal (div. of Hohmann & Barnard)
  3. Wire-Bond
  4. Heckmann Building Products Inc.
- B. Finish (Reinforcing and Ties):
1. Interior Partitions: Mill galvanized, ASTM A 641, Class 1, 0.4 oz. zinc coating per sq. ft.
  2. Exterior Walls: Hot-dipped galvanized, ASTM A 153, 1.5 oz. zinc coating per sq. ft.
- C. Horizontal Joint Reinforcement: Provide ASTM A 951 9-gauge deformed rods welded to cross-rods not more than 16 in. on center. Provide reinforcement as follows:
1. Single Wythe Walls: Truss or ladder type.
  2. Uninsulated Cavity and Composite Walls: Truss type.
  3. Provide prefabricated L- and T-shaped sections, at 8 inches on center vertically, for corners and intersections.
  2. Reinforcing width shall be 2 in. less than overall wall thickness.
- D. Reinforcing Steel: Shall be deformed bars conforming to ASTM A 615, Grade 60.
- E. Masonry Anchors: Tie wires shall be not less than 3/16 in. thick; shall be of sufficient length to provide not less than 6 in. masonry embedment; and, of width approximately two less than nominal wall thickness.
1. Masonry to Structural Steel Columns: Provide steel strap anchors as indicated below with adjustable 3/16 in. diameter vee-wire ties.
    - a. For wide flange, tube, or pipe structural steel columns that are NOT to receive spray-on fireproofing, use Hohmann and Barnard #359 or #359C strap anchor, welded or screw-attached to structural steel.

2. Miscellaneous Interior Connections: Zinc-coated corrugated metal ties, 7/8 in. x 7 in. x 18-gage minimum. Review applications with Architect prior to use.
3. New Masonry to Existing Masonry: Similar to Slip-Set Stabilizer Style V by Hohmann & Barnard.

### PART-3 EXECUTION

#### 3.01 Erection - General:

- A. Lay out and erect the work plumb, level, and true to line in accurately spaced 8 in. vertical and 16 in. horizontal coursing modules, attaining maximum usage of whole uncut units. Use no units shorter than 1/2 unit length at vertical corners and jambs. Keep bond pattern plumb and in alignment full height of wall. Generally, units shall be laid to break joint by 1/2 length of preceding courses.
  1. CMU Bond Pattern: Concrete masonry work shall be laid in running bond pattern, unless indicated otherwise.
- B. Finished appearance of the outer faces of exposed masonry surfaces shall be of prime consideration. Lay all units to line along the exposed face. Face units shall be selected for uniformity of texture and shall be free of chips, cracks, or other defects. No "shiners" or patching will be permitted in face work. Damaged units or units misaligned from the plane of the exposed face shall be removed and replaced.
- C. No hammer-cutting will be permitted.
- D. Units shall be dry when laid.
- E. Adjust all units to their final position while mortar is soft and plastic. Remove any units disturbed after mortar has stiffened, clean joints, and relay with fresh mortar.
- F. Lay hollow units with full mortar bedding on horizontal and vertical face shells. Units used in foundation walls, piers, pilasters, or next to grout or concrete filled cells shall be fully bedded on both face shells and webs. Solid units shall be laid in full unfurrowed horizontal and vertical mortar bedding.
- G. Where necessary for construction purposes to stop-off horizontal runs of masonry, rack back 1/2 unit length in each course. Tothing in new work will not be permitted. Exposed surfaces of set or partially set masonry shall be cleaned and lightly wetted to obtain best possible bond before joining with fresh masonry.
- H. Control Joints (Soft Joints): Unless otherwise shown on Drawings, place control joints in exposed masonry walls, spaced not more than 30 ft. apart. Control joints shall allow freedom of movement in a horizontal line parallel to the wall and must be capable of resisting lateral forces which may cause walls adjacent to control joint to become out of line with each other. Control joints shall be placed at junctions of bearing and non-bearing walls, at junctions of walls and columns, at pilasters, above lintels extending from edges of lintels up to ceiling, and in straight runs of wall. Control joints shown on the drawings are the minimum required. Provide additional control joints as required to prevent exposed shrinkage cracks.
  1. Review locations and construction of control joints with the Architect prior to masonry erection.

- I. Maintain a minimum of 3/8 inch clearance between masonry and steel columns or fireproofing on steel columns. Do not bond masonry to structural steel except with adjustable ties.
- J. Bearing walls supporting structural members shall have not less than three full courses, or 24 inches, of solid masonry units immediately under the bearing level of steel beams. Provide 8 inches solid masonry under bearing ends of short span joist.
- K. Where hollow core concrete block walls decrease in thickness, a course of solid masonry or concrete-filled units shall be interposed between the thicker and thinner sections regardless of whether shown on the Drawings or not.
- L. Chases and recesses, of sizes and locations predetermined by consultation with other trades, shall be built-in and not cut-in. Build chases plumb, free of internal projections, and at least one full unit length from jamb openings. Exposed concrete units shall have cells threaded over conduit; no face cutting will be permitted. Horizontal "in-wall" piping shall be enclosed within the units in neatly fitted horizontal chases saw-cut into the webs; hammer-cutting shall be avoided. Units shall be saw-cut, closely fitted, and grouted-in around the work of other trades projecting through or exposed in the face of the wall. Bolts, anchors, accessories, flashings, and other built-in items shall be solidly grouted and built-in as the work progresses. Door frames shall be filled solid with grout as the wall is built-up. Joints around windows, door frames, and elsewhere where caulking is called for shall be raked to receive sealant.
- M. Unless indicated otherwise on Drawings, extend interior masonry partitions full height to underside of structure of floor or roof construction above. Similarly, masonry that encases steel columns shall be carried full height of column to the underside of floor or roof deck above. Permanently close joint between top of walls and floor or roof construction above with gasket or other material acceptable to Architect; such closure shall be fire-rated where partition is required to be fire-resistance rated.
- N. Dwarf or free-standing low walls shall be constructed by threading masonry units over reinforcing bars protruding from floor and filling those cores encasing the rebars full with concrete or grout. Cap with solid masonry top course (not grout-filled block), unless indicated otherwise.
- O. Bearing walls and exterior walls terminating against a beam, soffit, or concrete slab shall be tied to overhead element with anchors at 32 inches o/c maximum, of a type which allows for vertical movement but restricts lateral movement. Construction joint between masonry and overhead element shall be slushed full with mortar.
- P. Abutting walls shall be bonded or anchored at their points of intersection. Bearing walls shall have alternate courses toothed into adjoining wall or, with Architect's review, rigid steel anchors set at maximum 48 in. vertical centers may be used, in lieu of toothed bonding. Non-bearing partitions shall be bonded to abutting walls with continuous joint reinforcement. Walls intersecting or adjoining structural framing and dependent upon this framing for lateral support shall be anchored to structural members with flexible metal anchors or ties.
- Q. New masonry work constructed as a continuation or extension of existing walls, with its face aligned on the same plane as that of the existing work to which it adjoins, and which face surface will be exposed as a final finished surface in the finished work shall be toothed and bonded into the existing work. New openings cut into existing similarly exposed finish masonry shall, likewise, have the new masonry toothed into the existing work.

- R. Existing loose masonry units shall be removed from existing walls which receive or adjoin new masonry work. Clean head and bed joints of existing residual mortar and lightly wet down the surfaces before tying or joining new work into existing work.
- S. Where counterflashing is indicated for installation on masonry, install embedded leg in horizontal masonry joint. Secure with lead wedges. Where internal through-wall flashing and weeps are also indicated, place embedded leg beneath through-wall flashing. Lap and seal joints between embedded sections and coat metal to prevent galvanic action in accordance with Division 07 Section covering counterflashing construction.
- T. If, during or after selective demolition operations, inspection of existing masonry reveals previously unknown conditions which are unsound or unacceptable to the application of new finishes, notify Architect of such conditions. Notification of Architect shall occur sufficiently in advance of scheduled installation work to allow Architect to make field observations and recommendations for such conditions and allow Contractor time to make authorized remedial repairs.

### 3.02 Mortars:

- A. Mortar ingredients shall be thoroughly mixed together in a mechanically-operated batch mixer for a period of not less than three-minute duration.
- B. Mortar materials shall be used within 2-1/2 hours of initial mixing. Mortar shall be of consistency convenient to its satisfactory use in the work, and may be retempered to plastic workability by remixing with additional water when beginning to stiffen from evaporation or absorption of a part of the mixing water. Retempering and use of mortar which has begun to set from chemical reaction will not be permitted.
- C. Equipment used for mixing, transporting, and holding of mortar shall be clean and free of hardened mortar or other foreign matter.

### 3.03 Wall Reinforcement:

- A. Horizontal Joint Reinforcement:
  - 1. Install in masonry wall bed joints at 16 in. o.c. Reinforcement shall, in addition, be placed in bed joints, 8 in. apart, immediately above lintels and below sills at window and door openings.
  - 2. Install continuously in walls, with side rods lapped at least 6 in. at splices and continually maintained at abutting walls and around corners by use of prefabricated or job-fabricated tee and corner sections. Continuity shall be interrupted only at vertical expansion and control joints.

### 3.04 Bond Beam Units:

- A. Provide bond beam units at all locations shown on Drawings and for horizontal pipe or conduit chases. Units shall be of texture to match face units. Fill channel cavity full with grout and two #4 reinforcing bars, unless indicated otherwise.

### 3.05 Lintels:

- A. General: Build in lintels as work progresses. Anchor lintels as indicated. Unless otherwise indicated, lintels shall have a minimum 8 inches of bearing at each end.
  - 1. Refer to Drawings for lintel sizes and configurations.

### 3.06 Ties:

- A. Anchor masonry walls to structural frame at points of juncture by means of flexible wall ties of type which provides lateral restraint while permitting horizontal and vertical movement. Place ties at 16 in. o.c. in alternate joints between wall reinforcement, and secure to structural framing by means of welding or "shot-in" anchoring devices employing power-actuated equipment.

### 3.07 Tooling:

- A. Exposed masonry joints shall be progressively tooled as the mortar takes its initial set. Mortar shall be compacted tightly into the joints to close cracks and crevices by use of tooling irons of profile to produce a round concave joint. Joints unexposed in the finish work shall be cut flush. Holes in joints of exposed masonry surfaces shall be filled with mortar and suitably tooled.
- B. Unless otherwise indicated, tool joints to the following profiles:
  - 1. Concrete Masonry Joints: Round, concave joint.

### 3.08 Cleaning New and Repaired Masonry:

- A. Masonry walls shall be kept reasonably clean, with faces stone-rubbed free of protruding and mislaid mortar as the work progresses.
- B. Block walls shall be rubbed down and dry brushed clean to acceptable paintable condition.

### 3.09 Control Joints:

- A. Construct vertical control joints in walls and partitions at locations shown on Drawings, or, if not shown, as directed by Architect in accordance with guidelines of Article 3.01 "Erection - General." Joint locations shall generally correlate with other building elements and, unless shown or directed otherwise, shall extend from top of foundation below grade to the full height of the exposed wall surface. Unless indicated otherwise, do not run rigid horizontal joint reinforcement through vertical control joints. Prepare for sealant and backing material application, specified in Division 7 Section "Joint Sealants."
  - 1. In concrete masonry work, control joints shall be raked to receive caulk.

### 3.10 Cold Weather Construction:

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
- B. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

### 3.11 Hot Weather Construction:

- A. Comply with "Technical Note No. 1," Revised March 1992, by the Brick Industry Association (formerly the Brick Institute of America) and comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

### 3.12 Repair, Pointing, and Cleaning (New Construction):

- A. Remove and replace masonry units which are loose, chipped, broken, stained, or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints at corners, openings, and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.
- C. Clean exposed CMU masonry by dry brushing at the end of each day's work and after final pointing to remove mortar spots and droppings.

### 3.13 Field Quality Control:

- A. Testing and Inspecting:
  - 1. Contractor shall engage and pay a qualified independent testing and inspecting agency to perform indicated field tests and inspections and to prepare test reports: [VERIFY W/ CM & OWNER]
  - 2. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
  - 3. Testing and inspection agency will report inspection results promptly and in writing to Owner, Contractor, Construction Manager, and Architect.
  - 4. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or other corrective work with specified requirements.
- B. Inspections shall be conducted in compliance with the 2009 International Building Code, Sections 1704.5, Sub-section 1704.5.2, and Table 1704.5.1 "Level I Special Inspection." Inspections shall be periodic or continuous in conformance with the Table. See Structural Drawings for additional information on special inspections.
- C. Testing Frequency: One set of tests shall be performed during construction for each 5000 sq. ft. of wall area or portion thereof.
- D. Mortar Test: For each mix provided, mortar shall be sampled and tested per ASTM C 780 for compressive strength.
- E. Grout Test: For each mix provided, grout shall be sampled and tested per ASTM C 1019 for compressive strength.

### 3.14 Protection of Work:

- A. During erection, the tops of all walls shall be kept dry and free of moisture penetration by covering at the end of each day or shut-down period, with a strong, continuous, waterproof

membrane, firmly secured in position and of sufficient width to overhang at least 1 ft. on each side of the wall.

- B. Masonry walls of which the faces will be exposed in the finished work shall be protected against mud staining or other similar circumstance by use of an impervious protective barrier, similar to polyethylene film, minimum 6 mil thickness, applied to walls after their erection. This barrier shall extend at least 24 in. up the wall above grade level and shall remain in place during the construction period, to be removed only after threat of staining no longer exists.

#### 3.15 Masonry Waste Disposal:

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

SECTION 05 5000 - METAL FABRICATIONSPART-1 GENERAL1.01 Summary:

- A. This Section covers metal fabrications of miscellaneous or ornamental nature except as indicated otherwise.
- B. This Section includes, but is not limited to:
  - 1. Miscellaneous loose bearing and leveling plates.
  - 2. Loose steel lintels.
  - 3. Miscellaneous steel framing and supports.
- C. Related work specified in other Sections:
  - 1. Division 08 Section "Aluminum Entrances, Storefront and Curtainwall" for miscellaneous aluminum trim and closures not otherwise specified.

1.02 Submittals:

- A. Product Data: For the following:
  - 1. Grout.
- B. Shop Drawings: Detail fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of fabrications and their connections. Indicate location, type, and size of fastenings. Show anchorage and accessory items. Distinguish between shop and field connections.
  - 1. Provide templates for anchors and bolts specified for installation under other Sections.
  - 2. Contractor shall check and verify all dimensions for proper fit of parts.
  - 3. Review by the Architect relates to the requirements for general arrangement and design, and does not relieve the Contractor of responsibility for errors in details, dimensions, or quantity of materials.
- C. Samples: As specified elsewhere in this Section, or as requested by Architect.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article, to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.03 Quality Assurance:

- A. Fabricator Qualifications: A firm or firms experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. Fabrication and installation shall be performed by experienced personnel and qualified welders in accordance with accepted industry standards as established by the National Association of Architectural Metal Manufacturers (NAAMM).

- B. Welding: Qualify procedures and personnel according to American Welding Society (AWS) D1.1 "Structural Welding Code--Steel," and AWS D1.3 "Structural Welding Code--Sheet Steel." Certify that each welder has passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

#### 1.04 Storage:

- A. All items, when delivered to the site, shall be stored in a safe place, clear of the ground, and protected with weatherproof covering until installed.

#### 1.05 Project Conditions - Field Measurements:

- A. Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measuring before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

#### 1.06 Coordination:

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### PART-2 PRODUCTS

#### 2.01 Materials - General:

- A. All materials shall be new, clean, undamaged, unrudded stock of sizes and weights indicated.
- B. Metal Surfaces - General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Components identified as products of certain manufacturers are so named to establish the minimum acceptable quality and design. Furnished components shall be equal to or better than the named items.

#### 2.02 Ferrous Metals:

- A. Steel Plates, Shapes, and Bars: ASTM A 36.

#### 2.03 Paints:

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements of FS TT-P-664; selected for good resistance to normal atmospheric corrosion, for compatibility with finish paint systems indicated, and for capability to provide a sound foundation for field-applied topcoats, despite prolonged exposure.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalanizing welds in steel, complying with SSPC-Paint 20.

#### 2.04 Fasteners:

- A. Furnish all required galvanized bolts, spacers, washers, and mechanical fastening devices for erection. Bolts, where exposed, shall be Phillips-head machine screws, except hex head machine screws will be permitted for pipe rail installation.

#### 2.05 Grout:

- A. Nonshrink, nonmetallic grout for setting railing posts in preset sleeves shall be factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

#### 2.06 Fabrication - General:

- A. Fabrication shall be in as large shop-assembled sections as large as practical for delivery and erection.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight edges. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.
- C. Cut, reinforce, drill, and tap metal fabrications as indicated and as needed to receive screws and similar items.
- D. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate and drain.
- E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use fasteners of type indicated or, if not indicated, Phillips-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- F. Provide for anchorage of type indicated; coordinate with supporting structure or material.
- G. Welding: Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- H. Finishing:
  - 1. Ferrous metal items without outside exposure, located in interior walls, or to be embedded in interior concrete work, shall receive one coat of shop primer after being cleaned of grease, flux and weld spatters. Prepare items for shop priming in compliance with SSPC-SP 3 and apply shop primer in compliance with SSPC-PA 1.
  - 2. Ferrous metal items with outside exposure, located in exterior walls, or to be embedded in exterior concrete work, shall be hot-dipped galvanized per ASTM A 123.
  - 3. Finishes, as applied, shall meet federal, state, and local V.O.C. requirements.

2.07 Miscellaneous Loose Bearing and Leveling Plates:

- A. Provide miscellaneous loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.08 Loose Steel Lintels:

- A. Provide steel lintels for masonry openings of size and shape shown on Drawings, and for masonry openings for which no other lintel is called for. If no size and shape is shown, lintels shall be of size and design to support the superimposed load at a maximum deflection of 1/600 of the span or 0.3", whichever is less, and of type to suit wall construction.

2.09 Miscellaneous Steel Framing and Supports:

- B. Provide sway bracing, hanger assemblies, and other steel items required to support partitions, entrances, and similar assemblies or equipment. Fabricate to sizes and details shown on Drawings and field verified dimensions.
- C. Where indicated, provide steel framing, fabricated to the size and detail required, to accommodate and support roof-mounted accessories or equipment such as roof hatches and mechanical equipment. Fabricate frames with coped or mitred corners, welded joints, and welds ground smooth. Provide shop-punched bolt holes for mounting frames to deck or for attachment of wood blocking or curbs.
- D. Coordinate with equipment manufacturer's requirements. Steel members shall be of size and shape shown in details, but in no case less than that required to safely support anticipated loads thereon. Connections shall, generally, be welded, except where bolting is called for or where bolting is more adaptable and practical in fabrication and erection. Members shall have shop-prepared bolt holes where required for field assembly, installation, or attachment of other materials, clip angles, or miscellaneous loose pieces of length, size, type, and quantity indicated or required to complete the Work.

PART-3 EXECUTION3.01 Installation - General:

- A. Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction.
- B. Perform cutting, drilling, and fitting required for installing metal fabrications. Set fabrications accurately in location, alignment, and elevation, with edges and surfaces level, plumb, true, and free of rack. Measure from established lines and levels.
- C. Provide temporary bracing or anchors for items that are to be built into concrete, masonry, or similar construction.
- D. Fit exposed connections accurately together to form hairline joints. Weld ferrous metal connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized or clear anodized after fabrication and are for bolted or screwed field connections.
- E. Field welding shall generally comply with same requirements as for shop fabrication welding.

- F. Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coating of bituminous paint.

### 3.02 Miscellaneous Steel Framing and Supports:

- A. Install to comply with requirements of items being supported, including equipment manufacturer's written instructions and requirements on shop drawings, if any.

### 3.03 Touch-Up and Cleaning:

- A. Touch-up Painting: Immediately after erection of shop primed items, clean field welds, bolted connections, and abraded areas of shop paint, then paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching-up shop-painted surfaces. Apply by brush or spray to provide a 2.0 mil minimum dry film thickness.
- B. For galvanized surfaces, clean welds, bolted connections, and abraded areas, then apply galvanizing repair paint to comply with ASTM A 780.

### 3.04 Protection:

- A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire units, or provide new units.

END OF SECTION



## SECTION 06 1000 - ROUGH CARPENTRY

### PART-1 GENERAL

#### 1.01 Summary:

- A. This Section covers the furnishing and installation of all wood framing, furring, grounds, blocking, curbs, and other items of concealed rough carpentry required in the Work, including all required nails, bolts, screws, and other fasteners of type and size suitable to installation.
- B. Related Sections:
  - 1. Finish carpentry and millwork are specified elsewhere in this Division.
  - 2. Division 07 Roofing Section for installation performance requirements for roof-related blocking.
  - 3. Division 01 Section "Alternates" for administrative and procedural requirements regarding alternates, and for description of each scheduled alternate.
  - 4. Division 01 Section "Allowances and Unit Prices" for administrative and procedural requirements regarding allowances and unit prices, and for description of each scheduled item of the Work.
  - 5. Division 07 Sections for installation performance requirements for roof and fascia-related wood blocking and nailers.
- C. Unit Prices and Quantity Allowances: Include quantity allowances for undesignated locations of wood blocking and plywood roof deck replacement and repair at reroof areas, on a unit price basis. Refer to Division 01 Section "Unit Prices and Quantity Allowances" for schedule of unit prices and quantity allowances and for related administrative and procedural requirements. Refer also to Part-3 Article "Undesignated Areas of Wood Nailer, Blocking, Curb and Plywood Deck Repair" in this Section.

#### 1.02 Submittals:

- A. Product Data for engineered wood products.
- B. Wood treatment data as follows, including chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials:
  - 1. For each type of preservative-treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
  - 2. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener-holding capacities of treated materials.

#### 1.03 Quality Assurance:

- A. Supplier of Wood Materials for Rough Carpentry Items: A qualified supplier that is certified for chain of custody by an FSC-accredited certification body.

#### 1.04 Delivery and Storage:

- A. Materials shall be delivered dry, stored off the ground, and well-covered with waterproof covering during job site storage.

PART-2 PRODUCTS2.01 Materials:

- A. General: Materials shall be new sound products, grade-stamped by the identifying mark of a competent and recognized grading agency or bureau, or otherwise identified by the registered mark of the manufacturer and acceptable to the Architect, and shall equal or exceed in quality those comparative grades used herein for reference.
- B. Wood Species: Unless otherwise indicated, species is optional, but known strength and performance levels of those species proposed for use shall be not less than required under the grading rules of:
1. West Coast Lumber Inspection Bureau (WCLIB) for non-preservative-treated lumber.
  2. Southern Pine Inspection Bureau (SPIB) for preservative treated lumber.
  3. The Engineered Wood Association (APA, formerly American Plywood Association) for plywood.
- C. Lumber: Not less than "Construction Grade," minimum 1500 f, MC19 after fire-retardant treatment, S4S.
- D. Plywood: APA Rated Sheathing, Exposure 1 (unless indicated otherwise), complying with U.S. Department of Commerce (DOC) PS1, "U.S. Product Standard for Construction and Industrial Plywood."
1. For roof sheathing, provide APA-rated Structural I sheathing with Exterior exposure durability classification.
- E. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use ACQ.
  2. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- F. Fire-Retardant-Treated Materials: Except for locations where wood which has been pressure-treated with wood-preservative is required, all lumber and plywood provided under this Section shall be fire-retardant-treated. Use materials complying with requirements in this paragraph, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
1. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10 feet beyond the centerline of the burners at any time during the test.
  2. Use treatment that does not promote corrosion of metal fasteners.
  3. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  4. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated or necessary.

5. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- G. Building Felt: Asphalt-saturated organic felt complying with ASTM D 226, Type I (No. 15 asphalt felt), unperforated.
- H. Fasteners for Use with Pressure-Treated Wood Products: Hot-dip zinc-coated complying with ASTM A 153 or Type 304 stainless steel.

### PART-3 EXECUTION

#### 3.01 Installation:

- A. Rough carpentry shall be performed by the methods and means accepted and normal to the trade. Members shall be accurately cut and set with square cut tight joints rigidly secured by proper mechanical fasteners of sufficient size and number.
- B. Lumber and plywood attached to steel members shall be secured thereto by bolts or screws. Members attached to concrete or masonry shall be secured thereto by bolts, unless otherwise accepted by the Architect.
- C. Nails and other fasteners shall be of type, size, and quantity dictated by IBC Table 2304.9.1, "Fastening Schedule" to firmly secure each member in permanent position.
  1. All non-stainless steel, ferrous metal fasteners used with pressure-treated wood products, whether preservative type or fire-retardant type treatment, shall be hot-dipped galvanized.
- D. Wood nailers, blocking, cants and curbs to which roofing work is attached shall be firmly anchored to resist a force of 200 lbs. per linear ft. in any direction. The thickness of perimeter nailers shall be such that the top of the nailer is flush with the surface to which the membrane is attached at the horizontal plane; coordinate with roofing Installer and roofing system details.
- E. Unidentified Areas of Wood Nailer, Blocking, Curb and Plywood Deck Repair: Existing wood nailers, blocking, curbs and decking of sound condition to which roofing is attached are intended to remain in place unless indicated to be removed. In anticipation of the possibility that removal of roofing system will reveal some existing deteriorated or otherwise unsound nailers, blocking, curbs or plywood decking in need of repair, this paragraph addresses the technical requirements for such repair.
  1. Replacement of Wood Nailers, Blocking, Curbs and Plywood Decking:
    - a. Base Bid shall include a Quantity Allowance for these types of work, at locations to be reviewed and pre-approved by Owner.
    - b. If, after removal of existing roofing, the examination of existing nailers, blocking, curbs and plywood decking reveals substrate conditions that are unacceptable to roofing Installer or roofing system manufacturer, notify Owner and Professional of conditions. Such notification shall occur sufficiently in advance of scheduled installation work to allow Owner or Professional to observe the conditions and allow the Contractor time to make authorized repairs.
    - c. Repair work includes removal of existing deteriorated nailers, blocking, curbs or plywood decking and installation of new wood nailers, blocking, curbs or decking of the same configuration on a unit price basis. Refer to Paragraph "Quantity Allowances and

Unit Prices" under Part-1 Article "Summary" in this Section for related requirements, including reference to quantity allowances to include in Bid.

END OF SECTION

SECTION 07 5323 – ADHERED EPDM ROOFING AND FLASHINGPART 1 - GENERAL1.01 Summary:

- A. This Section includes, but is not necessarily limited to, the following Work at selected roof areas:
1. Tear-off of existing roofing system.
  2. Removal and reinstallation of existing rooftop equipment to allow for added curb extensions.
  3. Adhered EPDM membrane roofing system.
    - A. 60-mil white membrane with 20-year warranty.
  4. Roof insulation.
  5. Roof drain rehabilitation.
  6. Roof walkway pads.
  7. Metal counterflashing and miscellaneous roof-related sheet metal work.
  8. Metal roof edge fasciae and related accessories.
- B. Related work specified in other Sections:
1. Division 06 Section "Rough Carpentry" for wood nailers, curbs, cants and blocking.
  2. Division 07 Section "Joint Sealants" for sealant at joints between metal flashing/trim and adjoining finished wall surfaces.
  3. Division 22, 23 and 26 Sections, respectively, for Plumbing, HVAC and Electrical rooftop work under those separate contracts.
- C. Provide design enhancements not indicated in the Drawings or Specifications but required by the accepted roofing system manufacturer's written instructions to achieve the 20-year roof service guaranty and to conform to the performance requirements.

1.02 Definitions:

- A. Roofing Terminology: Refer to ASTM D 1079 for definition of terms related to roofing work not otherwise defined in this Section.
- B. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and reinstalled.

1.03 Performance Requirements:

- A. General: Install sheet membrane roofing system, including roof membrane, elastomeric and metal flashings and trim, that is watertight; will not permit the passage of liquid water; and will withstand wind loads, thermally induced movement, and exposure to weather without failure. Slope roofing downward to drainage points.
- B. Material Compatibility: Provide roofing materials that are compatible with one another, and with existing construction where adjoining, under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

- C. Provide roofing system with minimum wind uplift resistance of 90 PSF. Unless indicated otherwise, install system in compliance with FM 1-75 installation requirements. Roofing system shall include new wood nailers and blocking, insulation, membrane, flashings, and metal trim.
1. Coordinate installation, size and configuration of wood nailers, blocking, cants and curbs to which roofing work is attached to ensure conformance with requirements of roofing, including firm anchorage and ability to resist a force of 200 lbs. per linear ft. in any direction.

#### 1.04 Submittals:

- A. Certificates of Conditions:
1. Contractor's Initial Certification: Prior to submitting product data and shop drawings, the Contractor shall submit a written statement, countersigned by an accepted roofing manufacturer's authorized agent or direct representative, certifying that roof deck, flashing attachments, and all other conditions as indicated in the Contract Documents and verified in the field have been or will be met as required to produce bondable or guaranteed roofing and flashing application.
  2. Manufacturer's Preinstallation Certification (refer to Part-3 Article "Examination," Paragraph "Manufacturer's Preinstallation Certification").
- B. Product Data: For each type of roofing, flashing and other product specified in this Section. Include data substantiating that materials comply with requirements.
- C. Shop Drawings: Include plans, sections, and details of the following:
1. EPDM sheet layout and seam locations.
  2. Base flashings and membrane terminations.
  3. Tapered insulation, including slopes.
  4. Sheet metal flashing and trim layout, profiles, methods of joining, anchorage, accessories, and adjoining construction.
- D. Samples:
1. Submit finish sample of metal roof edge trim for verification of finish and color.
  2. Submit other samples as requested by Architect or Owner.
- E. Installer's Qualification Data: Submit original letter from roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system.
- F. Manufacturer's System Certificate: Signed by roofing manufacturer certifying that the roofing system complies with requirements specified in the "Performance Requirements" Article. Upon request, submit evidence of meeting requirements.
- G. Fastener pull-out test report.
- H. Maintenance Data: For roofing system; include in maintenance manuals.
- I. Warranties: Special warranties specified in this Section.

- J. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.05 Quality Assurance:

- A. Roofing Installer Qualifications: Installer shall have a minimum five years specializing in the installation of roofing similar to that required for this Project and shall be approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product. Roofing Installer shall have installed a minimum of 1,000 squares of adhered EPDM roofing manufactured by the roofing manufacturer proposed and accepted for use on this Project.
- B. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and slopes indicated.
  2. Roof-covering assembly, including the foam plastic roof insulation, shall satisfactorily pass the FM 4450 or UL 1256 test standards.
- C. Preinstallation Conference: Before installing roofing system, conduct conference at Project site. Notify participants at least 5 working days before conference.
1. Meet with Owner; Architect; Owner's insurer, if applicable; roofing Installer; roofing system manufacturer's representative; and installers whose work interfaces with or affects roofing, including installers responsible for removal and reinstallation of roof accessories and roof-mounted equipment.
  2. Review schedule for coordination with building occupants and operations.
  3. Review means of access to roof for personnel, materials, and equipment.
  4. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
  5. Review and examine substrate conditions and finishes for compliance with requirements, including flatness and fastening. Especially review all fastening conditions where decking will be exposed from below in the finished work or where fasteners may otherwise be exposed.
  6. Review procedures for repair of unacceptable substrate conditions.
  7. Review loading limitations of deck during and after roofing.
  8. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
  9. Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.
  10. Review temporary protection requirements for roofing system during and after installation.
  11. Review roof observation and repair procedures after roofing installation.
  12. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.
- D. Details relating to the installation of the roof system shall be approved by the accepted roofing Installer and roofing system manufacturer, and installed in such a manner that the manufacturer will furnish the warranty specified.

- E. Engage properly licensed mechanical and electrical tradesmen to disconnect, temporarily remove, reinstall, and reconnect rooftop equipment, if disconnection is necessary, without increase in Contract Sum or Time.

#### 1.06 Delivery, Storage, And Handling:

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.07 Project Conditions:

- A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers' written instructions and warranty requirements. Do not work in rain, snow, or in presence of water.
- B. Field Measurements and Material Quantities: Contractor shall have sole responsibility for accuracy of measurements, estimates of material quantities and sizes, and site conditions that will affect work.
- C. Existing Conditions:
  - 1. Access to the existing roof shall be from the exterior only.
  - 2. Existing Roof Deck: Cast-in-place gypsum concrete on form boards, with reinforcement mesh and bulb tees; total thickness of 2-1/2 inches. Original construction documents indicate the existing deck is structurally level. Field verify assembly prior to preparation of Shop Drawings.
  - 3. Existing Roofing System: As noted on the Drawings. Field verify assembly prior to preparation of Shop Drawings.

#### 1.08 Scheduling:

- A. Except where interior building alterations are taking place and Owner has temporarily vacated such area(s), the building spaces directly below the existing roofs covered by this specification will be occupied and utilized by Owner. Do not interrupt or otherwise disturb Owner's programs and operations unless prior written approval is received from Owner.
- B. Owner will furnish a schedule to the Contractor identifying when occupied areas will be in use.
- C. Schedule performance of reroofing work to occur during unoccupied periods of time.

- D. It is not anticipated that the work of this Project will generate sufficient noise or other disturbance to require special scheduling due to day-to-day occupancy of building. Scheduling requirements, and other factors that may affect it, are discussed elsewhere in the Contract Documents.

#### 1.09 Warranty/Guaranty:

- A. Special Roof Service Guaranty: Furnish a full written roof service guaranty, without monetary limitation, signed by roofing system manufacturer, or an accepted surety, and prepared in such form and substance as hereinafter specified and agreeable to Owner. Guaranty shall provide for prompt repair, at no cost to Owner, of failures or faults in roofing or flashing membranes by any cause other than structural building failure, natural disaster, alteration or repair of membrane in a manner unprescribed by Guarantor, or change in original principal usage of building without Guarantor's knowledge and consent, for the time period stated below. Guaranty shall also provide Guarantor's inspection of roof during installation, at completion, and again two years thereafter. All costs for inspections and covered repairs shall be borne by Guarantor.
1. Guaranty Period:
    - a. Base Bid: 20 years from date of completion, and Owner's acceptance, of roof.
  2. Defects shall include, but not be limited to, the following:
    - a. Leakage of water into the building or within the construction.
    - b. Delamination of membrane.
    - c. Blistering, tearing, and other physical faults.
    - d. Loss of adhesion to substrate.
    - e. Failure to resist 72 mph wind gusts measured at 10 meters above the ground.

## PART 2 - PRODUCTS

### 2.01 Manufacture - Adhered EPDM Roofing System:

- A. Subject to compliance with requirements, provide one of the following adhered EPDM roofing systems, with indicated and necessary enhancements:
1. Base Bid: **White** EPDM Membrane
    - a. Sure-Seal®; Carlisle Syntec Systems, Carlisle Corp.
    - b. RubberGard®; Firestone Building Products Co.
    - c. GenFlex; GenFlex Roofing Systems, GenCorp Polymer Products.
    - d. Versigard™; Versico, Inc.
    - e. UltraGard®; Johns Manville Co.

### 2.02 Sheet Membrane:

- A. EPDM Sheet: Uniform, flexible sheet formed from a terpolymer of ethylene-propylene-diene, complying with ASTM D 4637, Type 1, of the following grade, class, thickness, backing, and exposed face color:
1. Grade and Class: Grade 1 and Class U, unreinforced.
  2. Thickness: 60 mils (1.5 mm), nominal.
  3. Backing: Unbacked.
  4. Exposed Face Color: White.

2.03 Auxiliary Membrane Materials:

- A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with EPDM membrane roofing.
  - 1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: 60-mil-thick EPDM, uncured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard bonding adhesive.
- D. Splice Primer and Tape: Manufacturer's standard synthetic rubber polymer primer and 3-inch-wide (minimum) butyl splice tape with release film.
- E. Lap Sealant: Manufacturer's standard single-component sealant.
- F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- G. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1 inch wide, extruded or roll-formed, with flanged or beaded edges for greater strength, and prepunched.
- H. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening sheet to substrate, and acceptable to roofing system manufacturer.
- I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, semi-cured EPDM flashing laminated to pressure-sensitive adhesive tape, in-seam sealants, compressible expansion joint fillers, termination reglets, and other accessories recommended by roofing system manufacturer for intended use.
- J. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55- to 60-mil- thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

2.04 Base Sheet Over Gypsum Concrete Deck:

- A. Modified Base Sheet: SBS-modified asphalt base sheet, roll weight 96.0 pounds, as manufactured by Carlisle SynTec. Provide modified base sheet for covering the existing gypsum concrete roof deck.
- B. Accessories:
  - 1. Fastener for attaching base layer of insulation over existing lightweight concrete on existing steel form deck over the Gymnasium shall be nailable type that will not penetrate the steel form deck.
    - a. OMG Roofing Products; OlyLok Locking Impact Nail for light weight concrete decks or equal. Lengths – 1.4 inches minimum to 3.8 inch maximum.

2.05 Roof Insulation Materials:

- A. General: Provide preformed roof insulation boards that comply with requirements, selected from manufacturer's standard sizes and of thicknesses indicated. Fabricate to shapes required by field verified conditions. Provide positive drainage at all roof areas.
  - 1. Thickness: Except where indicated otherwise, provide a multi-layered assembly of preformed polyisocyanurate insulation boards with a total minimum assembly thickness of 2 inches.
  - 2. Taper: Except where indicated otherwise, insulation shall be factory-tapered at 1/4 inch per foot (1:48) for drainage.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces. Minimum compressive strength as mandated by roofing system manufacturer to meet the specified warranty and performance requirements. Provide insulation boards complying with the following requirements:
- C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.06 Roof Insulation Accessories:

- A. General: Furnish roof insulation accessories recommended by roofing system and insulation manufacturers for intended use and compatible with sheet roofing material.
- B. Substrate Filler: Fibrous-felted, rigid insulation boards of wood fiber or other cellulosic-fiber and water-resistant binders, asphalt impregnated, chemically treated for deterioration, complying with ASTM C 208, Type II, Grade 1 or 2. Size to fit voids.
- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- D. Insulation and Substrate Filler Attachment: Furnish either of the following materials:
  - 1. Adhesive: Designed for fastening roof insulation to substrate, and included in roofing system manufacturer's single source roofing guaranty.
- E. Cold Fluid-Applied Adhesive for Insulation Attachment: Non-asphaltic adhesive formulated and successfully tested for adhering roof insulation to indicated substrates (roof deck and vapor retarder), and included in roofing system manufacturer's single source roofing guaranty. This category includes, but is not limited to, low-rise polyurethane foams such as the following:
  - 1. Carlisle Syntec, Fast 100™ Adhesive
  - 2. Firestone, I.S.O. Twin Pack Insulation Adhesive

2.07 Roof Walkway Material:

- A. Provide factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway material, approximately 3/16 inch (5 mm) thick, and acceptable to roofing system manufacturer. Either pads or rolls may be provided.

2.08 Roof Drains:

## A. Roof Drains in New Roofs:

1. Drains shall be Dura-coated cast iron body, with combination membrane flashing clamp/gravel guard, removable dome, adjustable (1-3/4 in. through 3-1/2 in.) Dura-coated cast iron extension with O-ring seal, Dura-coated cast iron dome, and two-piece Dura-coated cast iron under-deck clamp.
2. Drain shall be series ZC-100-EA-C as manufactured by Zurn Industries, of sizes shown on Drawings, or roof drains meeting this Specification by Josam, J. R. Smith, or Wade.

2.09 Metal Flashings and Trim:

## A. General: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the items indicated.

1. Fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
2. Fabricate sheet metal items of the thicknesses or weight needed to comply with performance requirements but not less than that listed below for each application.
3. Fabricate sheet metal work without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
4. Fabricate flashings and formed trim on suitable shop equipment with all breaks, interlocks, and similar bends neat and snug fitting.
5. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
6. Conceal fasteners and expansion provisions where possible. Exposed fasteners are generally not allowed on faces of sheet metal exposed to public view.

## B. Stainless Steel Sheet Material: ASTM A 167 Type 304, soft annealed stainless steel with 2D finish, except where harder temper is required for forming or performance. Provide 0.0187 inch (26 gage) minimum thickness, unless indicated otherwise.

## C. Elastomeric Sealant for Metal Flashings &amp; Trim: Generic non-hardening type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as recommended by sealant manufacturer.

## D. Miscellaneous Roof Flashing Fabrications: Pourable sealer pockets and miscellaneous flashings shall be stainless steel formed to match various existing flashing fabrications. Counterflash electrical conduit (if any) with shop-fabricated apron, secured in place by metal draw band. Solder, weld or otherwise waterproof joints in a manner acceptable to Architect.

## E. Two-Piece Counterflashing (Cap Flashing): Shop-fabricate two-piece interlocking assembly from stainless steel sheet to sizes and profiles indicated. Form in-wall reglet with 1/4-inch hook dam approximately 1-1/2 inch back from exterior face and vertical locking slot which requires no malleting or bending to hold insert member in place. Form counterflashing (cap) member to insert into and interlock with reglet and to provide spring-lock action tight against base flashing, with hemmed drip edge at bottom. Cap member shall cover not less than 4 inches over base flashing. Joints shall lap not less than 3 in. and be sealed with nonhardening, nonskinning,

nonmigrating polyisobutylene mastic sealant. Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Fry Springlok™ Type MA-4 for new wall construction, and MA-1-1/2 for cutting into existing wall construction; manufactured by Fry Reglet Corp.
  2. Fabricated assemblies, as manufactured by Keystone Flashing Co., complying with requirements and similar to the preceding.
- F. Roof Edge Fascias (Gravel Stops): A manufactured, two-piece, roof edge fascia system, complete with all necessary components, consisting of snap-on aluminum fascia cover in section lengths not exceeding 12 feet and a continuous formed 0.028-inch minimum thickness galvanized steel sheet cant dam with integral drip edge cleat. Provide matching prefabricated mitered and welded corner units and concealed splice plates of same material, finish and shape as fascia cover.
1. Aluminum: Extruded, minimum 0.075-inch thick, of manufacturer's standard alloy. Finish as specified below under paragraph "Aluminum Finishes."
    - a. Manufacture to profiles and dimensions indicated with allowance for expansion and contraction. Provide minimum 1" coverage over finished wall face below, where wall occurs.
    - b. Fascia system shall be FM-approved for Class 1-90 and comply with the 2003 International Building Code (IBC), Section 1504.5 (ANSI/SPRI ES-1), based on the basic wind speed stipulated in the IBC.
    - c. Acceptable Products: Subject to compliance with requirements, provide one of the following systems:
      - 1) Extruded Econosnap 1; W. P. Hickman Co.
      - 2) Type XP; Architectural Products Co.
      - 3) Permatite System 500; Metal-Era, Inc.
      - 4) SnapLok™ Fascia I Series, Extruded; MM Systems Corp.
  2. Fascia Accessories: Fascia extenders with continuous hold-down cleats.
- G. Miscellaneous Aluminum Cladding and Trim: Match roof edge fascia.
- H. Aluminum Finishes: For anodic finishes, comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes" for finish designations and application recommendations.
1. Exposed Finish: Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
  2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## PART 3 - EXECUTION

### 3.01 Reference Specification:

- A. Except where more stringent requirements or enhancements are specified in this Section or shown on the Drawings, substrates shall be prepared and roofing system and flashing shall be provided in accordance with the accepted roofing system manufacturer's written instructions.

### 3.02 Examination:

- A. General: Examine the project conditions at the appropriate times within the sequence of construction. Repeat examination as necessary.
- B. Manufacturer's Preinstallation Certification: After preparation operations and before beginning roofing insulation and membrane work, a representative of the roofing system manufacturer shall examine the various substrates and conditions and shall certify, in writing to the Owner, their acceptability for application of new materials.
- C. Examine substrates, areas, and conditions under which roofing and related work will be installed for compliance with requirements. Verify that substrates are of sound condition and have no unacceptable projections.
- D. Verify that all roof openings and penetrations are installed and braced and that roof drains are properly clamped into position.
- E. Examine walls, roof edges, and parapets for suitable conditions to receive installation of metal terminations, trim, and other manufactured roof specialties.
- F. Verify that wood nailers, blocking and other components are in place and secured. Verify perimeter nailers match required thicknesses of insulation.
- G. Substrates shall be clean and dry.
- H. Do not proceed with installation until unsatisfactory conditions have been corrected. Commencement of roofing application shall constitute acceptance of substrates by roofing Installer.

### 3.03 Preparation:

- A. All execution work shall be performed in a manner and at a time that minimizes the impact on Owner's occupied spaces below and protects to the maximum extent possible existing construction and contents that are intended to remain undisturbed. Protect, clean, repair and replace all such existing construction and contents from damage resulting from performance of Work. Prevent materials from spilling or migrating onto surfaces of other construction.
- B. Removal of Existing Roofing System: Tear-off existing roofing system down to existing roof deck. Existing system includes, but is not limited to, EPDM membrane, base flashings, insulation, expansion joints materials, wood nailers and blocking, cants, metal flashings and trim, and roof accessories. Unless indicated otherwise, existing built-in reglets for counterflashing shall remain and be re-used. Wood blocking of sound condition at roof edges, penetrations, and equipment curbs shall remain.
  - 1. Disposal: Collect and place demolished materials in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. Transport demolished materials off Owner's property and legally dispose of them.

- C. Existing Surfaces and Materials: Prepare substrates to provide firm, secure, smooth, and sound surfaces for new overlaid insulation and roofing materials.
1. At indicated locations, remove metal counterflashing and salvage for reinstallation. Where existing counterflashing is indicated to remain, bend up to perform base flashing work.
  2. Remove flashing materials from roof drains and scuppers.
  3. Remove base flashing from cants, curbs and vertical surfaces. Remove bituminous roofing cement as required by roofing system manufacturer.
  4. Remove cants.
  5. Where existing roof covering is sufficiently dry and irregularities can be repaired to serve as a suitable substrate, cut and flatten fish mouths, blisters, buckles, wrinkles and other irregularities in existing built-up roofing. Patch, repair, and seal to provide acceptable substrate for overlay materials.
  6. Where wet areas exist or other unsuitable conditions occur which cannot be repaired in place to achieve a suitable substrate, cut out and remove unacceptable materials. Install substrate filler as specified in Article "Insulation Installation."
  7. Clean substrate of dust, debris, and other substances detrimental to roofing and flashing installation according to roofing system manufacturer's written instructions. Remove sharp projections. Existing fasteners shall be well-secured and not projecting. Provide fillers of appropriate material or otherwise modify projections in excess of 1/8 inch out of plane and gaps wider than 1/4 inch.
- D. Fastener Pull-Out Testing: Retain independent testing and inspecting agency to conduct fastener pull-out tests according to SPRI FX-1, and submit test report to Architect and roofing manufacturer before installing new roofing system.
1. Obtain Architect's and roofing manufacturer's approval to proceed with specified fastening pattern. Roofing manufacturer may furnish revised fastening pattern commensurate with pull-out test results.
- E. Roofing Substrate Preparation:
1. Clean roofing substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
  2. Repair damage to existing substrates that results from removal of existing fasteners and materials and that is unacceptable to new roofing system manufacturer.
- F. Undesignated Areas of Roof Deck Repair:
1. General: Existing roof deck of sound condition is intended to remain in place. In anticipation of the possibility that removal of roofing system will reveal some existing areas of deteriorated or otherwise unsound deck in need of repair, this Article addresses the technical requirements for repair of such decking.
  2. Gypsum Concrete Roof Deck Repair: As specified in Division 03 Section "Gypsum Concrete Roof Decks."
- G. Wood Nailers, Blocking, and Curbs: Coordinate installation of wood nailers, blocking, and curbs, specified in Division 6 Section "Rough Carpentry," to which roofing work is attached, so as to comply with performance requirements. Unless otherwise shown, thickness of perimeter

nailers shall be such that the top of the nailer is flush with the adjoining surface to which the membrane is attached at the horizontal plane; coordinate with roofing system details.

- H. Using qualified and properly licensed tradesmen, move existing rooftop equipment where necessary in order to remove existing roofing materials, add curb height extensions and corresponding duct and conduit extensions, and install new roofing system. When units and equipment are to be moved, they shall be carefully disconnected, removed and protected from damage, all as acceptable to Owner. As soon as possible, reinstall and reconnect units in such a way that they are restored to prior operating condition.
- I. Indoor Air Quality Controls: To prevent dust, vapors, gases or odors from entering the building due to roofing Work and to minimize resulting disruptions to building occupants and operations, employ appropriate measures acceptable to Owner, including but not limited to the following:
1. Divert air intakes from work area by attaching scoops or temporary ductwork.
  2. Temporarily shut down or block air intakes.
  3. Temporarily close windows.
  4. Provide make-up air or intake air by alternative routes from sources away from work area.
  5. Perform work during unoccupied hours when ventilation system is not operating and windows are closed.
- J. Safety Requirements:
1. Comply with manufacturer's precautions and material safety data sheets (MSDS).
  2. Roofing application, material handling, and associated equipment shall conform to and be operated in conformance with OSHA safety requirements.
  3. Comply with federal, state, local and Owner fire and safety requirements.
  4. Coordinate schedule with Owner whenever work is expected to be hazardous to Owner, employees, and/or operators.
  5. Whenever roof deck is being repaired or replaced, maintain a crewman as a floor area guard.
  6. Maintain fire extinguisher within easy access whenever power tools, solvents, and other flammable materials are being used.
- K. Roof Drainage System: Maintain in functioning condition to ensure roof drainage at end of each workday and whenever precipitation occurs. Prevent debris from entering or blocking roof drains, rainwater conductors, scuppers, etc. Use roof-drain plugs specifically designed for this purpose. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
1. If roof drains will be temporarily blocked or unserviceable due to roofing system removal or partial installation of new membrane roofing system, provide alternative drainage method to remove water and eliminate ponding. Do not permit water to enter into or under existing membrane roofing system components that are to remain.
- L. Temporary Seals: Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of each workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
1. During demolition and tear-off of roofing, provide temporary seal at tie-ins between new and existing membranes, until permanent tie-ins are complete.

### 3.04 Roof Drains:

- A. New Roof Drains: Install new roof drains according to manufacturer's written instructions and the following:
  - 1. Secure drain to roof deck.
  - 2. Coordinate with Installer of rainwater conductors for final connection.
  - 3. Flash drain with adhered membrane, install clamping ring and strainer.
  - 4. Perform water test to ensure drain system has free flow of water without leaks.

### 3.05 Modified Base Sheet Installation over Gypsum Concrete Deck:

- A. After proper preparation of roof deck, allow any repaired light weight concrete to cure before installing base sheet.
- B. Install base sheet membrane over prepared gypsum concrete deck.
  - 1. Roll out and lap the base sheet 3 inches.
  - 2. Secure the base sheet with two rows of staggered fasteners running the long direction of the roll with nailable fasteners at 18 inches on center. Secure the base sheet at the seams with nailable fasteners at 9 inches on center.

### 3.06 Insulation Installation:

- A. General: Install insulation over roof deck in accordance with instructions of the insulation and roofing system manufacturers' written instructions. Insulation system shall be clean, smooth, dry, and free of loose and foreign materials.
- B. Coordinate installation of roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- C. Substrate Filler: Install substrate fillers by adhesive or hot asphalt method. Provide tapered edge strips and other incidental tapered substrate fillers to ensure positive slope to drains.
- D. Install tapered insulation to conform to slopes indicated and to Shop Drawings.
- E. Install multiple layers of insulation to achieve required thickness unless indicated otherwise. Install insulation with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- F. Trim surface of insulation where necessary at roof drains so completed surface is tapered to drain and provides a smooth transition which does not restrict flow of water.
- G. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation. Cut and fit insulation to within 1/4 inch of nailers, projections, and penetrations.
- H. Attaching Insulation on Metal Roof Deck (Mechanical Method): Except where otherwise indicated, install each layer of insulation and secure to deck using mechanical fasteners specially designed and sized for fastening specified board-type roof insulation to deck type(s) indicated. Fasten insulation according to requirements of FM's "Approval Guide" for specified Windstorm Resistance Classification.

- I. Attaching Insulation Over Base Sheet on Existing or Repaired Gypsum Concrete Deck (Adhered Method): Where indicated, install each layer of insulation and secure to deck using adhesive designed for fastening specified board-type roof insulation to base sheet of type indicated. Fasten insulation to comply with performance requirements and according to instructions of adhesive manufacturer and roofing system manufacturer. Protect adjoining surfaces from overspray and wind-blown adhesive.

1. Set insulation with non-asphaltic adhesive.

### 3.07 Adhered Roofing Membrane Installation:

- A. Install EPDM sheet over area to receive roofing according to roofing system manufacturer's written instructions, plus indicated enhancements. Unroll sheet and allow to relax for a minimum of 30 minutes.
- B. Accurately align sheets and maintain uniform side and end laps of minimum 3 inch dimension or greater as required by manufacturer. Stagger end laps. Do not stretch sheets.
- C. Apply bonding adhesive to substrate and underside of sheet, without globs or puddles, at rate required by manufacturer and allow to partially dry. Do not apply bonding adhesive to splice area of sheet.
- D. Mechanically or adhesively fasten sheet securely at terminations and perimeter of roofing.
- E. Apply roofing sheet with side laps shingled with slope of roof deck where possible.
- F. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing sheet in place with clamping ring.
- G. Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet terminations. Apply additional splice cover to all laps and intersections.
  1. Tape splices shall be a minimum of 2-1/2 in. wide using 3 in. wide splice tape extending 1/8 in. minimum to 1/2 in. maximum beyond the splice edge. Field splices at roof drains shall be located outside the drain sump.
  2. Use primer to clean the membrane prior to applying splice tape. Low VOC primer is required in areas where volatile organic compound (VOC) regulations are in effect.
  3. Remove dirt and excess dust from the mating surfaces of the overlapping membrane sheets by wiping with roofing system manufacturer's specially prepared splicing wipes or a clean rag. Accumulated dirt, footprints, etc. must be removed by scrubbing the membrane with warm water and a low sudsing soap; rinse with clean water.
  4. Dampen roofing system manufacturer's application pad with primer, and also apply a bead of primer to the dry membrane area to be cleaned.
  5. Scrub membrane in a circular motion to achieve a thin, even coat of primer on both membrane surfaces. Splice area must be uniform in color, streak-free, and free of globs or puddles.
  6. Allow primer to dry. Mark bottom membrane sheet with a crayon 1/2 in. from the edge of the top sheet along the entire splice length.
  7. Unroll approximately 3 ft. of splice tape. Align paper backing with marked line and press tape down to bottom sheet, using firm even hand pressure. Continue for the length of the splice. Tape roll ends should be overlapped 1 in. Allow top sheet to rest on paper

- backing. Tape placement is critical to obtain a minimum splice width of 2-1/2 inches. A minimum of 1/8 in. to a maximum of 1/2 in. of tape must extend beyond the splice edge. A continuous piece of splice tape must be used at all field or factory splice intersections.
8. Pull the paper backing from the splice tape beneath the top sheet and allow the top sheet to fall freely onto the exposed tape.
  9. Press top sheet onto tape using firm even hand pressure across the splice toward the splice edge.
  10. Immediately roll splice with a 2 in. wide steel roller, using positive pressure. Roll across the splice edge, not parallel to it.
  11. Install a 6 inch wide section (with rounded corners) of roofing system manufacturer's standard semi-cured pressure-sensitive flashing or uncured flashing over all field splice intersections and overlapped taped ends. Seal edges of flashing with lap sealant.
  12. **Additional Splice Cover: All splices shall be covered with an additional layer of pressure-sensitive flashing, a minimum of 5 inches wide.** Clean and prime surface to receive additional splice cover in accordance with manufacturer's recommendations. Center splice cover on exposed seam edge. Roll splice cover to achieve complete contact.
  13. Repair tears, voids, and lapped seams in roofing that do not meet requirements.
- H. Adhere protection sheet over membrane roofing at locations indicated.

### 3.08 Membrane Flashing Installation and Related Work:

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates.
  1. Where splice method is utilized, complete splice between flashing and main roof sheet before bonding flashing to vertical surface. This splice shall be sealed at least 3 in. beyond the fasteners which attach the membrane to the substrate.
  2. Flash all penetrations (pipes, conduits, etc.) passing through the membrane. Factory prefabricated pipe seals shall be used to flash all pipes where possible. Where prefabricated pipe seals cannot be installed, field fabricated pipe seals shall be used. Flashings and terminations shall be done in accordance with roofing system manufacturer's details.
  3. Flashing shall be done with the longest pieces practicable in accordance with roofing system manufacturer's recommendations.
- B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing. Care must be taken to assure that the flashing is not bridging where there is any change of direction of the flashing.
- C. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- D. Terminate and seal top of sheet flashings and mechanically anchor to substrate with termination bars.
- E. Expansion Joints: Install expansion joint fillers and covers in accordance with manufacturer's instructions and details. Unless indicated otherwise, provide roofing system manufacturer's standard expansion joint fillers of the general shape indicated for each different application. Provide compressible fillers for expansion joints below joint covers where shown; fillers shall be continuous and mechanically attached.

- F. Unusual Penetrations: Clusters of pipes and unusual shaped penetrations shall be sealed with pourable sealer, 2 in. deep minimum, in a pourable sealer pocket.

### 3.09 Metal Flashing and Trim Installation:

- A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor securely in place using fasteners as required and capable of resisting forces specified in performance requirements.
1. Install metal work level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil-canning, buckling, or tool marks. Install sheet metal flashing with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in permanently waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  2. Expansion Provisions: Provide for thermal expansion of exposed sheet metal flashing and trim Work. Space movement joints at maximum of 12 feet with no joints allowed within 18 inches of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
  3. Internally Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
  4. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.
  5. Conceal fasteners where possible unless otherwise indicated. Metal work securement shall prevent the metal work from either pulling free or buckling.
  6. Torch cutting of metal flashing and trim is not permitted.
- B. Counterflashings:
1. Coordinate installation of new counterflashing with installation of assemblies to be protected by counterflashing and with joint sealant work specified in Division 07 Section "Joint Sealants."
  2. Where existing counterflashing is scheduled for removal, existing joint sealants, roofing cement, and mortar shall be removed from raggle joint and face of masonry; cut or rake out mortar in existing wall joint to depth required to accept receiver. Do not damage masonry.
  3. Install receiver and secure with lead plugs on 12 inch centers. Seal raggle joint in a waterproof manner.
  4. Install counterflashing insert members with an upward push into the vertical locking slot after completion of the roof membrane and base flashing.
  5. Lap counterflashing joints a minimum of 3 inches and bed with sealant.
- C. Roof Edge Fascia Installation:
1. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
  2. Anchor roof edge fasciae to resist uplift and outward forces according to performance requirements.

### 3.12 Walkway Installation:

- A. Install walkway products in locations indicated. Cut rolls to create pads not exceeding 4 feet long. Provide 1 inch separation between pads for drainage. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### 3.13 Field Quality Control:

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
  - 1. Notify Architect and Owner 48 hours in advance of the date and time of inspection.
  - 2. Ascertain that roofing system has been installed according to manufacturer's specifications and details. Warranty must be issued as a condition of the acceptance of the installation.

### 3.16 Disposal, Protecting and Cleaning:

- A. Protect sheet membrane roofing from damage and wear during construction period.
- B. Correct deficiencies in or remove roofing that does not comply with requirements. Repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.
- D. Remove temporary protective coverings and strippable films as metal flashing, trim and specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction. Replace items that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- E. Waste Disposal: Do not re-use, re-cycle or dispose of material manufacturers product containers except in accordance with applicable regulations. Contractor is responsible for proper disposal of demolition debris, product containers, and unused materials.

END OF SECTION



## SECTION 07 8413 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
  - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
  - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.

2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
  - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
  - b. Classification markings on penetration firestopping correspond to designations listed by the following:
    - 1) UL in its "Fire Resistance Directory."

#### 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

#### 1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Grace Construction Products.
  2. Hilti, Inc.
  3. Nelson Firestop Products.
  4. Specified Technologies Inc.
  5. 3M Fire Protection Products.
  6. Tremco, Inc.; Tremco Fire Protection Systems Group.
  7. USG Corporation.

## 2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. Fire-resistance-rated walls include fire-barrier walls and fire partitions.
  - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. Horizontal assemblies include floors.
  - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
  - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  - 1. Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.
- F. Low-Emitting Materials: Penetration firestopping sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-wool-fiber or rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

## 2.3 FILL MATERIALS

- A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
  1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

## 2.4 MIXING

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing and inspecting agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- B. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

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

### 3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping with No Penetrating Items FS-1 (Gypsum Board Partitions):
  1. UL-Classified Systems: W-L- 0001-0999.

- C. Firestopping with No Penetrating Items FS-1a (Concrete on Metal Deck):
  - 1. UL-Classified Systems: F-A- 0013.
- D. Firestopping with No Penetrating Items FS-2 (Masonry Partition):
  - 1. UL-Classified Systems: W-J- 0001-0999.
- E. Firestopping for Metallic Pipes, Conduit, or Tubing FS-2a (Concrete on Metal Deck):
  - 1. UL-Classified Systems: F-A 1057.
- F. Firestopping for Metallic Pipes, Conduit, or Tubing FS-3 (Gypsum Board Partition):
  - 1. UL-Classified Systems: W-L- 1001-1999.
- G. Firestopping for Metallic Pipes, Conduit, or Tubing FS-4 (Masonry Partition):
  - 1. UL-Classified Systems: C-AJ- 1001-1999.
- H. Firestopping for Nonmetallic Pipe, Conduit, or Tubing FS-5 (Gypsum Board Partition):
  - 1. UL-Classified Systems: W-L- 2001-2999.
- I. Firestopping for Nonmetallic Pipe, Conduit, or Tubing FS-6 (Masonry Partition):
  - 1. UL-Classified Systems: C-AJ- 2001-2999.
- J. Firestopping for Electrical Cables FS-7 (Gypsum Board Partition):
  - 1. UL-Classified Systems: W-L- 3001-3999.
- K. Firestopping for Electrical Cables FS-7a (Concrete on Metal Deck):
  - 1. UL-Classified Systems: F-A 1057.
- L. Firestopping for Electrical Cables FS-8 (Masonry Partition):
  - 1. UL-Classified Systems: C-AJ- 3001-3999.
- M. Firestopping for Cable Trays with Electric Cables FS-9 (Gypsum Board Partition):
  - 1. UL-Classified Systems: W-L- 4001-4999.
- N. Firestopping for Cable Trays with Electric Cables FS-10 (Masonry Partition):
  - 1. UL-Classified Systems: C-AJ- 4001-4999.
- O. Firestopping for Insulated Pipes FS-11 (Gypsum Board Partitions):
  - 1. UL-Classified Systems: W-L- 5001-5999.
- P. Firestopping for Insulated Pipes FS-11a (Concrete on Metal Deck):
  - 1. UL-Classified Systems: F-A 5029.

- Q. Firestopping for Insulated Pipes FS-12 (Masonry Partitions):
  - 1. UL-Classified Systems: W-J- 5001-5999.
- R. Firestopping for Miscellaneous Electrical Penetrants FS-13 (Gypsum Board Partitions):
  - 1. UL-Classified Systems: W-L- 6001-6999.
- S. Firestopping for Miscellaneous Electrical Penetrants FS-14 (Masonry Partitions):
  - 1. UL-Classified Systems: C-AJ- 6001-6999.
- T. Firestopping for Miscellaneous Mechanical Penetrants FS-15 (Gypsum Board Partitions):
  - 1. UL-Classified Systems: W-L- 7001-7999.
- U. Firestopping for Miscellaneous Mechanical Penetrants FS-16 (Masonry Partitions):
  - 1. UL-Classified Systems: C-AJ- 7001-7999.
- V. Firestopping for Groupings of Penetrants FS-17 (Gypsum Board Partitions):
  - 1. UL-Classified Systems: W-L- 8001-8999.
- W. Firestopping for Groupings of Penetrants FS-18 (Masonry Partitions):
  - 1. UL-Classified Systems: C-AJ- 8001-8999.

END OF SECTION

## SECTION 07 920 - JOINT SEALANTS

### PART-1 GENERAL

#### 1.01 Summary:

- A. The Work of this Section includes, but is not limited to, sealing or caulking the following:
1. Perimeter joints, interior and exterior, between new aluminum windows and surrounding construction.
  2. Perimeter joints, interior and exterior, between new aluminum entrance, storefront and curtainwall frames and surrounding construction.
  3. Perimeter joints, on both sides of frame, between all other new aluminum or hollow metal frames and the adjoining wall construction.
  4. Joints between top of roofing two-piece counterflashing and adjoining work above.
  5. Perimeter of new exterior louvers.
  6. Other joints between dissimilar materials, as directed by the Architect.
- B. Related work specified in other Sections:
1. Division 07 Section "Penetration Firestopping" for fire-resistant building joint-sealant systems.
  2. Division 08 Section "Glazing" for glazing sealants.
  3. Division 09 Section "Gypsum Board" for acoustical sealants.

#### 1.02 References:

- A. ASTM C 1193 - Standard Guide for Use of Joint Sealants.
- B. ASTM C 1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.

#### 1.03 Submittals:

- A. Product Data: Manufacturer's technical literature and specifications for each product to be furnished. Clearly indicate applications for which each kind of sealant is to be used.
- B. Samples for Initial Color Selection: Actual sealant bead samples of manufacturer's full standard color range for initial color selection by Architect.
- C. Mock-Ups/Samples for Verification: Provide installed and finished samples, each approximately 4 feet long, for verification by Architect of color selections and representative quality of installation. Provide at each typical joint application between similar and dissimilar materials, at locations acceptable to Architect. Approved samples may remain as part of the finished Work.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience.

#### 1.04 Quality Assurance:

- A. Installer Qualifications: Engage a single experienced installer to perform all of the joint sealant work specified in this Section. Installer shall be one who has specialized in installing joint

sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

#### 1.05 Delivery, Storage, and Handling:

- A. Deliver materials in manufacturer's original, unopened containers.
- B. Store between 40 and 90 degrees F (4-32 degrees C).

#### 1.06 Project Conditions:

- A. Do not apply clear water repellent sealers, waterproofing compounds, or other architectural coatings to surfaces to which sealers will be applied without first verifying compatibility.
- B. Install sealers when air and substrate temperatures are over 40 degrees F (4 degrees C) and rising, but less than 100 degrees F (37 degrees C), unless specific installation instructions are obtained from manufacturer.

### PART-2 PRODUCTS

#### 2.01 Materials - General

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

#### 2.02 Sealant Materials:

- A. First-quality products of manufacturer, delivered in unopened containers, properly stored, mixed, and applied in strict accordance with the manufacturer's printed instructions.
- B. Exterior Locations (Unless Otherwise Indicated): Polymer-based urethane liquid, two-part, non-sag sealant. Provide one of the following, or accepted substitute:
  1. Mameco International; Vulkem 227
  2. Pecora Corporation; Dynatrol II
  3. Polymeric Systems, Inc.; PSI-501
  4. Sonneborn Building Products; Sonolastic NP-2
  5. Tremco; Dymeric
  6. Bostic Construction Products; Chemcalk 500
- C. Heat-Resistant Sealant: Silicone adhesive/sealant rated for temperature applications from – 80 deg F to to 500 deg F continuously, and intermittently to 600 deg F; complying with Federal Specification TT-S-001543A, Class A; Federal Specification TT-S-00230C, Class A; ASTM C 920, Type S, Grade NS, Class 25, Use NT, G, A, M and O.

- D. Siliconized Acrylic Latex Sealant: Tremflex 834, as manufactured by Tremco, or approved equal by Pecora, Polymeric Systems, Sonneborn Building Products, or Bostic Construction Products.
1. Applications: Perimeter joints of interior hollow metal frames.
- E. All Other Interior Locations: Polymer-based urethane liquid, one-part, non-sag sealant. Provide paintable sealant for interior applications. Subject to compliance with paintability requirement, two-part type sealant may be used in lieu of one-part sealant at the Contractor's option. Provide one of the following, or accepted substitute:
1. Mameco International; Vulkem 921
  2. Pecora Corporation; Dynatrol I-XL
  3. Polymeric Systems, Inc.; Permapol RC-1
  4. Sonneborn Building Products; Sonolastic NP-1
  5. Tremco; Dymonic
  6. Bostic Construction Products; Chemcalk 100
- F. Colors shall selected by Architect from manufacturer's full range.
- G. Primers shall be clear, nonstaining types as recommended by the sealant manufacturer.

### 2.03 Joint Sealant Backing:

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and, are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings (Backer Rod): ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
1. Type C: Closed-cell material with a surface skin.
  2. Type B: Bicellular material with a surface skin.
  3. Type: Any material indicated above recommended by sealant manufacturer for application.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## PART-3 EXECUTION

### 3.01 Preparation:

- A. Joints to be sealed shall have substrates that are clean, dry, and free of loose dust and dirt, and shall have been maintained at the recommended temperature for at least 12 hours.
1. At existing joints indicated to receive new sealant, remove existing sealant and backing material.

- B. Insert compressible foam backer rod in joints which are no less than 3/8-inch deep and are deeper than the joint width.
- C. Install bond breaker tape, or other bond breaker material recommended by manufacturer suitable to the application, for the following joints indicated to receive sealant:
  - 1. In joints that do not or can not receive compressible foam backer rod and which are subject to movement due to thermal, moisture or structural factors.
- D. Porous materials (e.g., masonry, concrete, wood) shall be primed prior to application of sealant.

### 3.02 Application:

- A. Compactly fill and seal joints subject to moisture penetration or air infiltration with caulking material. Tool joints, if necessary, using a pointing iron dipped in solvent to provide a neat tight joint.
- B. Comply with sealant manufacturer's guidelines for acceptable joint configurations and range of sealant depth-to-width ratios that will produce optimum sealant performance. In no case shall the sealant be of less than 3/16 in. depth at the midsection of the joint sealant profile. Profile of exposed joints shall be concave. Do not build-up with compound.

END OF SECTION

SECTION 08 0610 - DOOR SCHEDULEPART 1 GENERAL1.01 Summary:

- A. This Section includes the attached Door Schedule.
- B. Related Sections:
  - 1. Section 08 1113 for hollow metal doors and frames.
  - 2. Section 08 1400 for wood doors.
  - 3. Section 08 4000 for aluminum doors and entrances.
  - 4. Section 08 7100 for finish door hardware.
  - 5. Section 09 9000 for field-applied door and frame finishes.
  - 6. Divisions 26 & 28 for control wiring and power connections of electrified door hardware.
- C. Refer to Drawings for door locations, elevation types, frame types, and details.
- D. Field verify in-place opening dimensions prior to fabrication of door frames where openings are existing-to-remain or will be construction prior to frame installation.

PART-2 PRODUCTS

Not Used.

PART-3 EXECUTION3.01 Door Schedule:

- A. Refer to schedule on following pages.
- B. Selective abbreviations used on Door Schedule:

ETR	Existing to Remain
R.M.	Removable Mullion
S.S.	Stainless Steel



SECTION 08 0610 – DOOR SCHEDULE  
Renovations to Stanton Middle School

PP7651  
Date: 20 April 2015

Door No.	Size	Door		Frame				Threshold	Hdw.	Remarks	Sign Type
		Mat'l.	Type	Mat'l.	Type	Head	Jamb				
<b>FIRST FLOOR - AREA A</b>											
AS1-B	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B	Exist. Alum.	--	--	--	Metal	2		--
AS3-B	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B	Exist. Alum.	--	--	--	Metal	4		--
A103-CA	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B1	Exist. Alum.	--	--	--	--	1		--
A103-CB	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B1	Exist. Alum.	--	--	--	--	3		--
A103-CC	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B	Alum.	F5	--	--	Metal	2		--
A103-CD	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B	Alum.	F5	--	--	Metal	2		--
A108C-A	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B	Alum.	F6	--	--	Metal	2		--
A108C-B	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B	Alum.	F6	--	--	Metal	2		--
A109C-A	(1) 3'-0" x 7'-2" x 1 3/4" (1) 2'-0" x 7'-2" x 1 3/4"	Alum.	C	Alum.	F1A	H4 Sim.	J1 Sim.	Metal	2		--
<b>FIRST FLOOR - AREA B</b>											
B106C-A	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B	Alum.	F4	H4	J3	Metal	2		--
B106C-B	(2) 3'-0" x 7'-0" x 1 3/4"	Alum.	B	Alum.	F4	H4	J3	Metal	2		--
<b>FIRST FLOOR - AREA C (ALTERNATE BID)</b>											
C021-A	3'-0" x 7'-2" x 1 3/4"	Alum.	C1	Alum.	F2	H9	J7	--	7	Add under alternate bid Electric Strike	--
C021-B	3'-0" x 7'-2" x 1 3/4"	Alum.	C1	Alum.	F3	H9	J7	--	6	Add under alternate bid	--
C021C-A	3'-0" x 7'-0" x 1 3/4"	Wood	C1	H.M.	F2A	H10	J8	--	6	Add under alternate bid	--
C021D-A	3'-0" x 7'-0" x 1 3/4"	Wood	C1	H.M.	F1	H11	J9	--	6	Add under alternate bid	--
C021D-B	3'-0" x 7'-0" x 1 3/4"	Wood	C1	H.M.	F1	H11	J9	--	6	Add under alternate bid	--
C021E-A	3'-0" x 7'-0" x 1 3/4"	Wood	C1	H.M.	F1	H11	J9	--	5	Add under alternate bid	--
C135V-A	(2) 3'-0" x 7'-2" x 1 3/4"	Alum.	C	Alum.	F1A	H4 Sim.	J1 Sim.	Metal	2		--

END OF SECTION



SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMESPART-1 GENERAL1.01 Summary:

- A. This Section includes hollow metal doors, hollow metal door frames and sidelights, and hollow metal borrowed light frames. Such items are denoted as "hollow metal" ("HM") on the Door Schedule and Drawings.
- B. Related work specified in other Sections:
  - 1. Division 8 Section "Door Schedule" for schedule of doors.
  - 2. Division 8 Section "Finish Hardware" for door hardware.
  - 3. Division 8 Section "Glazing" for glass to be installed in hollow metal doors and frames.
  - 4. Division 9 Section "Painting" for field painting of hollow metal doors and frames.
  - 5. Division 10 Section "Louvers and Vents" for louvers in hollow metal doors and frames.
  - 6. Divisions 26 & 28 for control wiring and power connections of electrified door hardware, and for electrified security access devices to be installed in the hollow metal doors and/or frames provided under this Section.

1.02 Submittals:

- A. Product Data: For each type of product indicated, including, but not limited to, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Show the door numbers shown on the Contract Documents. If the manufacturer desires to use another numbering system, the Shop Drawings shall also contain the Architect's number. Failure to include the Architect's number on the Shop Drawings will be sufficient grounds for rejection without further action. Include the following:
  - 1. Elevations of each door and frame design. Show location, size, and hand of each door. Show fire-resistance ratings and labels to be provided
  - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
  - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples: Representative samples of certain items shall be submitted to Architect upon his request.

1.03 Quality Assurance:

- A. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

1.04 Delivery, Storage and Protection:

- A. Doors and frames shall be properly protected, handled, and delivered undamaged to the site. Twisted, dented, or otherwise damaged units will be subject to rejection. Scratches or chips of

the paint film shall be immediately touched-up with rust-inhibitive paint in the field. Doors shall be individually wrapped.

- B. Items shall be carefully and neatly stored at the site on platforms or dunnage, and fully covered and protected from damage by any cause. Provide separators and other provisions to assure adequate ventilation between units. Store doors in vertical position.

#### 1.05 Project Conditions:

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

#### 1.06 Coordination:

- A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

### PART-2 PRODUCTS

#### 2.01 Manufacturers:

- A. Subject to compliance with requirements, provide hollow metal doors and frames by one of the following manufacturers:
  - 1. Amweld Building Products
  - 2. Ceco Door Products
  - 3. Curries Company
  - 4. Kewanee Corporation
  - 5. Overly Manufacturing Company
  - 6. Pioneer Industries
  - 7. Steelcraft; an Ingersoll-Rand Company.
  - 8. Windsor Republic Doors.

#### 2.02 Hollow Metal Frames:

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet not less than 14 gauge thickness and conforming to ASTM A 653, Commercial Steel (CS), Type B; with minimum A60 zinc-iron-alloy (galvannealed) coating designation. Fabricate frames with mitered or coped corners, full-profile welded.
- C. Frames shall be double-rabbit type, sharply formed to size with profile shown on Drawings, and of design to suit job conditions, being factory set up assemblies, having hairline joints, and full-profile welded connections. Sidelight and transom frames shall be of similar construction, integral with door frames or separate units as detailed. Provide internal reinforcement necessary

- for rigid anchorage or stiffness where shown or required, and internal splice reinforcement at field splices.
- D. Frames shall be provided with temporary steel spreaders for shipment and handling.
  - E. Provide loose stops, temporarily fixed for shipment, for all glazed, paneled, or louvered openings. Where indicated, "acoustical" frames shall be prepared for double glazing, with two sets of glass stops provided for installation of two separate glass panes in the same opening.
  - F. Frames shall have closed backs on jambs, transom bars, and headers where exposed, as noted or otherwise required. Exposed ends of sidelight and window frames shall, likewise, be closed. Exterior frames shall have an integral drip cap continuous along the frame header at door head. Back bands shall be of widths required by Drawing details, but not less than 1/2 in. wide. No raw edges shall be exposed.
  - G. Frames erected back-to-back shall be through-bolted together with at least three o.h. sex bolts spaced equidistant along the height of the stop with internal spacers at bolt locations. Provide internal splice reinforcement at jointure of frame heads.
  - H. New frames occurring in existing openings, or in locations where their size or construction could be influenced by existing work, shall be fabricated to those dimensions and existing conditions verified at the site.
  - I. Certain frames, where called for on Drawings, shall be provided with loose stops, internal reinforcement, and other required provisions for anchor bolt fastening at jambs into existing work.
  - J. Certain frames, where called for on the Drawings or in the Door Schedule, shall be prepared to receive alarm contacts, which shall be furnished and installed by Electrical Contractor.
  - K. Frames shall be shop mortised, internally reinforced, drilled and tapped for templated hardware, and provided with 26 gauge mortar guards at hardware cut-outs.
    - 1. Provide openings for rubber bumpers: Three per single door; two per double opening.
    - 2. Minimum Hardware Reinforcement Required:
 

Hinges:	8 gauge
Strike:	12 gauge
Closer:	12 gauge
Surface-Mounted Hardware:	12 gauge
  - L. Provide not less than three anchors per jamb up to 70 in. opening height and one additional for each additional 30 in. of opening height; of type suitable to wall construction or UL requirements of at least 16 gauge thickness; and, adjustable floor knee anchors. Frames mounted in steel stud partitions, or walls other than masonry, shall have adjustable jamb anchorage strut extensions to structure above.

### 2.03 Hollow Metal Doors:

- A. General: Provide flush doors of size and design indicated, of 1-3/4 in. thickness, fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8. Doors shall be neat in appearance, free of warp or buckle, and all bends sharp and true. All parts and reinforcements shall be of steel.

- B. Exterior Doors: Fabricated from metallic-coated steel sheet not less than 16 gauge thickness and conforming to ASTM A 653, Commercial Steel (CS), Type B; with minimum A60 zinc-iron-alloy (galvannealed) coating designation.
- C. Doors shall be internally reinforced by one of the following methods:
1. Minimum 22 gauge continuous, full height, full depth vertical stiffeners spaced not more than 6 in. apart and spot welded to each face sheet 4 in. on center, spaces between stiffeners filled full height with organic incombustible insulation.
  2. One-piece resin-impregnated honeycomb core with sanded edges and securely bonded to both face sheets.
  3. Interior of doors completely filled with a rigid urethane or styrene core, foamed in-place, and chemically bonded to all interior surfaces. Urethane foam is to be self-bonding, self-hardening, and self-extinguishing.
- D. Vertical door edges shall be mechanically interlocked or smooth with no visible welds as standard with manufacturer. Top and bottom edges shall be fully closed full width with continuous minimum 16 gauge channels welded to both face sheets. Exterior doors, and doors located in moisture-laden or wet locations, shall be fully closed and sealed weathertight.
- E. Doors shall have finished glass and louver openings of size indicated. Provide loose stops (temporarily fixed for shipment) for all glazed and louvered openings. Exterior doors shall have two weep holes in bottom edge and a flush filler for weather-strip attachment where such stripping is specified, and the core shall be insulated for a minimum R-value of 12.
- F. Doors shall be mortised, reinforced, drilled, and tapped at the factory for templated hardware.
1. Minimum hardware reinforcement required:
 

Hinge:	8 gauge
Locks, Bolts, Holders:	12 gauge
Closer:	12 gauge
Surface-Mounted Hardware:	12 gauge
  2. Reinforce doors as necessary to allow for attachment of hardware without through-bolting.

#### 2.04 Steel Finishes:

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Finish standard steel door and frames after assembly. All surfaces of frames, inner and outer, shall receive this treatment.
- B. Metallic-Coated Steel Surface Preparation: Clean galvannealed surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Steel Surface Preparation: Clean non-galvannealed surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove

mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." Phosphatize prior to prime paint application.

- D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free baked-on primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

### PART-3 EXECUTION

#### 3.01 Erection:

- A. Frames shall be temporarily braced in plumb and square final position until permanently built into the building construction. Frames shall be rigidly secured in place with jamb anchors tied into wall construction, and floor knees and sill anchors secured with expansion bolts or power-driven fasteners.
- B. Frames in masonry and concrete walls shall be filled full with grout. Secure ceiling struts to construction above with fasteners to suit conditions.
- C. Doors shall be hung with specified hardware to swing free, close snug, and stay in any open position.
- D. Where frames are too large to shop-assemble as one unit, field weld sections together and grind welds smooth.

#### 3.02 Existing Openings:

- A. Limited allowance is permitted in the manufacture of those doors and frames to be fitted into existing openings. The manufacturer may adhere to accepted industry standard sizes, with jamb and/or head frame members accordingly sized to accommodate the opening size. Such existing opening dimensions and surrounding construction conditions shall be verified at the site before those doors and frames are fabricated.

#### 3.03 Clearances:

Measured from finished floor material:

- A. Non-Fire-Rated Doors:
  1. Jambs and Heads: 3/32 in.
  2. Meeting Edges, Pairs of Doors: 1/3 in.
  3. Bottoms: 1/8 in. at thresholds or carpet; and, 3/8 in. elsewhere.
- B. Fire-Rated Doors: Comply with NFPA 80
- C. Smoke Doors: Doors in smoke partitions shall comply with NFPA 105.

3.04 Adjusting and Cleaning:

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

END OF SECTION

## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Solid core doors with wood veneer faces.
2. Factory finishing wood doors.
3. Factory fitting wood doors to frames and factory machining for hardware.
4. Louvers installed in flush wood doors.
5. Light frames and glazing installed in wood doors.

- B. Related Sections:

1. Division 08 Section "Door Schedule".
2. Division 08 Section "Hollow Metal Doors and Frames".
3. Division 08 Section "Glazing".
4. Division 08 Section "Door Hardware".

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

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ANSI A208.1 - Wood Particleboard.
3. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
4. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
5. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
6. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
7. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A classifications. Include factory finishing specifications.

- B. Shop Drawings shall include:

1. Indicate location, size, and hand of each door.
2. Indicate dimensions and locations of mortises and holes for hardware.
3. Indicate dimensions and locations of cutouts.
4. Indicate requirements for veneer matching.
5. Indicate location and extent of hardware blocking.
6. Indicate construction details not covered in Product Data.

7. Indicate doors to be factory finished and finish requirements.
8. Indicate fire protection ratings for fire rated doors.

C. Samples for Initial Selection: For factory finished doors.

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.
  - a. Provide samples for each species of veneer and core material.
  - b. Finish veneer faced door samples with same materials proposed for factory finished doors.
3. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. Warranty: Provide sample of manufacturer's warranty.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors".
- C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL10C.
  1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer's construction label, indicating compliance to independent 3<sup>rd</sup> party certification agency's procedure, except for size.
  2. Temperature Rise Limit: Where required and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.
  3. Smoke Control Door Assemblies: Comply with NFPA 105.
    - 1) Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
- D. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing flush wood doors.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.

- B. Package pre-finished doors individually in plastic bags and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top rail with opening number used on Shop Drawings.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

## 1.7 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - b. Telegraphing of core construction in wood face veneers exceeding 0.01 inch in a 3-inch span.
  - 2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.
  - 3. Warranty Period for Solid Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 DOOR CONSTRUCTION – GENERAL

- A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Premium.
- B. Fire Rated Doors: Provide construction and core as needed to provide fire ratings indicated.
  - 1. Category A Edge Construction: Provide fire rated door edge construction with intumescent seals concealed by outer stile (Category A) at 45, 60, and 90 minute rated doors. Comply with specified requirements for exposed edges.
  - 2. Pairs: Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
    - a. Provide fire retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals.
    - b. Where required for concealed hardware, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.

## 2.2 CORE CONSTRUCTION

### A. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.
2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.
3. Blocking: As indicated under article "Blocking".

## 2.3 BLOCKING

### A. Fire Rated Doors:

1. Provide blocking as indicated below:
  - a. HB1: 5 inch in doors indicated to have closers and overhead stops.

## 2.4 VENEERED DOORS FOR TRANSPARENT FINISH

### A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods: Architectural Series.
2. Eggers Industries: Premium Series.
3. Graham: GPD Series.

### B. Interior Solid Core Doors:

1. Grade: Premium.
2. Faces: Veneer grades as noted below; veneer minimum 1/50-inch (0.5mm) thickness at moisture content of 12% or less.
  - a. To match existing.
3. Match between Veneer Leaves: Book match.
4. Assembly of Veneer Leaves on Door Faces:
  - a. Running Match.
5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Transom Match: Continuous match.
7. Vertical Edges: Matching same species as faces. Wood or composite material, one piece, laminated, or veneered. Minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.

8. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit sanded before applying face veneers.
10. At doors over 40% of the face cut-out for lights and or louvers, furnish engineered composite lumber core.

## 2.5 LIGHT FRAMES AND GLAZING

- A. Wood Beads for Light Openings in Wood Doors up to and including 20-minute rating:
  1. Wood Species: Same species as door faces.
  2. Profile:
    - a. M1 Flush Bead.
    - b. At wood core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Metal Frames for Light Openings in Fire Rated Doors over 20-minute Rating: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.
  1. Manufacturers:
    - a. Air Louver.
    - b. All Metal Stamping.
    - c. Anemostat.
    - d. Pemko.
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

## 2.6 FABRICATION

- A. Factory fit doors to suit frame opening sizes indicated.
  1. Comply with requirements in NFPA 80 for fire rated doors.
  2. Undercut: As required per manufacturer's templates and sill condition.
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.
- C. Openings: Cut and trim openings through doors in factory.
  1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
3. Louvers: Factory install louvers in prepared openings.

D. Electrical Raceways: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.

## 2.7 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Transparent Finish: Provide a clear protective coating over the wood veneer allowing the natural color and grain of the selected wood species to provide the appearance specified. Stain is applied to the wood surface underneath the transparent finish to add color and design flexibility.

1. Finish: Meet or exceed WDMA I.S. 1A TR8 UV Cured Acrylated Polyester finish performance requirements.
2. Staining:
  - a. As selected by Architect from manufacturer's full range.
  - b. Custom stain to match architect's sample.
3. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

### 3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Installation Instructions: Install doors and frames to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.

C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

- D. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.
- E. Field modifications to doors shall not be permitted, except those specifically allowed by manufacturer or fire rating requirements.

### 3.3 ADJUSTING

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

END OF SECTION 081416



SECTION 08 4000 - ALUMINUM ENTRANCES AND STOREFRONTSPART-1 GENERAL1.01 Summary:

- A. This Section includes:
1. Aluminum entrances, including stile-and-rail doors and flush doors with aluminum facings.
  2. Aluminum storefront systems.
  3. Insulated metal panels that are glazed into aluminum storefront frames.
  4. Aluminum sills, trim, closures, and other accessories associated with entrance and storefront systems.
- B. Related work specified in other Sections:
1. Division 7 Section "Joint Sealants" for joint sealants installed at perimeter joints of frames, sills, trim, and other aluminum components.
  2. Division 8 Section "Aluminum Windows" for operable windows inserted in storefront frame openings.
  3. Division 8 Section "Door Hardware."
  4. Division 8 Section "Door Schedule."
  5. Division 8 Section "Glazing."
  6. Division 10 Section "Fixed Louvers" for louvers to be installed in aluminum doors or into aluminum storefront frames.
  7. Divisions 26 & 28 for security system work in aluminum entrances.

1.02 System Description and Performance Criteria:

- A. Entrance and storefront framing systems shall meet or exceed the performance requirements specified in this Section, and which equal or exceed those required by the Architectural Aluminum Manufacturers Association (AAMA). Test reports certified by an independent test laboratory on similar units must be available on request. Failure includes the following:
1. Air infiltration and water penetration exceeding specified limits.
  2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing units.
- B. Glazing: Physically and thermally isolate glazing from framing members.
- C. Thermally Broken Construction: Except where otherwise indicated, provide exterior entrance and storefront systems that isolate aluminum exposed to exterior from aluminum exposed to interior with a material of low thermal conductance.
- D. Wind Loads: Provide framing systems, including anchorage, capable of withstanding wind-load design pressures indicated on structural Drawings, or if not so indicated, pressures calculated according to the American Society of Civil Engineers' ASCE 7, "Minimum Design Loads for Buildings and Other Structures," 6.4.2, "Analytical Procedure," but under no circumstances less than a design pressure of 25 psf.
1. Deflection of framing members in a direction normal to wall plane is limited to 1/175 of clear span or 3/4 inch (19 mm), whichever is smaller, unless otherwise indicated.

2. Static-Pressure Test Performance: Provide framing systems that do not evidence material failures, structural distress, failure of operating components to function normally, or permanent deformation of main framing members exceeding 0.2 percent of clear span when tested according to ASTM E 330.
  - a. Test Pressure: 150 percent of inward and outward wind-load design pressures.
  - b. Duration: As required by design wind velocity; fastest 1 mile (1.609 km) of wind for relevant exposure category.
- E. Dead Loads: Provide framing system members that do not deflect an amount that will reduce glazing bite below 75 percent of design dimension when carrying full dead load.
  1. Provide a minimum 1/8-inch (3.18-mm) clearance between members and top of glazing or other fixed part immediately below.
  2. Provide a minimum 1/16-inch clearance between members and operable windows and doors.
- F. Live Loads: Provide framing systems, including anchorage, that accommodate the supporting structures' deflection from uniformly distributed and concentrated live loads indicated without failure of materials or permanent deformation.
- G. Resistance to Air Infiltration: Leakage in storefront systems shall not exceed 0.06 cu. ft. per minute per sq. ft. of wall area when tested in accordance with ASTM E 283 at a pressure differential of 6.24 psf.
- H. Resistance to Water Infiltration: No uncontrolled leakage when tested in accordance with ASTM E 331 at a test pressure differential as follows:
  1. Storefront System: 8 psf.
  2. Water leakage is defined as uncontrolled water infiltrating systems or appearing on systems' normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.
- I. Thermal Movements: Provide entrance and storefront systems, including anchorage, that accommodate thermal movements of systems and supporting elements resulting from the following maximum change (range) in ambient and surface temperatures without buckling, damaging stresses on glazing, failure of joint sealants, damaging loads on fasteners, failure of doors or other operating units to function properly, and other detrimental effects.
  1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- J. Structural-Support Movement: Provide entrance and storefront systems that accommodate structural movements including, but not limited to, sway and deflection.

### 1.03 Submittals:

- A. Product Data: For each product specified. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Indicate certified performance capabilities in compliance with the criteria specified herein.

- B. Shop Drawings: Show details of fabrication and installation, including plans, elevations, sections, details of components, provisions for expansion and contraction, attachments to other work, weepage, internal dams and seals, and adjoining construction.
1. Provide drawings, as reviewed by Architect, to other trades installing related and adjoining work, sufficiently in advance of such related work for coordination and proper construction of adjoining conditions.
  2. Doors, frames and hardware sets on the Shop Drawings shall carry the door, frame and hardware set numbers shown on the Contract Documents. If the manufacturer desires to use another numbering system, the shop drawings shall also contain the Architect's number. Failure to include the Architect's number on the shop drawings will be sufficient grounds for rejection without further action.
  3. Show miscellaneous aluminum trim for all applications not otherwise specified. Show related means of installation and fasteners.
- C. Samples for Verification
1. Main Framing Members: 8-inch long, full-size sections of extrusions with factory-applied color finish selected. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.
  2. Two insulated aluminum panel samples, minimum 6" x 6".
  3. Other representative samples of items shall be submitted to the Architect at his request.
- D. Field Test Reports: Upon request of Architect, submit independent laboratory test reports that show compliance with performance requirements for entrance and storefront systems.
- E. Maintenance Data: For aluminum-framed systems. Include in maintenance manuals.

#### 1.04 Quality Assurance:

- A. Installer Qualifications: Field erection shall be by manufacturer's franchised Installer, and by personnel experienced and regularly employed in this trade, with a history of successful in-service performance.
- B. Source Limitations: Obtain entrance and storefront systems through one source from a single manufacturer.

#### 1.05 Delivery, Storage and Handling:

- A. Components and units shall be well and properly protected, handled, and delivered undamaged to the site. Twisted, dented, or otherwise damaged units will be rejected. Items shall be carefully and neatly stored at the site on platforms or dunnage, and be fully covered and protected from damage by any cause.

#### 1.06 Project Conditions:

- A. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating systems without field

measurements. Coordinate construction to ensure actual dimensions correspond to established dimensions.

#### 1.07 Warranty:

- A. Special Warranty: Manufacturer's warranty in which manufacturer agrees to repair or replace aluminum entrances and storefronts that fail in materials or workmanship within **2 years** from date of Substantial Completion. Failures include, but are not limited to, the following:
1. Failure to meet performance requirements.
  2. Structural failures including excessive deflection.
  3. Water leakage, air infiltration, or condensation.
  4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  5. Insulating glass failure.
- B. Manufacturer's Special Warranty on Insulated Metal Panel Lamination: Written warranty, made out to Owner and signed by panel manufacturer agreeing to furnish replacements for insulated-panel units that delaminate, or evidence other failure due to improper lamination, within specified warranty period indicated below.
1. Warranty Period: **5 years** from date of Substantial Completion.

### PART-2 PRODUCTS

#### 2.01 Manufacturers:

- A. Subject to compliance with requirements, provide products by one of the following:
1. Kawneer Company, Inc. (**Basis of Design**)
  2. EFCO Corporation.
  3. International Aluminum Corporation; U.S. Aluminum.
  4. Tubelite Architectural Systems.
  5. YKK AP America Inc.
  6. Oldcastle Building Envelope.

#### 2.02 Materials:

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with the requirements of standards indicated below.
1. Sheet and Plate: ASTM B 209.
  2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
  3. Extruded Structural Pipe and Tubes: ASTM B 429.
  4. Bars, Rods, and Wire: ASTM B 211.
- B. Steel Reinforcement: Complying with ASTM A 36 for structural shapes, plates, and bars; ASTM A 611 for cold-rolled sheet and strip; or ASTM A 570 for hot-rolled sheet and strip.
- C. Other Steel Members: ASTM A7, bonderized and shop primed.

- D. Fasteners:
1. Concealed bolts, cadmium-plated steel.
  2. Exposed fasteners, stainless steel.
- E. Glazing Accessories: Manufacturer's standard pressure-glazing systems of black, resilient glazing gaskets, setting blocks, and shims or spacers; nonmigrating; compatible with sealants; fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- F. Refer to Section 08 8000 for more information on glazing.
- G. Sealants: Silicone, or other type recommended by manufacturer suited for each specific purpose, of color matching framing members.
- H. Door Weather-Stripping:
1. At Heads and Jambs: Compression-style thermoplastic elastomer in a tubular shape with a semirigid polymeric backing.
  2. At Meeting Stiles of Doors: Sliding weather-stripping of wool, polypropylene or nylon woven pile with nylon-fabric or aluminum strip backing complying with AAMA 701 requirements.
  3. At Door Bottoms: Unless thresholds specified in Division 8 Section "Finish Hardware" are of type with compression weather-stripping set into a raised door stop, equip door bottom rail with an EPDM blade sweep strip applied with concealed fasteners.
- I. Miscellaneous Items of Metal: Miscellaneous brake-formed aluminum trim and integral metal parts of entrance and storefront systems shall be furnished and installed to shape and size detailed or required. These members shall be aluminum, or other nonstaining metal, as follows:
1. Extruded Shapes: Minimum 0.062 in. thick for glass holding members.
  2. Sheet: Brake-formed, minimum 0.050 in. thick.
  3. Flashing: Minimum 0.024 in. thick.
- J. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos, formulated for 30-mil thickness per coat.

### 2.03 Entrance Systems:

- A. Glazed Stile-and-Rail Aluminum Doors: Provide manufacturer's standard 1-3/4-inch-thick glazed doors with minimum 0.125-inch-thick, extruded tubular rail and stile members. Provide stile and rail members from manufacturer's available options that most nearly equate to the sizes and profiles shown.
1. Basis of Design: Kawneer Series 500 Doors.
  2. Stile Design: Wide stile over 4 inches wide.
  3. Intermediate Rail Design (where rail is indicated): 7-1/2 to 8-1/2 inches high.
  4. Bottom Rail Design: 10 inches high.
  5. Glazing Preparation: Exterior doors shall be prepared for 1-inch tempered insulating glass. Interior doors shall be prepared for 1/4-inch tempered monolithic glass. Provide square glazing stops.

- B. Flush Aluminum Entrance Doors with Aluminum Facing:
1. Basis of Design: Kawneer Flushline Series.
  2. Face Sheets: Architectural quality, 5005 alloy aluminum sheet, 0.050-inch thick with laminated 1/8 in. hardboard backer.
    - a. Exposed Surface Texture: Embossed with vertical ribs.
  3. Core: Foamed-in-Place urethane, 2.5 pcf, CFC-free.
  4. Glazing Preparation: Where glazing is indicated, exterior doors shall be prepared for 1-inch tempered insulating glass.
- C. Unless otherwise shown, door frames shall be door manufacturer's standard 2 in. x 4-1/2 in. aluminum framing system(s), matching the adjoining storefront framing face dimension, and equipped with integral stops and weather-stripping.
- D. Provide drips, of matching finish, at all entrances that are flush to outside face of exterior wall.

#### 2.04 Storefront System:

- A. Provide 2 in. x 4-1/2 in. flush-glazed framing system where "Storefront" is indicated. Exterior storefront framing shall be prepared for 1-inch insulating glass units or insulated panels, and interior storefront framing shall be prepared for 1/4" monolithic glass units and glazing adapters; manufacturer's non-thermally-broken version of framing system, of matching dimensions, may be used at interior locations.
1. Basis of Design:
    - a. Exterior Storefront: Kawneer Trifab® VG 451UT.
    - b. Interior Storefront: Kawneer Trifab® VG 450, center glass plane.
  2. Provide sill flashing sections.
  3. Thermal Breaks in Storefront System: Manufacturer's standard mechanically and adhesively bonded high-density polyurethane, or insulbar, thermal break material separating inside portion of frame members from outside portion.
  4. Provide two-piece vertical mullions for expansion and contraction at suitable intervals in accordance with manufacturer's recommendations.

#### 2.05 Insulated Metal Panels:

- A. Laminated aluminum-faced insulated panels; flat, with no deviations in plane exceeding 1/16 inch in 24 inches or 1/8 inch over entire panel. Fabricate panels to the configuration indicated; and of the material, finish, and thickness indicated. Provide one panel to fill each entire opening without exposed joints.
1. Panel Sizes: As indicated.
  2. Panel Thickness: 1 inch, nominal.
  3. Face Sheets: 0.032" thickness, smooth-surfaced aluminum sheet complying with ASTM B 209, of alloy and temper as recommended by manufacturer for use and finish indicated. Finish as follows:
    - a. Exposed Face: Clear anodized in accordance with AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
    - b. Concealed Face: Mill.

4. Stabilizer Sheets: Manufacturer's standard nominally 3/16" thick corrugated plastic or 1/8" thick tempered water-resistant hardboard.
  5. Core: Polystyrene thermal insulation complying with ASTM C 578, Type IV or VII requirements, 1.60 lb/cu. ft. minimum density, and with an aged thermal-resistivity value of 5.00 deg F x h x sq. ft./Btu x in. at 75 deg F.
  6. Edge Configuration: Vented to the exterior, where feasible.
- B. Manufacturer of Insulated Aluminum Panels: Subject to compliance with requirements, provide panels by one of the following:
1. Citadel Architectural Products.
  2. Laminators, Inc.
  3. Mapes Industries, Inc.
  4. Panel Tech.

#### 2.06 Fabrication - General:

- A. Each system shall be designed to suit job conditions and conform to the details and dimensions indicated. Fabricate systems of tubular framing members, complete with all doors, reinforcing, anchors, trim, and other accessories and pertinent parts required to complete the Work.
1. Systems and other components shall be prefabricated and delivered preassembled to the maximum extent possible.
  2. Opening dimensions and surrounding construction conditions shall be verified at the site before doors and frames are fabricated.
  3. Provide formed and finished aluminum sheet trim where indicated. At exterior walls, fabricate trim to configuration and shape that is not continuous from outside to inside and that do not contribute to a thermal bridge, in combination with other wall components, from outside to inside.
  4. Connected door and frame members shall be fitted to flush hairline joints and utilize concealed fasteners to the maximum extent possible.
- B. Provide additional reinforcing wherever necessary to ensure the rigidity of framing systems.
1. The hinge side of each door jamb, when not applied directly to wall or other structural support, shall be reinforced internally the full height of overall frame opening.
- C. Assembly: Door stiles and rails shall be factory-assembled with concealed steel tension rods, or, by mechanical clip fastening and SIGMA deep penetration and fillet welds.
- D. Templates for finish hardware, specified in Division 8 Section "Door Hardware," shall be furnished to the entrance and door fabricator for use in mortising, cut-outs, reinforcement, and other required hardware preparation.
1. Reinforcement: Provide 1/8 in. aluminum or 7-gauge steel reinforcement for closers, hinges, and door strikes.
  2. Where indicated to receive electrified hardware or security system components, coordinate and prepare frames and doors to receive alarm contacts and other security system components.

2.07 Aluminum Door and Framing Finishes:

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Finish for all Exposed Aluminum Components: As determined by Architect from the following options:
  - 1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker. Interior aluminum may be AA-M12C22A31, Class II, 0.010 mm.
- D. Miscellaneous Finishes: Concealed aluminum items may be mill finish unless otherwise noted.

PART-3 EXECUTION3.01 Examination:

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

3.02 Erection:

- A. General: Comply with manufacturer's written instructions for installing entrances, doors, frames, hardware, accessories, and other components.
- B. Install entrances, frames, and trim level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to walls and other adjacent construction.
- C. Erect all components in a neat workmanlike manner, with joints neatly and tightly fitted and sealed. Joints shall be carefully and securely fastened with concealed fasteners.
- D. Set sill members in bed of sealant for weathertight construction.
- E. Assemble and install components to drain condensation, water penetrating joints, and moisture migrating within members to the exterior.
- F. Install complete anchorage systems to secure all components in a rigid manner to develop the full design criteria of the system and install all fasteners, caulking, and sealants necessary or required to make the system complete, sound, and weather-tight.
- G. Specified hardware shall be furnished to, and installed and adjusted by, the aluminum entrance fabricator/erector. Comply with all applicable installation requirements specified in Section 08710 "Finish Hardware." Coordinate with Electrical Contractor for proper installation of all related wiring, conduit, and powered connections.
  - 1. Provide temporary cylinders for construction period.

2. Install drips on head frame member of all entrance doors that are flush to outside face of exterior wall.
- H. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.
1. Concealed surfaces of members in contact with masonry and concrete shall be asphaltic-coated.
- I. Insulated aluminum panels shall be glazed into storefront framing. Coordinate and neatly cut openings in panels for duct passage and louver installation. Seal all edges watertight.
- J. Aluminum Trim: Includes extruded or brake-formed sills, covers, closures, and other shapes shown or necessary to finish, cover and protect substrate conditions that are not desirable to be exposed.
1. Unless extruded shapes are indicated, brake-form to profiles shown.
  2. Set sill members in bed of sealant for weather-tight construction.
  3. Where indicated, or where otherwise needed to provide thermal break, install compressible foam tape over supporting substrate. Install trim over tape, compressing it slightly, while mechanically attaching trim at concealed locations. Exterior trim sections shall generally not be permitted to extend more than 1 inch past the face of sealant, so as not to thermally bridge between the exterior and interior. Tape is not to be permanently relied on to hold trim.
  4. Provide trim with expansion joints not exceeding 12 ft. o/c. At each expansion joint, provide concealed splice plates of same material, finish and shape as cover trim. Secure splice plates with concealed mechanical fasteners. At vertical trim, in lieu of using splice plates, trim may be installed "shingle" style with each succeeding section overlapping the one below by no less than 1 inch.
  5. Seal overlaps at splice plates and other locations with a nonhardening, polyisobutylene sealant to prevent air, water and insect intrusion.

### 3.03 Adjusting:

- A. Adjust doors, hardware, and accessories to make a tight fit at contact points and weather-stripping for smooth operation and weather-tight closure. Lubricate hardware and moving parts.

### 3.04 Protection and Cleaning:

- A. Protect metal and glass surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact surfaces, remove contaminants immediately according to manufacturer's written recommendations.
- B. Clean aluminum surfaces immediately after installation in each major building area. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean glass immediately after installation in each major building area. Comply with manufacturer's written recommendations for cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- E. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensures systems are without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 08 5200 - ALUMINUM WINDOWSPART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following types of aluminum-framed windows and related work:
  - 1. Projected windows (inward projecting, bottom-hinged, "hopper" style).
- B. Related Sections include the following:
  - 1. Division 7 Section "Joint Sealants."
  - 2. Division 8 Section "Aluminum Entrances, Storefronts and Curtainwalls" for frames into which windows of this Section 08 5200 are to be installed.
  - 3. Division 8 Section "Glazing" for glazing requirements for aluminum windows.

## 1.2 DEFINITIONS

- A. HC: Heavy Commercial.
- B. Performance grade number, included as part of the AAMA/NWWDA product designation code, is actual design pressure in pounds force per square foot (pascals) used to determine structural test pressure and water test pressure.
- C. Structural test pressure, for uniform load structural test, is equivalent to 150 percent of design pressure.
- D. Minimum test size is smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

## 1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified and that are of test size indicated below:
  - 1. Minimum size required by AAMA/NWWDA 101/I.S.2.
- B. AAMA/NWWDA Performance Requirements: Provide aluminum windows of the performance class and grade indicated that comply with AAMA/NWWDA 101/I.S.2.
  - 1. Performance Class: HC
  - 2. Performance Grade for Fixed and Projected Windows: 60 minimum.

## 1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

- B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:
1. Joinery details.
  2. Flashing and drainage details.
  3. Weather-stripping details.
  4. Thermal-break details.
  5. Glazing details.
  6. Window system operators: Show locations, mounting and details for installing operator components and controls.
  7. Caulk stops and joint sealant configurations at opening perimeter joints.
- C. Samples for Verification: For aluminum window components required, submit samples of size indicated below.
1. Main Framing Member: 12-inch-long, full-size sections of extrusions with selected finish.
  2. Architect reserves the right to require additional samples that show fabrication techniques, workmanship, and design of hardware and accessories.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of aluminum window. Test results based on use of down-sized test units will not be accepted.
- E. Maintenance Data: For operable window sash, operating hardware, weather-stripping, and finishes. Include in maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.
- B. Source Limitations: Obtain aluminum windows through the same source as the aluminum storefront and curtainwall framing and from a manufacturer acceptable to the aluminum storefront and curtainwall framing manufacturer.
- C. Fenestration Standard: Comply with AAMA/NWWDA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
- D. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within **2 years** from date of Substantial Completion. Failures include, but are not limited to, the following:
1. Failure to meet performance requirements.
  2. Structural failures including excessive deflection.
  3. Water leakage, air infiltration, or condensation.
  4. Faulty operation of movable sash and hardware.
  5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  6. Insulating glass failure.
- B. Warranty Period for Insulating Glass: **10 years** from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Projected Windows: Subject to compliance with requirements, provide one of the following product lines:
1. Kawneer Company, Inc., Series 8225TL. (Basis of Design, with 2-1/4" deep frame)
  2. EFCO, Series 2700.
  3. Winco Manufacturing Co., Series 1175.
  4. TRACO, Series TR2800/TR2500.
  5. Wausau Window and Wall System, Series 2250.
  6. Win-Vent, Series 800.
  7. Custom Window Company, Series 8250
  8. Graham Architectural Products, Series 6500.
  9. YKKAP, Series YOW-225-TU
  10. Boyd Aluminum, Series 2300 Narrow Sightline or Series 2300
  11. Peerless, Series 1800 (2" depth) or 2500 (2-1/2" depth)

### 2.2 MATERIALS, GENERAL

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, not less than 16,000-psi minimum yield strength, and not less than 0.062-inch thickness at any location for the main frame and sash members.
- B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components. Cadmium-plated steel fasteners are not permitted.
1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125 inch thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
  2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

- C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated. Cadmium-plated steel anchors, clips, and accessories are not permitted.
- D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated. Cadmium-plated steel reinforcing members are not permitted.
- E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action, and completely concealed when aluminum window is closed.
  - 1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/NWWDA 101/I.S.2.
- F. Replaceable Weather Seals: Comply with AAMA 701/702.
- G. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.
- H. Caulk Stops: If aluminum frame abutting wall opening does not have integrally extruded caulk stop returns, provide PVC or aluminum caulk stop inserts at all perimeter frame members, effective for interior and exterior sealant applications.

### 2.3 GLAZING

- A. Glass and Glazing Materials: Refer to Division 8 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.
  - 1. Units shall be wet seal glazed.
- B. Glazing System:
  - 1. Manufacturer's standard factory-glazed system for 1-inch insulating glass.

### 2.4 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows and sized to accommodate sash or ventilator weight and dimensions. Cadmium-plated hardware is not permitted. Do not use aluminum in frictional contact with other metals. Where exposed, provide solid bronze die-cast zinc with special coating finish or nonmagnetic stainless steel.
- B. Project-In Windows: Provide the following operating hardware:
  - 1. Hinges: Concealed four- or six-bar friction hinge, complying with AAMA 904, with positive stop and adjustable-slide friction shoe of nylon or other nonabrasive, nonstaining, noncorrosive, durable material; two hinges per ventilator.

2. Operating Handle and Lock (for all ventilators with bottom rail at or below 5'-8" A.F.F.): Combination lever handle and cam-action lock with concealed pawl and keeper; one per ventilator if 40" or less wide; if over 40" wide, provide two per ventilator.
3. Operator (for all ventilators with locking rail/operator above 5'-8" A.F.F.): Pivot-shoe-type, gear-type rotary operator.

## 2.5 WINDOW FABRICATION

- A. General: Fabricate aluminum windows, in sizes indicated, that comply with AAMA/NWWDA 101/I.S.2 for window types, performance class and performance grade indicated. Include a complete system for assembling components and anchoring windows.
  1. Frame: Minimum 2 inches deep. Perimeter frame shall be continuous unless window configuration exceeds the maximum test size and stacking and/or mullions are required to comply with performance requirements.
- B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.
- D. Weather-Stripping: Provide full-perimeter weather-stripping for each operable sash and ventilator.
- E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- F. Factory-Glazed Fabrication: Comply with requirements in Division 8 Section " Glazing" and with AAMA/NWWDA 101/I.S.2.
- G. Glazing Stops: Provide snap-on glazing stops coordinated with Division 8 Section "Glazing" and glazing system indicated. Provide glazing stops to match color of sash and ventilator frames.

## 2.6 WINDOW FINISH

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Finish for all Exposed Aluminum Components: As determined by Architect from the following options:
  1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker. Interior aluminum may be AA-M12C22A31, Class II, 0.010 mm.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; operational clearances; and other conditions affecting performance of work.
  - 1. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets for weathertight construction. Do not obstruct proper drainage of window system.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

### 3.3 ADJUSTING

- A. Adjust operating sashes and ventilators, hardware, and accessories for a tight fit at contact points and weather-stripping for smooth operation and weathertight closure. Lubricate and adjust hardware and moving parts.

### 3.4 PROTECTION AND CLEANING

- A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

- C. Clean glass immediately after installing and glazing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION



SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Sliding doors.
  - 3. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Electromechanical door hardware, power supplies, back-ups and surge protection.
  - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
  - 1. Division 08 Section “Door Hardware Schedule”.
  - 2. Division 08 Section “Hollow Metal Doors and Frames”.
  - 3. Division 08 Section “Interior Aluminum Doors and Frames”.
  - 4. Division 08 Section “Flush Wood Doors”.
  - 5. Division 08 Section “Access Control Hardware”.
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 80 - Fire Doors and Windows.
  - 4. NFPA 101 - Life Safety Code.
  - 5. NFPA 105 - Installation of Smoke Door Assemblies.
  - 6. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards:
  - 1. ANSI/BHMA Certified Product Standards - A156 Series
  - 2. UL10C – Positive Pressure Fire Tests of Door Assemblies

### 1.3 SUBMITTALS

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

2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
  1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.
  1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

- E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
    - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
    - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
      - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
      - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
    - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
  3. NFPA 101: Comply with the following for means of egress doors:
    - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
    - b. Thresholds: Not more than 1/2 inch high.
  4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
    - a. Test Pressure: Positive pressure labeling.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
1. Function of building, purpose of each area and degree of security required.
  2. Plans for existing and future key system expansion.
  3. Requirements for key control storage and software.
  4. Installation of permanent keys, cylinder cores and software.

5. Address and requirements for delivery of keys.

- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  3. Review sequence of operation narratives for each unique access controlled opening.
  4. Review and finalize construction schedule and verify availability of materials.
  5. Review the required inspecting, testing, commissioning, and demonstration procedures
- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

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

#### 1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

- C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

#### 1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  - 1. Structural failures including excessive deflection, cracking, or breakage.
  - 2. Faulty operation of the hardware.
  - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
  - 1. Ten years for mortise locks and latches.
  - 2. Five years for exit hardware.
  - 3. Twenty five years for manual surface door closers.
  - 4. Two years for electromechanical door hardware.

#### 1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

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

### 2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.
    - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
  2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
  3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
  - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
    - 1) Out-swinging exterior doors.
    - 2) Out-swinging access controlled doors.
    - 3) Out-swinging lockable doors.
5. Acceptable Manufacturers:
  - a. Hager Companies (HA).
  - b. McKinney Products (MK).
  - c. Ives (IV)

B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Acceptable Manufacturers:
  - a. Hager (HA).
  - b. Ives (IV).
  - c. Pemko Manufacturing (PE).
  - d. Select (SE).

## 2.3 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
- C. Cylinders: Original manufacturer cylinders complying with the following:
  1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
  2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored-Lock Type: Cylinders with tailpieces to suit locks.

4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  5. Keyway: Match Facility Restricted Keyway.
- D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified patented cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
1. Acceptable Manufacturers:
    - a. Schlage Lock (SC) - Everest D Series.
- E. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:
1. Master Key System: Cylinders are operated by a change key and a master key.
- F. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two (2)
  2. Master Keys (per Master Key Group): Two (2)
- G. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

## 2.4 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.
1. Acceptable Manufacturers:
    - a. Schlage (SC) – L9000 Series.
    - b. No Substitution – Facility Standard.
- B. Lock Trim Design: As specified in Hardware Sets.

## 2.5 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
  2. Strikes for Bored Locks and Latches: BHMA A156.2.
  3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
  4. Dustproof Strikes: BHMA A156.16.

## 2.6 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
  2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
    - a. Fire Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions to be used only with exit devices for which they have been tested.
  3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is not acceptable except in any case where the door light extends behind the device as in a full glass configuration.

5. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
  6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
    - b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.
  7. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.
  8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.
1. Acceptable Manufacturers:
    - a. Von Duprin (VD) - 35A/98 XP Series.
    - b. No Substitution – Facility Standard.
- C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish. Provide keyed removable feature, stabilizers, and mounting brackets as specified in the Hardware Sets. At openings designed for severe wind load conditions due to hurricanes or tornadoes, provide manufacturers approved mullion and accessories to meet applicable state and local windstorm codes.
1. Acceptable Manufacturers:
    - a. Von Duprin (VD) - 9954 Series.

## 2.7 DOOR CLOSERS

### A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
  - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
  - c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
  - d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

### B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Acceptable Manufacturers:
  - a. LCN Closers (LC) - 4040XP Series.
  - b. No Substitution – Facility Standard.

## 2.8 ARCHITECTURAL TRIM

### A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:
  - a. Stainless Steel: 300 series, .050-inch thick, with countersunk screw holes (CSK).
4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.
6. Acceptable Manufacturers:
  - a. Ives (IV).
  - b. Rockwood Manufacturing (RO).
  - c. Trimco (TC).

## 2.9 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
  1. Acceptable Manufacturers:
    - a. Ives (IV).
    - b. Rockwood Manufacturing (RO).
    - c. Trimco (TC).

## 2.10 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Acceptable Manufacturers:
  - 1. Pemko Manufacturing (PE).
  - 2. Reese Enterprises, Inc. (RS).
  - 3. National Guard (NG).

## 2.11 ELECTRONIC ACCESSORIES

- A. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
  - 1. Acceptable Manufacturers:
    - a. Von Duprin (VO) - PS.

## 2.12 FABRICATION

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

## 2.13 FINISHES

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

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

### 3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### 3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

### 3.5 ADJUSTING

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

### 3.6 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.

- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

### 3.7 DEMONSTRATION

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

### 3.8 DOOR HARDWARE SCHEDULE

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
- B. Manufacturer's Abbreviations:

1. MK - McKinney
2. AD - Adams Rite
3. PE - Pemko
4. RF - Rixson
5. RO - Rockwood
6. VD - Von Duprin
7. SC - Schlage
8. 00 - Other
9. BL - Blumcraft
10. IV - Ives
11. HS - HES
12. FO - Folger Adam
13. LC - LCN Closers
14. OT - By Others
15. BM - Besam
16. SU - Securitron
17. FA - Falcon
18. LU - Lund Equipment Co., Inc.

#### **Hardware Schedule**

**Set: 1.0**

Doors: A103-CA

2 Continuous Hinge	CFM__HD1		PE
1 Mullion	KR4954 7'0	SP28	VD
1 Rim Exit Device	CD XP98EO	US32D	VD
1 Rim Exit Device	CD XP98NL-OP 110MD-NL	US32D	VD
1 Vandal Resistant Trim	VR910-DT	630	IV
1 Vandal Resistant Trim	VR910-NL	630	IV
3 Cylinder	Cylinder as required.	626	SC
2 Door Closer	4040XP SCUSH	AL	LC
1 Weatherstrip	By Door/ Frame Manufacturer		00
2 Sweep	307APK		PE

**Set: 2.0**

Doors: A103-CC, A103-CD, A108C-A, A108C-B, AS1-B, B106C-A, B106C-B

2 Continuous Hinge	CFM__HD1		PE
1 Mullion	KR4954 7'0	SP28	VD
1 Rim Exit Device	CD XP98EO	US32D	VD
1 Rim Exit Device	CD XP98NL-OP 110MD-NL	US32D	VD
1 Vandal Resistant Trim	VR910-DT	630	IV
1 Vandal Resistant Trim	VR910-NL	630	IV
3 Cylinder	Cylinder as required.	626	SC
2 Door Closer	4040XP SCUSH	AL	LC
1 Threshold	171A MS10SS		PE
1 Weatherstrip	By Door/ Frame Manufacturer		00
2 Sweep	307APK		PE

**Set: 3.0**

Doors: A103-CB

2 Continuous Hinge	CFM__HD1		PE
1 Mullion	KR4954 7'0	SP28	VD
2 Rim Exit Device	CD XP98EO	US32D	VD
2 Vandal Resistant Trim	VR910-DT	630	IV
2 Cylinder	Cylinder as required.	626	SC
2 Door Closer	4040XP SCUSH	AL	LC
1 Weatherstrip	By Door/ Frame Manufacturer		00

2 Sweep 307APK PE

**Set: 4.0**

Doors: AS3-B

2 Continuous Hinge	CFM__HD1		PE
1 Mullion	KR4954 7'0	SP28	VD
2 Rim Exit Device	CD XP98EO	US32D	VD
2 Vandal Resistant Trim	VR910-DT	630	IV
2 Cylinder	Cylinder as required.	626	SC
2 Door Closer	4040XP SCUSH	AL	LC
1 Threshold	171A MS10SS		PE
1 Weatherstrip	By Door/ Frame Manufacturer		00
2 Sweep	307APK		PE

**Set: 5.0**

Doors: C021E-A

3 Hinge	TA2714 x NRP	US26D	MK
1 Classroom Lock	L9070 L 17	626	SC
1 Cylinder	Cylinder as required.	626	SC
1 Door Closer	4040XP CUSH	AL	LC
1 Kick Plate	K1050 10" X 2" LDW 4BE CSK	US32D	RO
1 Door Stop	409	US32D	RO
3 Silencer	608		RO

**Set: 6.0**

Doors: C021-B, C021C-A, C021D-A, C021D-B

3 Hinge	TA2714 x NRP	US26D	MK
1 Security Classroom Lock	L9071 L 17	626	SC
2 Cylinder	Cylinder as required.	626	SC
1 Door Closer	4040XP CUSH	AL	LC
1 Kick Plate	K1050 10" X 2" LDW 4BE CSK	US32D	RO
1 Door Stop	409	US32D	RO
3 Silencer	608		RO

**Set: 7.0**

Doors: C021-A

3 Hinge (heavy weight)	T4A3786	US26D	MK
1 Storeroom Lock	L9080 L 17	626	SC
1 Cylinder	Cylinder as required.	626	SC
1 Electric Strike	6211	US32D	VD
1 Door Closer	4040XP REG	AL	LC
1 Kick Plate	K1050 10" X 2" LDW 4BE CSK	US32D	RO
1 Weatherstrip	By Door/ Frame Manufacturer		00
1 Sweep	307APK		PE
1 Push Button	PB		SU
1 Power Supply	PS900		FA

Notes: CARD READER BY OTHERS. PRESENTING AUTHORIZED CREDENTIAL TO CARD READER OR PUSH BUTTON AT RECEPTION DESK WILL UNLOCK ELECTRIC STRIKE ALLOWING ACCESS. FREE EGRESS BY LEVER.

END OF SECTION 087100

SECTION 08 8000 - GLAZINGPART-1 GENERAL1.01 Summary:

- A. This Section includes glass and glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Aluminum windows.
  2. Doors.
  3. Glazed entrances and storefront framing.
  4. Interior hollow metal framing, including borrowed lites.
  5. Fire-protection rated glazing.
- B. Related work specified in other Sections:
1. Division 08 Section "Aluminum Entrances and Storefronts" for glazing accessories for use in those systems.
  2. Division 08 Section "Aluminum Windows" for factory-glazing of aluminum windows.
- C. Definitions:
1. VLT (or Tvis): Visible Light Transmittance; a higher VLT value indicates that a greater amount of visible spectrum incident light is passing through the glazing.
  2. SHGC: Solar Heat Gain Coefficient; the fraction of the heat from the sun that enters through a window, expressed as a number between 0 and 1.

1.02 Performance Requirements:

- A. General: Provide glazing systems capable of withstanding normal movement and wind and impact loads (where applicable) without failure, including loss or breakage attributable to the following: Defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and strengths required to meet or exceed the following criteria:
1. Minimum glass thickness shall comply with ASTM E 1300, with a Design Wind Load of 25 lbs. per sq. ft. and probability of breakage for vertical glazing of 8 lites per 1000 when subjected to a load duration of 60 seconds or less.
  2. Minimum Glass Thickness for Aluminum Frames: Not less than 1/4 inch.
- C. Thermal Movement: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg. F, ambient; 180 deg. F, material surfaces.

1.03 Submittals:

- A. Product Data: For each glass product and glazing material indicated or required.
- B. Samples for Initial Selection: Submit 6" x 6" square samples of manufacturer's full range of tinted monolithic glass units for initial selection of "colored" or "tinted" glass units.
- C. Samples for Verification:
  - 1. Submit 12 in. x 12 in. square samples as follows, for verification of proposed selections for each different color and combination of exterior, insulating float glass, insulating unit assemblies representative of the products that will be furnished for glazing.
  - 2. Fire protection rated glazing products (may be 6 in. x 6 in. samples).
- D. Glazing Schedule: List glass types, thicknesses, VLT and SHGC for each glass product. Use same designations indicated on Drawings.
- E. Shop Drawings: Include building elevations showing glass types and locations for each glazed exterior opening, as follows:
  - 1. Aluminum windows and storefronts.
  - 2. Doors and sidelights.
- F. Certificates: Submit certificates from respective manufacturers attesting that glass and glazing materials furnished for the Project comply with requirements.

1.04 Quality Assurance:

- A. Glazing for Fire-Resistance Rated Door and Window Frame Assemblies: Glazing for assemblies that comply with NFPA 80 that are listed and labeled by Underwriters Laboratories (UL), for fire ratings indicated, based on testing per NFPA 252.
- B. Safety Glazing Materials: Comply with testing requirements in 16 CFR 1201 as follows:
  - 1. Vision panels 100 sq. in. or less in area located in fire-resistance-rated doors shall comply with Category I requirements.
  - 2. All other safety glazing materials shall comply with Category II requirements.
- C. Glass dimensions shall be verified from the work at the building or from the manufacturer of the frames, doors, etc. in which the glass is to be set, prior to ordering.
- D. Source Limitations: Obtain each different type of glass unit from a single manufacturer. Multiple manufacturers may be used, but not for the same type of glass. Do not mix glass products from different manufacturers in the same insulating glass units.

1.05 Warranty:

- A. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  - 1. Warranty Period: **10 years** from date of Substantial Completion.

2. Deterioration of insulating glass shall include failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

## PART-2 PRODUCTS

### 2.01 Manufacturers:

- A. Subject to compliance with requirements, glass products shall, unless indicated otherwise, be produced by one or more of the following manufacturers:
  1. AGC Flat Glass North America, Inc.
  2. PPG Industries, Inc.
  3. Pilkington North America
  4. Guardian Industries Corp.

### 2.02 Glass Materials:

- A. Glass materials and types shall be as indicated on the Drawings and as herein defined. All glass shall bear the manufacturer's identifying label.
- B. Primary Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); class as indicated in "Glass Schedule" Article.
- C. Heat-Treated Float Glass: ASTM C 1048, Type I (transparent glass, flat), Quality q3 (glazing select); class, kind, and condition as indicated in other paragraphs of this Section.
- D. Silicone-Coated Spandrel Glass: ASTM C 1048, Condition C (spandrel glass, one surface silicone coated), Type I (transparent flat glass), Quality-Q3, and complying with other requirements specified.
  1. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.
- E. Sealed Insulating Glass Units for Aluminum Frames: Preassembled 1-inch thick units consisting of inner pane and outer pane of glass separated by a dehydrated air space hermetically sealed with a metal-to-glass bond; complying with ASTM E 774 for Class CBA units and with requirements specified in "Glass Schedule" Article.
  1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
  2. Spacer Specifications: Aluminum with medium bronze-anodized finish; manufacturer's standard corner construction; dessicant shall be molecular sieve or silica gel, or blend of both.
  3. Provide manufacturer's **10 year** warranty.
- F. Fire Protection Rated Glazing: Technical Glass Products Firelite Plus, 5/16-inch thick fire-rated and safety-rated (Cat. I & II) clear ceramic glazing, with premium grade polished Firelite Plus surfaces only.

### 2.03 Auxiliary Glazing Materials:

- A. Glazing tapes, compounds, and sealants shall be as recommended by frame or door manufacturer, compatible with adjoining materials, in compliance with applicable regulatory requirements, and, where in a fire-rated opening, identical to product used in test assembly.
  - 1. VOC Content: Sealants used inside of the weatherproofing system shall be in accordance with the referenced standards recognized by LEED for Schools indicated in Division 01 Section "LEED Requirements."
- B. Gaskets and wedges furnished by aluminum frame manufacturer and, when not factory-glazed, by window manufacturer.
- C. Coordinate vision light frame glazing pocket sizes for the fire-protection rated glazing applicable to each fire-rated door. Refer to Division 08 Sections "Hollow Metal Doors and Frames" and "Wood Doors," under which vision light frames and stops are to be supplied.

### 2.04 Glass Applications:

- A. Monolithic Uncoated Clear Float Glass: Class 1 (clear) units. Provide Kind FT (fully tempered) at all applications.
  - 1. **Applications:** For all interior uses, except for fire-rated openings.
  - 2. **Thickness:** Minimum 1/4-inch, except where thicker is noted or is required by performance criteria.
- B. Sealed Insulating Glass - **Clear Vision Units:** 1-inch thick, low-emissivity units. Comply with the following:
  - 1. Outdoor Lite: 1/4-inch thick, Type I (transparent glass, flat), Class 1 (clear) float glass.
  - 2. Air Space: 1/2 inch thick.
  - 3. Indoor Lite: 1/4-inch thick, Type I (transparent glass, flat), Class 1 (clear) float glass.
  - 4. Low-Emissivity Coating: Pyrolitic or sputter-coat application, on second or third surface.
  - 5. Provide the following performance characteristics:
    - a. Visible Light Transmission: 60% (+4%/-2%).
    - b. Solar Heat Gain Coefficient: 0.2 – 0.3.
  - 6. **Applications:** For all building exterior uses, including glazing in entrances and storefront framing, except where tinted or spandrel glass units are indicated.
    - a. Provide Kind FT (fully tempered) at all exterior entrances and storefront framing below door head height, and at all other locations where safety glass is required by law or regulation or indicated on the Drawings.
    - b. Provide Kind HS (heat-strengthened) float glass in place of annealed where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article.
    - c. Otherwise, kind may be annealed.

- C. **Sealed Insulating Glass – Tinted/Colored Vision Units:** 1-inch thick, low-emissivity units. Comply with the following:
1. **Outdoor Lite:** 1/4-inch thick, Type I (transparent glass, flat), Class 2 (tinted) float glass. Tint shall be selected by Architect from manufacturer's full range.
  2. **Air Space:** 1/2 inch thick.
  3. **Indoor Lite:** 1/4-inch thick, Type I (transparent glass, flat), Class 1 (clear) float glass.
  4. **Low-Emissivity Coating:** Pyrolitic or sputter-coat application, on second or third surface.
  5. Provide the following performance characteristics:
    - a. **Solar Heat Gain Coefficient:** 0.2 – 0.4.
  6. **Applications:** For building exterior uses where noted on Drawings.
    - a. Provide Kind FT (fully tempered) at all exterior entrances and storefront framing below door head height, and at all other locations where safety glass is required by law or regulation or indicated on the Drawings.
    - b. Provide Kind HS (heat-strengthened) float glass in place of annealed where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article.
    - c. Otherwise, kind may be annealed.
- D. **Sealed Insulating Glass - Spandrel Units:** 1-inch thick units, **visible one side.** Comply with the following:
1. **Outdoor Lite:** 1/4-inch thick, Type I (transparent glass, flat), Class 2 (tinted) float glass.
    - a. **Tint Color:** Match vision units.
  2. **Air Space:** 1/2 inch thick.
  3. **Indoor Lite:** 1/4-inch thick, Type I (transparent glass, flat), Class 1 (clear) float glass.
    - a. **Opaque Silicone Coating Color:** Provide color that allows exterior appearance of unit to match the vision insulated glass units as closely as possible.
    - b. **Coating Location:** Fourth surface.
  4. **Applications:** For spandrel units visible from one side as designated on Drawings.
    - a. Provide Kind FT (fully tempered) at all exterior storefront framing below door head height, and at all other locations where safety glass is required by law or regulation or indicated on the Drawings.
    - b. Provide Kind HS (heat-strengthened) float glass in place of annealed where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article.
- E. **Sealed Insulating Glass - Spandrel Units:** 1-inch thick units, **visible two sides.** Comply with the following:
1. **Outdoor Lite:** 1/4-inch thick, Type I (transparent glass, flat), Class 1 (clear) float glass.
    - a. **Opaque Silicone Coating Color:** Provide color that allows exterior appearance of unit to match the vision insulated glass units as closely as possible.
    - b. **Coating Location:** Second surface.
  2. **Air Space:** 1/2 inch thick.

3. Indoor Lite: 1/4-inch thick, Type I (transparent glass, flat), Class 1 (clear) float glass.
    - a. Opaque Silicone Coating Color: Provide color that allows exterior appearance of unit to match the vision insulated glass units as closely as possible.
    - b. Coating Location: Third surface.
  4. **Applications:** For spandrel units visible from two sides as designated on drawings.
    - a. Provide Kind FT (fully tempered) at all exterior storefront framing below door head height, and at all other locations where safety glass is required by law or regulation or indicated on the Drawings.
    - b. Provide Kind HS (heat-strengthened) float glass in place of annealed where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in "Performance Requirements" Article.
- F. Fire-Protection Rated Glazing: Provide for interior doors and sidelights of fire-rated openings.

### PART-3 EXECUTION

#### 3.01 Glazing - General:

- A. Glazing shall be performed in accordance with practices recommended in the Flat Glass Jobbers Association installation manual, as herein specified, and as recommended by the glazing materials, frame and window manufacturers.
- B. Glass shall be set with smooth straight edges and to the full sizes required by the openings.
- C. Surfaces to receive glazing compounds shall be thoroughly cleaned and prepared in compliance with compound manufacturer's recommendations.
- D. Install glass units in accordance with glass and framing manufacturer's printed instructions, with setting blocks, spacers, and all other necessary accessories as recommended, and as required for coverage by the glass manufacturer's warranty.
- E. Guarantee work under this Section in accordance with Contract Documents against leakage of water and against glass breakage due to faulty materials or workmanship of installation.

#### 3.02 Glazing Wood Doors:

- A. Bed glass in glazing compound and secured in place with wood moldings or metal trim, as applicable, furnished by the door manufacturer. Fill nail holes with filler having compatible color to molding finish.

#### 3.03 Glazing Hollow Metal Doors and Frames:

- A. Secure glass in place by metal moldings furnished by the door or frame manufacturer, and bedding tape, compound, and/or sealant recommended by the door or frame manufacturer.

#### 3.04 Glazing Aluminum Windows, Entrances and Storefronts:

- A. Install glass units using snap-in type stops and gaskets provided by door and frame manufacturer.

### 3.05 Aluminum Windows:

- A. Aluminum windows shall be factory-glazed, per manufacturer's standards of construction. Refer to Division 08 Section "Aluminum Windows."

### 3.06 Protection and Cleaning:

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Wash all exposed surfaces of new entrance and framing systems also, as recommended by those system manufacturers.

END OF SECTION



## SECTION 08 9119 - FIXED LOUVERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Fixed, extruded-aluminum louvers.

##### B. Related Requirements:

1. Section 08 4000 "Aluminum Entrances, Storefronts and Curtainwalls" for doors into which louvers are to be installed.

#### 1.2 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

- B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

- C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).

- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

- E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

#### 1.3 ACTION SUBMITTALS

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

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

- C. Samples: For each type of metal finish required.

## 1.4 FIELD CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on a uniform pressure of 30 lbf/sq. ft., acting inward or outward.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

### 2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louvers: For application as shown on Elevation 1/A4.1 between upper and lower storefront systems.
  - 1. Basis of Design: Construction Specialties Model A4097.
  - 2. Manufacturers: Subject to compliance with requirements, provide approved equal products by one of the following:
    - a. Airolite Company, LLC (The).
    - b. American Warming and Ventilating; a Mestek Architectural Group company.
    - c. Architectural Louvers; Harray, LLC.
    - d. Industrial Louvers Inc.
  - 3. Louver Depth: 4 inches.
  - 4. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
  - 5. Mullion Type: Exposed.

6. Louver Performance Ratings:
  - a. Free Area: Not less than 50.4% for 48-inch-wide by 48-inch-high louver.
  - b. Point of Beginning Water Penetration: Not less than 900 fpm.
  - c. Air Performance: Not more than 0.15-inch wg static pressure drop at 900-fpm free-area velocity.
7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

B. Horizontal, Wind-Driven-Rain-Resistant Louver for Openings in Storefront Frame:

1. Basis of Design: Construction Specialties Model RSH-5700.
2. Manufacturers: Subject to compliance with requirements, provide approved equal products by one of the following:
  - a. Airolite Company, LLC (The).
  - b. American Warming and Ventilating; a Mestek Architectural Group company.
  - c. Architectural Louvers; Harray, LLC.
  - d. Industrial Louvers Inc.
3. Louver Depth: 5 inches.
4. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
5. Louver Performance Ratings:
  - a. Free Area: Not less than 45.8% for 48-inch-wide by 48-inch-high louver.
  - b. Air Performance: Not more than 0.13-inch wg static pressure drop at 900-fpm free-area intake velocity.
  - c. Wind-Driven Rain Performance: Not less than 99percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 500 fpm.
6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

## 2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
  1. Screen Location for Fixed Louvers: Interior face.
  2. Screening Type: Insect screening.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
  1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
  2. Finish: Mill finish unless otherwise indicated.
  3. Type: Non-rewirable, U-shaped frames.
- D. Louver Screening for Aluminum Louvers:
  1. Insect Screening: Stainless steel, 18-by-18 mesh, 0.009-inch wire.

## 2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Fasteners: Use types and sizes to suit unit installation conditions.
  - 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
  - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

## 2.6 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing to produce uniform appearance.
- C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  - 1. Frame Type: Channel unless otherwise indicated.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Provide extended sills for recessed louvers.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.7 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Clear Anodic Finish (for all louvers except those noted to have “Colored Finish”): AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
- C. High-Performance Organic Finish (for louvers with “Colored Finish”): Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### 3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

### 3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

## SECTION 09 0610 - ROOM FINISH SCHEDULE

### PART-1 GENERAL

#### 1.01 Summary:

- A. This Section includes the attached Room Finish Schedule.
- B. The Room Finish Schedule indicates the intended interior substrate materials and exposed field-applied finishes, but is not necessarily comprehensive. Other portions of the Drawings or Specifications may indicate selective or particular requirements for specific rooms or locations.
- C. Unless otherwise indicated, unscheduled/unnumbered dependent spaces, such as closets, shall be considered a part of that major scheduled area or room in which they occur, or to which they adjoin, and the scheduled finishes shall likewise be applied to such areas.
- D. Finish work includes surface preparation, unless indicated as included under the responsibilities of related Sections or separate contractors.
- E. Refer to other Sections for specifications regarding each new or modified substrate and finish indicated.
- F. Related work specified in other Sections:
  - 1. Various Division 01 Sections for general requirements related to cutting and patching.
  - 4. Unit Masonry Assemblies- Section 04 2000
  - 5. Metal Fabrications - Section 05 5000
  - 7. Finishes – Other Division 09 Sections
  - 8. Painting Schedules – Section 09 9000
- H. Field-applied exterior finishes are indicated on the Drawings or in other Sections.
- I. All references to "North," "East," etc. are based on Project North as shown on Drawings.

### PART-2 PRODUCTS

Not Used.

### PART-3 EXECUTION

#### 3.01 Room Finish Schedule:

- A. Refer to schedule, attached to following pages.



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**GENERAL NOTES:**

1. For Footnotes, see last page of Schedule.
2. Unless material or finish is preceded by "Existing" (Ex.), schedule is indicating new materials and finishes.
3. New finishes are field-applied, unless indicated otherwise.
4. Unless otherwise indicated, unnumbered subordinate spaces, such as closets or passageways, shall be finished the same as the room they serve, whether or not separated by a door from the main space.
5. Paint any new exposed sprinkler piping.

**ABBREVIATIONS:**

ACT	Acoustical Tile	FRP	Fiberglass Reinforced Plastic Panels
Conc.	Concrete	GL.	Glass or Glazed
CMU	Concrete Masonry Units	Gyp. Bd.	Gypsum Board
CPT	Carpet	PLAS.	Plaster
CT	Ceramic Tile	PNT	Paint
DFS	Direct-applied Finish System	RGB	Reinforced Gypsum Board
ETR.	Existing to Remain	RUB.	Rubber
Exist.	Existing	SAT	Spray Acoust. Treatment
Exp.	Exposed	Terr.	Terrazzo
		VCT	Vinyl Composition Tile

Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes	
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height		
<b>FIRST FLOOR PLAN AREA A</b>																	
A017	RECEPTION	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	7'-10"	
A017A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	7'-6"	
A017B	COPY	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	7'-6"	1
A017 AB	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	8'-0"	1
A100	VESTIBULE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	9'-6"	2	
A101	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
A102	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1

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Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes	
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height		
A103	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
A103C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	13'-9"	
A104	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
A105	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
A106	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
A107	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
A107C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	7'-10"	1, Clg. slopes at windows
A108C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 TECTUM	--	9'-0"	
A109	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
A109A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	SPLINE	--	9'-10"	
A109C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	7'-10"	1
A118T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	7'-8"	1
A119G	GIRLS TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	PLAS.	--	8'-0"	

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Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
A120B	BOYS TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
A121J	JANITOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	--	
A125	STAGE	EXIST.	EXIST.	EXIST.	EXIST.	--	EXIST.	--	EXIST.	--	--	--	EXIST. PLAS.	--	11'-2"	
								12'-8"								
A125B	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	16'-0"	
A125S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	PAINT	EXIST.	PAINT	EXIST.	PAINT	EXIST.	PAINT	EXIST. PLAS.	--	8'-0"	
A127	FITNESS ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. SPLINE	--	9'-4"	
															8'-10"	
A128G	GIRLS TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
A128B	BOYS TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
A129B	BOYS LKR. RM. TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
A130	PHONE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	--	
A131	BOYS LOCKER ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	9'-8"	
A131A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	8'-0"	
A131S	SHOWER	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
A131T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	8'-0"	
A132	GIRLS LOCKER ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	9'-8"	
A132A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	7'-8"	
A132G	GIRLS' TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
A132J	JANITOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
A132S	SHOWER	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
A132T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	7'-8"	
A133	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
A134	GYMNASIUM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	--	
A134A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	11'-4"	
A134B	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	11'-4"	
A134C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	8'-4"	

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height		
<b>FIRST FLOOR PLAN AREA B</b>																	
B022	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
B023	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
B024	SCIENCE LAB	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	--	8'-10"	1	
													2X4 ACT	--	7'-4"		
B025	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
B026	SCIENCE LAB	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-0"	1
B026S	PREP ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	7'-6"	1
B027	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"	1
B028	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-2"	1
B028A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	8'-6"	1
B029	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-0"	1
B030	LOUNGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-0"	

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
B030T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
B031	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
B032	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	--	
B033	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	8'-0"	
B033A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	8'-2"	
B035	LIBRARY	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	VARIES SEE PLAN	2,4
B035A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	1
B035B	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	1
B035C	LAN	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	1
B036	ART STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	8'-8"	
B037	ART ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-0"	1
B037A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-6"	1
B038A	ART STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-4"	1

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height		
B038M	MENS	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	8'-0"	1
B038W	WOMENS	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	8'-0"	1
B040	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	11'-2"	1
B040A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	CONC.	--	8'-0"	
B040B	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	CONC.	--	8'-0"	
B040C	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	CONC.	--	8'-0"	
B040D	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	11'-2"	1
B040E	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT	--	9'-0"	
B041	COMPUTER LAB	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	9'-6"	2
B042	COMPUTER LAB	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXP.	--	--	
B042A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	CONC.	--	8'-0"	
B042B	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	CONC.	--	8'-0"	
B042C	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	CONC.	--	8'-0"	

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Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
B042D	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. CONC.	--	8'-0"	
B043V	VESTIBULE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. ACT	--	8'-3"	
B104C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-2"	1, Clg. slopes at windows
B105C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-3"	1
B106C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-2"	1, Clg. slopes at windows
B110C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-2"	1
B122J	JANITOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
B123	TRANS. ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	--	
B124	BOILER ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	--	
B124A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	--	
B124B	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	--	
B124T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	--	
B125	CAFETERIA	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 TECTUM	--	11'-0" 13'-4"	

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
B126	KITCHEN	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. SPLINE	--	9'-0"	
B126A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. SPLINE	--	9'-0"	
B126B	LAUNDRY	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. CONC.	--	9'-4"	
B126C	WALK-IN	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	--	--	--	
B126D	WALK-IN	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	--	--	--	
B126J	JANITOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. SPLINE	--	9'-0"	
B126S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. SPLINE	--	9'-0"	
B126T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. SPLINE	--	9'-0"	
<b>FIRST FLOOR PLAN AREA C</b>																
C001	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	7'-8"	1
C016	AUDION	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	VARIES	
C016A	MECHANICAL	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	VARIES	

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
C016B	PROJ/STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	VARIES	
C016C	EXTERIOR MECHANICAL	EXIST.	--	--	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	--	--	--	SEE ROOF PLAN
C016D	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	9'-8"	
C016E	CONF.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	1
C016F	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	9'-8"	
C017C	VAULT	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
C017D	LAN.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	7'-8"	1
C017E	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-2"	1
C017F	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-2"	1
C017G	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	7'-5"	
C017J	JANITOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	10'-4"	
C017M	MENS' TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
C017S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
C017W	WOMENS' TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
C018	WAITING	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	7'-8"	1
C018A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-5"	1
C018B	COTS	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-5"	1
C018C	HEALTH	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. SPLINE	--	8'-5"	
C018D	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. SPLINE	--	8'-0"	
C018T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
C019	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	1
													EXIST. PLAS.	--	7'-10"	
C019A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	1
C019B	MUSIC ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	1
														--	7'-8"	
C020	MUSIC ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	12'-6"	1
														--	16'-4"	
C020A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	1

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
C020S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. CONC.	--	8'-0"	
C021	MUSIC ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	12'-6"	1,9
															16'-4"	
C021A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. CONC.	PAINT	8'-0"	2,9
C021B	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. CONC.	PAINT	8'-0"	2,9
C100	CONF.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-11"	
													EXIST. GYP. BD.	--	7'-9"	
C100A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-4"	
C100B	LOUNGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-4"	
C100C	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-0"	
													EXIST. GYP. BD.	--	7'-8"	
C100D	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-0"	
													EXIST. GYP. BD.	--	7'-8"	
C100E	CONF.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-0"	
													EXIST. GYP. BD.	--	7'-9"	

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
C100F	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. GYP. BD.	--	7'-10"	
C101	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-7"	
C101C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	
C101J	JANITOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	--	
C102	CONF.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-0"	
C102C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	7'-11"	2
													EXIST. PLAS.	--	7'-8"	
C102S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	
C102V	VESTIBULE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
C103	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-0"	
															8'-10"	
C103A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. GYP. BD.	--	7'-10"	
C103C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-0"	
													EXIST. GYP. BD.		--	
C103S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. GYP. BD.	--	7'-10"	

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Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
C103V	VESTIBULE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	
													EXIST. PLAS. AT ENTRY	--	7'-2"	
C104	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	
C104A	BREAK ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-0"	
C104S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	
C105	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-2"	
C105A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	11'-4"	
C106J	JANITOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	--	--	
C106M	MENS' TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-8"	
C106W	WOMENS' TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-8"	
C107	LOUNGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-0"	
C108	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-2"	

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
C109	SPEECH	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-6"	1, 2
													EXIST. GYP. BD.	--	8'-0"	
C110	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
C111	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
C112	COPY ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
C113	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
													EXIST. GYP. BD.	--	7'-6"	
C113S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
C114	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
													EXIST. GYP. BD.	--	7'-6"	
C115	GUIDANCE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
													EXIST. GYP. BD.	--	7'-6"	
C116	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
C117	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	ACT 1	--	8'-4"	2
													EXIST. GYP. BD.	--	7'-11"	
C135V	VESTIBULE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	7'-7"	1

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					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height		
<b>SECOND FLOOR PLAN AREA A</b>																	
A201C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	8'-5"+/-	1
A250T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	PLAS.	--	8'-0"	
A251	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
A252	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
A252B	BOYS' TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	PLAS.	--	8'-0"	
A252G	GIRLS' TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	PLAS.	--	8'-0"	
A252J	JANITOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXP.	--	--	
A253	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
A253A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
A254	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
A254A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
A255	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1

SECTION 09 0610 - ROOM FINISH SCHEDULE  
 RENOVATIONS TO STANTON MIDDLE SCHOOL

PP7651  
 Date: 20 APRIL 2015

Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes	
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height		
A256	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
A256A	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-1"+/-	1
A257	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	--	9'-4"+/-	1,3	
													EXIST. GYP. BD.	--	8'-0"+/-		
A258	MECH. ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXP.	--	11'-2"+/-	
<b>SECOND FLOOR PLAN AREA B</b>																	
B202A	OFFICE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-0"	1
B202C	CORRIDOR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	8'-9"	1
																8'-0"	
B260	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
B261	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1
B262	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	--	8'-10"+/-	1	
													EXIST. GYP. BD.	--	7'-0"+/-		
B263	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	2X4 ACT	--	9'-4"+/-	1

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 RENOVATIONS TO STANTON MIDDLE SCHOOL

PP7651  
 Date: 20 APRIL 2015

Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
B264	SCIENCE LAB	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-4"+/-	1
B264A	PREP ROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	7'-6"+/-	1
													EXIST. GYP. BD.	--	8'-6"+/-	
B264L	LAN	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	8'-9"+/-	1
B265	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-4"+/-	1
B266	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-4"+/-	1
B266S	STORAGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	7'-9"+/-	1
B267	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-4"+/-	1
B268	CLASSROOM	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 ACT	--	9'-4"+/-	1
B269	FACULTY LOUNGE	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST ACT	--	9'-3"	
B269T	TOILET	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	8'-0"	

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Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
<b>STAIR TOWERS</b>																
A1S1	STAIR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	VARIABLES	
A2S1	STAIR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 TECTUM	--	9'-1" +/-	
B1S2	STAIR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	VARIABLES	
B2S2	STAIR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 TECTUM	--	9'-1" +/-	
A1S3	STAIR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. PLAS.	--	VARIABLES	
A2S3	STAIR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. 2X4 TECTUM	--	9'-1" +/-	
C1S4	STAIR	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST.	EXIST. EXP.	--	--	
<b>PARTIAL FIRST FLOOR PLAN AREAS A AND C (ALTERNATE BID)</b>																
C021	OFFICE	EXIST. CONC.	CPT	RUB.	EXIST. CMU	PAIN	EXIST. CMU	PAIN	GYP. BD.	PAIN	EXIST. CMU	PAIN	ACT 1	--	9'-0" 11'-6" 16'-4"	2,5,6,7,8,10
							GYP. BD.				GYP. BD.					

SECTION 09 0610 - ROOM FINISH SCHEDULE  
 RENOVATIONS TO STANTON MIDDLE SCHOOL

PP7651  
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Space No.	ROOM NAME	SUB-FLOOR	FLOOR FINISH	WALL BASE	NORTH WALL		EAST WALL		SOUTH WALL		WEST WALL		CEILING			Footnotes
					Material	Finish	Material	Finish	Material	Finish	Material	Finish	Material	Finish	Height	
C021A	STORAGE	EXIST. CONC.	VCT	RUB.	EXIST. CMU	PAINT	EXP.	PAINT	8'-0" +/-	2,5,6,7,8,10						
C021B	STORAGE	EXIST. CONC.	VCT	RUB.	EXIST. CMU	PAINT	EXP.	PAINT	8'-0" +/-	2,5,6,7,8,10						
C021C	HALL	EXIST. CONC.	VCT	RUB.	GYP. BD.	PAINT	GYP. BD.	PAINT	EXIST. CMU	PAINT	EXIST. CMU	PAINT	ACT 1	--	9'-0"	2,5,6,7,10
C021D	CONF.	EXIST. CONC.	CPT	RUB.	GYP. BD.	PAINT	EXIST. CMU	PAINT	EXIST. CMU	PAINT	GYP. BD.	PAINT	ACT 1	--	9'-0"	2,5,6,7,8,10
									CMU							
C021E	CONF.	EXIST. CONC.	CPT	RUB.	GYP. BD.	PAINT	GYP. BD.	PAINT	GYP. BD.	PAINT	EXIST. CMU	PAINT	ACT 1	--	9'-0"	2,5,6,7,10

**FOOTNOTES:**

- Existing 2x4 acoustical tile ceiling panels are scored for 2x2 (2<sup>nd</sup> Look).
- Remove existing ceiling(s) and suspension system(s) in their entirety including any secondary ceiling(s) above visible ceiling.
- Existing plaster ceiling at 8'-0" h. +/- to remain at closets.
- Along eastern exterior window wall of Library B035, coordinate with work by H.C. and provide new finishes including: Remove existing bulkhead, remove approx. 3'-0" width of existing carpet flooring, provide new carpet flooring to match existing, patch and repair existing wall materials and paint to match existing, provide new rubber wall base to match existing.
- Existing VAT flooring to be removed by the Owner under a separate contract. Patch and repair existing concrete slab to receive new scheduled flooring.
- Remove existing wall base and prepare wall to receive new scheduled base.
- Patch and repair existing wall material(s) to receive new scheduled finish.
- Remove existing wall paneling and wood furring.
- Delete room under Alternate Bid.
- Provide room under Alternate Bid.

END OF SECTION

## SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

### PART-1 GENERAL

#### 1.01 Summary:

- A. This Section includes, but is not necessarily limited to, assemblies comprising the following primary materials:
  - 1. Interior gypsum wallboard (Gyp. Bd. or GWB).
  - 2. Abuse-resistant gypsum wallboard.
  - 2. Non-load-bearing gage-metal framing, furring, acoustical batt insulation, and accessories for assemblies covered by this Section.
- B. "Assemblies," as used herein, may include partitions, bulkheads, soffits, ceilings, furred-out wall finishes, column enclosures, and other similar constructions. Refer to Drawings for specific types of assemblies required.
- C. Related work specified in other Sections:
  - 1. Division 6 Section "Rough Carpentry" for wood framing, blocking, and furring.

#### 1.02 Definitions:

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

#### 1.03 Referenced Standards:

- A. Various standards of the following organizations are referenced in this Section:
  - 1. American Society for Testing Materials (ASTM).
  - 2. American National Standards Institute (ANSI).
  - 3. Gypsum Association (GA).

#### 1.04 Submittals:

- A. Product Data: For each type of product indicated.
- C. Samples: Upon request of Architect.

#### 1.05 Quality Assurance:

- A. Single-Source Responsibility for Steel Framing: Obtain steel framing members for gypsum board assemblies from a single manufacturer, unless otherwise indicated.
- B. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.
- C. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to board manufacturer.
- D. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to

ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual" or design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual" or United States Gypsum Co. publication SA-100, "Construction Selector."
- F. Gypsum Board Assembly Preinstallation Conference: Conduct a preinstallation meeting with at least Contractor, Gage-Metal Framing Installer, Gypsum Board Installer, Architect, and Manufacturer's Representative. Review the following:
1. Control joint locations and construction.
  2. Reinforced gypsum board installation requirements.
  3. Coordination issues with all applicable trades.
  4. Finishing levels.
  5. Other pertinent issues, including conditions where construction of gypsum board assemblies may be problematic.

#### 1.06 Delivery, Storage, and Handling:

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover, keep dry and protect against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Neatly stack gypsum boards flat to prevent sagging.
- C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

#### 1.07 Project Conditions:

- A. Environmental Limitations, General: Comply with ASTM C 840 or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Minimum Room Temperature: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg. F. For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg. F for 48 hours prior to application and continuously thereafter until drying is complete.
- C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

## PART 2 PRODUCTS

### 2.01 Manufacturers:

- A. Subject to compliance with requirements, provide products by one of the following manufacturers, except where otherwise indicated:
1. Steel Framing and Furring:
    - a. Clark Steel Framing Systems.
    - b. Dale Industries, Inc. - Dale/Incor.
    - c. Dietrich Industries, Inc.
    - d. MarinoWare; Division of Ware Ind.
    - e. National Gypsum Company.
    - f. Unimast, Inc.
  2. Gypsum Board and Related Products:
    - a. G-P Gypsum Corp.
    - b. National Gypsum Co.
    - c. United States Gypsum Co.

### 2.02 Metal Suspended Ceiling and Soffit Framing:

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.0625-inch-diameter (16 ga.) wire, or double strand of 0.0475-inch-diameter (18 ga.) wire.
1. Framing manufacturer's standard furring channel clips may be used in lieu of tie wires for attachment to carrying channels in non-fire-resistance rated assemblies.
- C. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper, 0.162-inch-diameter (8 ga.).
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 inch (16 ga.), a minimum 1/2-inch-wide flange, with manufacturer's standard corrosion-resistant zinc coating. Depth shall be 1-1/2 inches, unless otherwise indicated, or unless otherwise warranted by larger-than-usual dead load or hanger spacing.
- E. Hat-Shaped, Rigid Furring Channels (Furring Members): Formed of commercial-steel sheet with manufacturer's standard corrosion-resistant zinc coating. ASTM C 645, 7/8 inch deep, and minimum base metal thickness of 0.0312 inch (20 ga.).
- F. At Contractor's option, grid suspension system for interior ceilings may be used in lieu of conventional carrying channel and furring system. Grid system shall consist of ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock. Subject to compliance with requirements, provide systems by one of the following:
1. Armstrong World Industries, Inc.
  2. Chicago Metallic Corporation
  3. USG Interiors, Inc.

### 2.03 Metal Partition and Soffit Framing:

- A. Components, General: Comply with ASTM C 754 for conditions indicated. Steel sheet components shall comply with ASTM C 645 requirements for metal and have manufacturer's standard corrosion-resistant zinc coating.
  - 1.
- B. Steel Studs and Runners: ASTM C 645; minimum base metal thickness of 0.0312 inch (20 ga.); and depth as indicated. Studs shall have knurled flange faces and web punchouts.
  - 1. At curved walls and bulkheads, provide curved runners top and bottom.
- C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch-deep flanges.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated. Minimum base metal thickness of 0.0312 inch (20 ga.) unless indicate otherwise.
- E. Cold-Rolled Channel Bridging: 0.0538-inch bare steel thickness, with minimum 1/2-inch- wide flange, 1-1/2-inch depth, and 1-1/2 by 1-1/2 inch, 0.068-inch-thick, galvanized steel clip angles for attachment to studs.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645; minimum base metal thickness of 0.0312 inch (20 ga.); 7/8 inch depth unless otherwise indicated.
- G. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission; asymmetrical configuration with face attached to single flange by a slotted leg (web).
- H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum bare metal thickness of 0.0188 inch (25 ga.), and depth required to fit insulation thickness indicated.
- I. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

### 2.04 Interior Gypsum Board Products

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- C. Gypsum Wallboard: ASTM C 36.
  - 1. Regular Type:
    - a. Thickness: 5/8 inch, unless otherwise indicated; may be 1/2 inch thick at ceilings.
    - b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
  - 2. Type X:
    - a. Thickness: 5/8 inch, unless otherwise indicated.
    - b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- D. Abuse-Resistant Gypsum Wallboard:

1. Acceptable Products:
  - a. Hi-Abuse XP Wallboard panels as manufactured by National Gypsum.
2. Thickness: 5/8 inch.

#### 2.05 Trim Accessories:

- A. Interior Trim: ASTM C 1047.
  1. Material: Galvanized steel sheet; except at shower areas, which shall be rolled zinc.
  2. Shapes indicated below by reference to Fig. 1 designations in ASTM C 1047:
    - a. Cornerbead, with expanded flanges, for outside corners, unless otherwise indicated.
    - b. LC-bead, with both face and back flanges; expanded face flange formed to receive joint compound. Use LC-beads for edge trim, unless otherwise indicated.
    - c. L-bead, with face flange only; expanded face flange formed to receive joint compound. Use L-bead for edge trim where LC-bead cannot be used.
    - d. U-Bead: Use in janitor closets, storage rooms, and mechanical or electrical utility-type spaces where gypsum board abuts other construction.
    - e. One-piece expansion (control) joint formed with V-shaped slot and removable strip covering slot opening.
    - f. Curved-Edge Cornerbead: With notched or flexible flanges; use at curved openings.

#### 2.06 Joint Treatment Materials:

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
  1. Interior Gypsum Wallboard: Paper.
  2. Tile Backing Board and Cementitious Backer Units: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
  3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound.
  5. Skim Coat: Level 5 Finish shall be provided by application of USG Sheetrock Brand Primer-Surfacer Tuff-Hide or National Gypsum Proform Brand Surfacer/Primer; tint as recommended by painter.
- D. Joint Compound for Tile Backing Panels and Cementitious Backer Units: As recommended by manufacturer of panel.

#### 2.08 Auxiliary Materials:

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. Subject to compliance with requirements, provide one of the following:
1. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
  2. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
- C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- D. Steel Drill Screws for Fastening Panels: ASTM C 1002, unless otherwise indicated.
1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  2. For fastening panels to wood blocking, use self-drilling, self-tapping oval head screws of length required.
  3. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- E. Isolation Strip at Exterior Walls: Asphalt-saturated organic felt, ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
- F. Sound Attenuation Blankets (Acoustical Batt Insulation): ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool. Insulation shall have maximum flame-spread and smoke-developed indices of 25 and 50, respectively, when tested in accordance with ASTM E 84.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  2. Alternate Bid: Provide "Cotton Armor" acoustical insulation in lieu of fiberglass. This insulation has rapidly renewable material content.

### PART-3 EXECUTION

#### 3.01 Examination:

- A. Examine substrates to which gypsum board assemblies attach or abut, with Installer present, including welded hollow metal frames, cast-in-anchors, and structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.02 Preparation:

- A. Control Joint Locations: **Review with Architect** prior to layout and erection if not already done so as part of the Gypsum Board Assembly Preinstallation Conference.

### 3.03 Installing Steel Framing, General:

- A. Comply with ASTM C 754; and ASTM C 840 requirements that apply to framing installation. Comply with panel manufacturer's installation recommendations where they are more stringent than the ASTM standards.
- B. Install supplementary framing, blocking, and bracing in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction, and to resist loads imposed by operation of doors. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
  - 1. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly, and laterally support assembly. Use deep-leg deflection track where indicated.
  - 2. **Do NOT attach framing to roof deck in a manner that relies on the roof deck to support the vertical load of partition/ soffit/ bulkhead assemblies.** In such instances, provide supplemental support framing that relies on structural roof framing, columns, load-bearing walls, or adjoining partitions for proper support and transference of vertical loads.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently. Refer to "Installing Trim Accessories" Article for location requirements.

### 3.04 Installing Suspended Steel Ceiling and Soffit Framing:

- A. Suspend ceiling hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
  - 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
  - 4. Do not attach hangers to steel roof deck.
  - 5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- B. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member and transversely between parallel members.
- C. Wire-tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

- D. Install suspended steel framing components in sizes and spacings indicated, but not less than that required by the referenced steel framing and installation standards and by the panel manufacturer's guidelines for each type of ceiling or soffit panel. Maximum spacings:
1. Hangers: 48 inches o/c.
  2. Carrying Channels (Main Runners): 48 inches o/c.
  3. Furring Channels (Furring Members): 16 inches o/c; 12 inches o/c at ceilings using water-resistant gypsum board.
- E. Grid Suspension System (If used): Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

### 3.05 Installing Steel Partition and Soffit Framing:

- A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction. Install studs plumb, square, and properly aligned to the lines and locations shown on the Drawings.
1. Where studs are installed directly against exterior walls, install asphalt-felt isolation strip between studs and wall.
  2. Secure track to floor and overhead structural elements with proper fasteners placed at not more than 24 in. o.c.
  3. Floor tracks shall be set in a continuous double bead of acoustical sealant.
  4. Apply continuous double bead of acoustical sealant between masonry walls and first stud of gypsum board partitions between rooms.
- B. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at lower heights. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
1. Cut studs 1/2 inch short of full height to provide perimeter relief.
  2. For fire-resistance-rated and STC-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.
- C. Install steel studs and furring at no greater spacing than 16 inches o/c.
- D. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.
- E. Curved Partitions/ Soffits (if any):
1. Cut top and bottom track (runners) through leg and web at 2-inch intervals for arc length. In cutting lengths of track, allow for uncut straight lengths of not less than 12 inches at ends of arcs.
  2. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
  3. Support outside (cut) leg of track by clinching steel sheet strip, 1-inch-high-by-thickness of track metal, to inside of cut legs using metal lock fasteners.

4. Begin and end each arc with a stud, and space intermediate studs equally along arcs at stud spacing recommended in writing by gypsum board manufacturer for radii indicated. On straight lengths of not less than 2 studs at ends of arcs, place studs 6 inches o.c.
- F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    1. Install two studs at each jamb, unless otherwise indicated.
  - G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

### 3.06 Applying and Finishing Panels, General:

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side. Extend batts to top of stud cavity, unless otherwise indicated.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts. At hollow metal frames anchored to stud framing, spot grout at each jamb anchor clip and immediately insert gypsum panels into frames.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels. Refer to "Installing Trim Accessories" Article for location requirements.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally or as specifically indicated. Fit gypsum panels around penetrating structural members, ducts, pipes, and conduits.
  1. Where gypsum board is indicated to not extend full height to underside of deck, panels shall extend not less than 4 in. above the adjoining finished ceiling elevation.
- J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/8- to 1/4-inch-wide spaces at these locations, and trim edges with U-, LC- or L-bead edge trim as indicated elsewhere where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

- K. Seal construction at perimeters of partitions, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through-penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
  - 1. Space screws a maximum of 12 inches o/c for vertical applications.
- M. Space fasteners in panels that are tile substrates a maximum of 8 inches o/c.

### 3.07 Panel Application Methods:

- A. Single-Layer Application:
  - 1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
  - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of board.
    - b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.
  - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  - 4. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- B. Laminating to Substrate (if any): Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations for preparation and installation. Temporarily brace or fasten gypsum panels until fastening adhesive has set. The installation of gypsum board shall be an indication of acceptance of the wall surface and Installer shall assume the responsibility for any unacceptable finished work caused by wall conditions.
- C. Curved Partitions (if any): Use single layer application method with gypsum board matching straight wall board thickness where radius of curve is large enough to comply with manufacturer's recommendations for such application. Use double layer method with 1/4- and 3/8-inch thick flexible panels where radius of curve is too small for single layer board.
  - 1. Install panels horizontally and unbroken, to the extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
  - 2. Wet gypsum panels on surfaces that will become compressed where curve radius prevents using dry panels. Comply with gypsum board manufacturer's written recommendations for curve radii, wetting methods, stacking panels after wetting, and other preparations that precede installing wetted gypsum panels.
  - 3. On convex sides of partitions, begin installation at one end of curved surface and fasten gypsum panels to studs as they are wrapped around curve. On concave side, start

fastening panels to stud at center of curve and work outward to panel ends. Fasten panels to framing with screws spaced 12 inches o.c.

4. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.
5. Allow wetted gypsum panels to dry before applying joint treatment.

### 3.08 Installing Trim Accessories:

- A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length, and spacing of fasteners.
- B. Install cornerbead at external corners.
- C. Install edge trim where edge of gypsum panels will be exposed.
  1. Install LC-bead where gypsum panels abut other construction and back flange can be attached to framing or supporting substrate, unless otherwise indicated.
  2. Install L-bead where edge trim can only be installed after gypsum panels are installed.
  3. Install U-bead where gypsum panels abut other construction in janitor closets, storage rooms, and mechanical or electrical utility-type spaces.
  4. Install control joints according to ASTM C 840 and manufacturer's recommendations. Locate control joints where indicated and/or as directed by Architect. In general, any straight run of gypsum drywall shall be subdivided by control joints not exceeding 30 feet on center.

### 3.09 Finishing Gypsum Board Assemblies:

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged areas using setting-type joint compound.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840, for locations indicated:
  1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
  2. Level 2: Where panels are substrate for tile, embed tape and apply separate first coat of joint compound to tape, fasteners and trim flanges.
  3. Level 4: At panel surfaces exposed to view in janitor closets, storage rooms, and mechanical/ electrical/ utility spaces, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners and trim flanges.
  4. Level 5: **At all other locations**, embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of **primer/surfacer** over entire surface.

### 3.11 Closure of Head-of-Wall Joints:

- A. At gypsum board partitions that extend to the underside of floor/roof slabs/decks or other continuous solid-structure surfaces, permanently close joints and voids between top of partitions and floor or roof construction above with compressible gasket or other resilient material acceptable to Architect.
  - 1. Where new metal roof/ floor deck units lay across exposed non-fire-rated heads-of-partitions, closure of flutes is specified under Division 5 Section "Steel Deck." Fill remaining gap between bottom of deck and head-of-partition; hold fill material 1/2 inch back from exposed face of partition.
  - 2. Where partition is required to be fire-resistance rated, closure is specified under Division 7 Section "Firestopping."

### 3.12 Protection:

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

END OF SECTION

SECTION 09 5100 – ACOUSTICAL PANEL CEILINGSPART-1 GENERAL1.01 Summary:

- A. This Section includes acoustical ceilings consisting of suspended exposed-grid systems with lay-in acoustical panels.
- B. Related work specified in other Sections:
  - 2. Division 9 Sections “Acoustical Treatments” for individually suspended acoustical ceiling panels.

1.02 Submittals:

- A. Product Data: Manufacturer's complete technical descriptive literature for each item required, including specifications and installation recommendations.
- C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Within 60 days after award of Contract, submit coordination drawings for all new or altered areas, drawn accurately to a scale no less than 1/8" = 1'-0", coordinating penetrations and ceiling-mounted items. Coordinate with other prime contractors to obtain necessary information and agreement on location of penetrations and ceiling-mounted items. Upon review and acceptance by Architect, incorporate revisions (if any) into an AutoCAD-based file. Furnish one hard copy of accepted shop drawings and one updated CAD-file copy to all other applicable prime contractors for their further information and use. Show the following:
  - 1. Ceiling suspension system members.
  - 2. Method of attaching hangers to building structure.
  - 3. Bulkheads, soffits, areas with drywall ceilings (if any), and areas of exposed structure (if any).
  - 4. Room names and numbers, ceiling types, and ceiling elevations above the finished floor.
  - 5. Special moldings at walls, column penetrations, and other junctures with adjoining construction, including all curved walls and bulkheads.
  - 6. Ceiling-mounted items, including light fixtures; HVAC air distribution devices; speakers; fire alarms; sprinkler heads; and other similar devices or fixtures.
- D. Shop Drawings: Show details and information pertinent to construction, installation, and placement of all components required for continuous, smooth wall angles at curved walls, bulkheads and circular columns. Include sections of typical curved wall angle.

1.03 Quality Assurance:

- A. Installer Qualifications: Engage an experienced installer who has completed acoustical tile ceilings and finishes similar in material, design, and extent to that indicated for this Project and with a minimum five-year record of successful in-service performance.
- B. Source Limitations for Ceiling Units: Obtain each type of acoustical panel from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

- C. Source Limitations for Suspension System: Obtain each type of suspension system from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

#### 1.04 Delivery, Storage and Handling:

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

#### 1.05 Project Conditions:

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. The work area shall be reasonably clean and the structure in proper condition to receive acoustical materials. Acoustical work shall follow the installation of ductwork, piping and conduit located in ceiling space above ceilings.

#### 1.06 Coordination:

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

#### 1.07 Extra Stock:

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Acoustical Ceiling Units:
    - a. ACT Type 1: Four extra cartons of full-size units of each type.

## **PART-2 PRODUCTS**

### 2.01 Acoustical Ceilings, General:

- A. Humidity Resistance: Unless indicated otherwise, ceiling panels shall be rated for 90% humidity conditions and shall have a 10-year sag- and warp-resistance warranty, comparable to Armstrong's "HumiGuard Plus" products.
- B. Acoustical Ceiling Colors: Manufacturer's standard white, unless indicated otherwise.

- C. Fire-Test-Response Characteristics: Provide ceilings (ceiling panels/tiles, grids and accessories) that comply with the following requirements:
1. Fire-response tests were performed by UL, ITS/Warnock Hersey, or another independent testing and inspecting agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
  2. Surface-burning characteristics of acoustical panels shall comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.
- D. Dimensions: Length by width dimensions for lay-in ceiling panels are nominal dimensions. Actual dimensions are to be factory-cut sizes that fit within suspended ceiling grids having standard modular dimensions matching the specified panel nominal length and width.

### 2.02 Acoustical Ceiling Systems:

- A. ACT-1: 24 in. x 48 in. x 3/4 in. lay-in panels with angled tegular edge profile and center "scored" dividing line for 2' x 2' look; wet-formed panel composed of mineral fiber with a factory-applied, vinyl latex paint finish; minimum light reflectance (LR) rating of 0.80; minimum ceiling attenuation class (CAC) of 35; and minimum noise reduction coefficient (NRC) of 0.55. Suspension system – Type A. Subject to compliance with requirements, provide one of the following panel products:
1. Armstrong World Industries; Fine Fissured Second Look II, product #1761.
  2. Approved equal by USG Interiors or CertainTeed Corp.

### 2.03 Suspension Systems:

- A. General: Unless indicated otherwise, suspension grids shall comply with ASTM C 635 "Intermediate Duty" Classification.
- B. Suspension System Types:
1. Type A: Exposed grid system with 15/16 in. wide face, similar to Chicago Metallic Corporation "211 Snap-Grid" system or equivalent by Armstrong World Industries, CertainTeed Corp., or USG Interiors. Exposed flanges shall be of white baked enamel finish. System shall include angle or channel perimeter molding.
    - a. At curved walls and bulkheads, provide curved wall angle similar to Chicago Metallic Corporation CurvGrid. Field cut and formed edges made up of straight sections will not be permitted.
- C. Suspension System Accessories: Provide all accessories necessary to complete installation, including, but not limited to, the following:
1. Preformed, factory-finished, bull-nosed corners to match grid material and finish. Provide corners where grid meets bull-nosed block.
  2. Provide impact clips at toilet room and gymnasium ceilings.
  3. Provide retention clips for ceilings located in wind locks and vestibules.

4. Where building expansion joints occur, provide white, dual durometer polyvinylchloride (PVC) bellows-style filler for 1-inch joint width in suspended lay-in acoustical ceilings, selected from the following options:
  - a. Allway HC/HCW Series; Construction Specialties, Inc.
  - b. DX Series; MM Systems Corp.
  - c. Wabo FastWrap CES Series; Watson Bowman Acme Corp.

### PART-3 EXECUTION

#### 3.01 Ceiling Installation:

- A. Comply with ASTM C 636 per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook." Do NOT attach to roof decking.
- B. Suspend main beams spaced at 24 in. or 48 in. o.c., as indicated on Drawings, from structure above by minimum #12 gauge galvanized wire hangers spaced not more than 48 in. o.c.
- C. Install interlocking cross-tees at 24 in. o.c. to form a 24 in. x 48 in., or 24 in. x 24 in. grid pattern.
- D. System shall be accurately leveled to within 1/8 in. in 12 ft. 0 in. Deflection shall not exceed 1/360 of the span of any component.
- E. Provide matching perimeter molding around separate room areas, abutting walls, and around columns and similar protrusions, unless indicated otherwise.
  1. At circular column covers, provide circular wall angle with reveal, factory-formed to match diameter of covers; aluminum, finished to match ceiling grid; MM Systems Corp. Series WCR.
  2. At radiused bulkheads and walls, provide curved wall angle, factory-formed to match diameter of bulkheads and walls; aluminum, finished to match ceiling grid. Field cut and formed edges made up of straight sections will not be permitted.
- F. Where perimeter molding meets expansion joint trim, provide a clear break in the molding equal to no less than the expansion joint width.
- G. Scribe and cut panels at borders and penetrations to provide a neat, precise fit in center of panel, typically. Coordinate with work of HVAC, plumbing and electrical trades.
- H. Tegular Panel Installation: At perimeter conditions, set perimeter molding so that its bottom leg is below level of exposed face of tee-bars by same dimension as tegular edge recess of panel. Fill between perimeter molding and tee bars with "Teg Tabs." Refer to manufacturer's applicable instructions.

#### 3.03 Cleaning:

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

END OF SECTION

## SECTION 09 6500 - RESILIENT FLOORING

### PART-1 GENERAL

#### 1.01 Summary:

- A. This Section includes, but is not limited to, resilient flooring and related accessories as follows:
  - 1. Resilient tile flooring.
  - 2. Rubber base.
  - 3. Transition/reducer strips.
- B. Do not install resilient flooring or base under, or behind, built-in cabinets or casework having enclosed bases. Installation of resilient base on and around built-in cabinets and casework shall be included with the Work of this Section.
- C. Replace existing resilient flooring damaged in the Work, or as otherwise called for in the Contract Documents, with new resilient flooring to match existing.
- D. Related work specified in other Sections:
  - 1. Division 01 Section "Selective Demolition" and Division 9 Section "Room Finish Schedule" for removal of existing non-asbestos flooring and wall base.
  - 2. Division 01 Section "Alternates" for administrative and procedural requirements regarding alternates, and for description of each scheduled alternate.

#### 1.02 Submittals:

- A. Product Data: Manufacturer's descriptive technical literature for each item required.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.
- C. Samples for Verification: For those products which have specific colors or patterns indicated, submit two samples for verification.
- D. Product Certificates: Signed by manufacturers of resilient products certifying that each product furnished complies with requirements.
- E. Maintenance Data: For resilient floor tile.

#### 1.03 Quality Assurance:

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
  2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.
- D. Flooring products shall comply with the slip-resistance requirements of the Americans with Disabilities Act and other applicable accessibility regulations.

#### 1.04 Project Conditions:

- A. No Work of this Section shall be commenced until the building is properly enclosed and heated, if required, and the work of other trades, including painting, is complete. Rooms and subfloors shall be maintained at a minimum temperature of 70 degrees F for at least 48 hours before, during, and after installation of flooring materials.
- B. Installation conditions shall conform to the recommendations of the material manufacturer.

#### 1.05 Delivery and Storage:

- A. Deliver materials to the job site, store indoors, and maintain at room temperature for at least 48 hours before being used.

### PART-2 PRODUCTS

#### 2.01 Resilient Flooring Products, General:

- A. Color Selections: Except where specific color selections are indicated, colors of all resilient flooring product patterns specified will be selected by the Architect.

#### 2.02 Resilient Tile Flooring:

- A. Vinyl Composition Tile (VCT): Smooth-surface, factory-waxed tile, 12 in. x 12 in. in size x 1/8 in. thickness, conforming to ASTM F 1066, Class 2. Provide Imperial Texture Standard Excelon, as manufactured by Armstrong, or approved equal products by Mannington ("Essentials" & "Inspirations"), Azrock, Congoleum or Tarkett.
1. One color will be selected from manufacturer's full range.

#### 2.03 Resilient Accessories:

- A. Rubber Wall Base: Product complying with ASTM F 1861, Type TS (Thermoset Vulcanized Rubber) Group 1 (Solid), and the following:
1. Style: Cove with standard top-set toe.
  2. Height: 4 inches, unless otherwise indicated.
  3. Minimum Thickness: 1/8 inch.
  4. Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns produced for rubber wall base complying with requirements indicated. Color shall be through entire body of base cross-section.
  5. Lengths: Coils in lengths standard with manufacturer, but not less than 96 feet.
  6. Outside Corners: Job formed.

7. Acceptable Manufacturers for Type TS Base:

- a. Roppe
- b. Allstate
- c. Burke Flooring Products
- d. Flexco.
- e. Nora

B. Transition/Reducer Strips:

- 1. VCT-to-Non-Carpet Floor Finish Applications: Rubber strip, approximately 1-1/4 in. wide, tapering from 1/8 in. thick to edge thickness of adjoining material, or to 0 in. thickness if providing transition to a concrete floor or other finished surface contiguous with substrate beneath new VCT finish. Color to be selected by Architect.
- 2. Carpet-to-VCT Applications: Rubber strip equal to Roppe #61 tile/carpet transition strip, approximately 1-1/2 in. wide, with undercut on one side for carpet and on opposite side for resilient floor tile. Color to be selected by Architect.

2.04 Installation Accessories:

- A. Adhesives: Waterproof, VOC-compliant, high-strength adhesive of type and kind recommended for use by the resilient materials manufacturer, and specifically formulated for the intended purpose.
- B. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic cement based formulation provided or approved by resilient product manufacturer for applications indicated. VOC compliant.
- C. Floor Sealer and Polish: Per manufacturer's written instructions.

PART-3 EXECUTION

3.01 Examination:

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Installer shall notify Contractor in writing of conditions that will prevent satisfactory finished work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of finish materials or otherwise result in unsatisfactory finished work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with installation of flooring materials shall be an indication of acceptance of the substrates, and the Installer shall assume the responsibility for any unacceptable finished work caused by subfloor conditions.

3.02 Preparation:

- A. Existing floors to receive new resilient flooring shall have existing floor coverings removed, unless indicated otherwise. Existing walls and other surfaces to receive new resilient wall base shall have existing wall base removed.

- B. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.
- C. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings, existing adhesives, curing and sealing compounds, and other substances that are incompatible with new adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. **Do not use solvents.**
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
  - 4. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until they are same temperature as space where they are to be installed. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.03 Flooring Installation:

- A. Comply with manufacturer's written instructions for installing flooring.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Lay tile in an alternating pattern, unless designated otherwise by Architect, starting at the center of the space and working outward toward the walls. Adjust border width to size required by scribing border tiles to the wall, and cutting and fitting in place after the field tile has been installed.
- E. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- F. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- G. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

- H. Install transition/reducer strip at all points, e.g. center of doorways, where resilient flooring terminates at adjoining dissimilar flooring materials or at a different level than the adjoining finish flooring.

#### 3.04 Rubber Base Installation:

- A. Install base, of proper type, along all walls of areas where indicated and wherever base of other materials is not otherwise provided. Install base in longest continuous lengths practical, with minimum number of joints. Joints shall be tight, full height of base.
1. Do not install base until wall painting is completed and thoroughly dry.
  2. Base installation shall follow erection of demountable partitions and built-in cabinets, where such occurs.
- B. Inside and outside corners shall be job-formed. Form outside corners by shaving a strip approximately 1/4 in. wide and 1/2 the thickness of the base from the back of the base where the corner will be made. Bend the corner prior to applying the base to the wall. Do not form outside corners less than 6 inches from the end of the piece of base. Install base tight to walls and snug to floors, without gaps or sags.
- C. Clean-off any excess adhesive and wipe with a damp dressing-soaked cloth.

#### 3.05 Cleaning, Polishing and Protection:

- A. Comply with manufacturer's written instructions for cleaning, polishing and protecting floor tile. Review cleaning and polishing methods and materials with Owner.
- B. Perform the following operations immediately after completing floor tile installation:
1. Remove adhesive and other blemishes from exposed surfaces.
  2. Sweep and vacuum surfaces thoroughly.
  3. Damp-mop surfaces to remove marks and soil.
  4. No sooner than four days after installation, apply coats of floor polish.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Final Floor Sealer and Polish: Shortly before substantial completion inspection, remove soil, visible adhesive and surface blemishes from floor tile surfaces before applying liquid floor sealer and polish.
1. Strip factory finish using non-aggressive stripper solution recommended by flooring manufacturer. Thoroughly rinse and allow floor to dry completely.
  2. In areas of high traffic, apply one coat of liquid sealer.
  3. Apply five coats of liquid floor polish.
- E. Protect finished floors with covering of undyed, nonasphaltic building paper until Substantial Completion.

END OF SECTION



SECTION 09 6813 – TILE CARPETINGPART-1 GENERAL1.01 Summary:

- A. This Section includes the following:
  - 1. Modular carpet tile.
- B. Related Sections:
  - 2. Division 3 Section "Hydraulic Cement Underlayment" for repair of large areas of existing subfloors with self-leveling or troweled cement-based underlayment systems.
  - 3. Division 9 Section "Resilient Flooring" for resilient wall base and accessories installed with carpet.
- C. Alternate Bids: Refer to Division 1 Section "Alternates" for administrative and procedural requirements regarding alternates, and for description of each scheduled alternate. A price is requested for various alternative carpets to that which is specified for the Base Bid.

1.02 Submittals:

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation recommendations for each type of product and substrate.
- C. Shop Drawings: Submit carpet schedule, with clarifying layouts as needed, indicating where each different carpet type, color and dye lot is to be used. Show:
  - 1. Locations of insets and borders (if any).
  - 2. Locations and details of edge, transition, and other accessory strips.
  - 3. Other special detail conditions, e.g. stepped risers and treads.
- D. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.
- E. Samples for Verification: Submit at least two full-size samples of each selected carpet tile.
  - 1. Label each sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings or in schedules.
  - 2. The Architect and Owner reserve the right to have such samples tested for specification compliance by an independent laboratory of their choosing.
- F. Certifications: Submit certifications that all proposed materials meet or exceed the specifications and standards established herein and that materials are guaranteed free from manufacturing defects. Itemize certifications to show compliance with each criterium. No carpet shall be delivered to job site, nor considered acceptable for use in the work, except carpet which is certified by the manufacturer as having the construction equal to, or exceeding, the specifications stated. Actual test reports by independent laboratories may be submitted in lieu of certifications.
- G. Installer's Qualification Data: If requested by Architect, submit the following:
  - 1. FCIB Certification, or evidence of compliance with program requirements.

2. An experience record showing training and experience in similar work for personnel who will be assigned to this Project.
  3. List and describe similar work satisfactorily completed with location, date of contracts, together with names and addresses of Owners.
  4. List of facilities and equipment available to do the work.
- H. Maintenance Program: Manufacturer shall provide three copies of detailed maintenance program recommendations, including schedule, materials, methods, and types of equipment. Particular attention shall be paid to stain removal procedures. List precautions for cleaning materials and methods that could be detrimental to carpet.

#### 1.03 Quality Assurance:

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board (FCIB) or who can demonstrate compliance with its certification program requirements. Installer shall have at least five years experience in this type of work and with the type of carpet specified. Work for this Project shall be performed by qualified and experienced mechanics working under the supervision of an experienced supervisor who has also been doing this type of work for five years.

#### 1.04 Measurements:

- A. Dimensions supplied in the Drawings are approximate. Contractor shall carefully field verify all dimensions and other conditions affecting Work, and shall be responsible for proper installation of carpet.

#### 1.05 Delivery, Storage, and Handling:

- A. Contractor shall be responsible for the scheduling, receiving, and storage of carpet goods on Site. Goods shall be delivered to the job site in the manufacturer's bundles and clearly marked as to size, dye lot, and materials. A written record of received goods shall be submitted to the Architect. Carefully protect carpet from soiling and damage.
- B. Contractor shall provide proper and sufficient storage space for the carpet, materials, and equipment necessary, and be responsible to see that the areas to be carpeted are in condition to receive the carpet.

#### 1.06 Project Conditions:

- A. General: Comply with Carpet and Rug Institute publication CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."
- B. Building must be preheated to between 65 and 70 degrees F, inclusive, for at least 24 hours prior to installation. Temperature should be kept constant night and day during installation. New concrete shall have cured for at least 60 days prior to installation.
- C. Installation conditions shall conform to the recommendations of the material manufacturer.

#### 1.07 Coordination:

- A. Prior to carpet installation, coordinate door installation with floor finish thickness to ensure doors are hung to clear the carpet.

1.08 Guarantees:

- A. The Contractor shall, at his expense and upon written notice from the Architect or Owner, promptly and properly replace any and all improper work and material that may become apparent after final acceptance. Strict adherence to this Specification will be required by the Owner, and the Contractor shall receive no compensation for loss in replacement of rejected goods.
- B. Materials shall be guaranteed free from manufacturing defect.

1.09 Warranty:

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Carpet Warranty: Written non-prorated warranty, signed by carpet manufacturer agreeing to replace carpet that does not comply with requirements or that fails within specified warranty period, under wet or dry conditions. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 15 percent loss of face fiber, edge raveling, snags, runs (zippering), or delamination. Chair pads shall not be required for warranty coverage.
  - 1. Warranty Period: Minimum **fifteen (15) years** from date of Substantial Completion for each phase of construction. If manufacturer's standard warranty period for installed product is longer than 15 years for one or more features of the carpet, then the manufacturer's standard warranty period shall apply to those features.
  - 2. Provide all additional warranties offered by the accepted manufacturer as standard with the specified products, such as anti-staining, colorfastness, 20 lb. tuft bind (wet or dry - per ASTM D 1335); or, no cupping, doming, or dishing.

1.10 Extra Materials:

- A. Furnish extra materials described as follows, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents:
  - 1. Carpet Tile: Full, unopened boxes of carpet equal to 2 percent of amount installed for each type and color indicated, but not less than one full box each.

PART-2 PRODUCTS2.01 Carpet Products, General:

- A. Carpet Performance Criteria: Comply with the following:
  - 1. 16 CFR 1630 Methenamine Pill Test: Pass.
  - 2. ASTM E 648 Flooring Radiant Panel Test: Class 1 (critical Radiant Flux 0.45 W/sq. cm).
  - 3. ASTM E 662 Smoke Density: Mean average (flaming) of 450 or lower.
  - 4. AATCC-134 Electrostatic Propensity: Mean Average 2.8 K.V. or lower at 70 degrees F and 20 percent relative humidity, with permanent antistatic treatment.

5. Indoor Air Quality: Carpet, adhesives, and seam sealers shall comply with the “Green Label Plus” Testing and Labeling Programs of the Carpet and Rug Institute (CRI), or approved equivalent testing program.
  6. AATCC-16 Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units).
  7. Permanent anti-stain treatment.
  8. Minimum Yarn Weight: 20 oz. per sq. yd. for field carpet.
  9. Yarn System: Type 6,6 Nylon or Type 6 Nylon, as used with the specified carpet.
  10. Color System: Solution dyed or yarn dyed, as used with the specified carpet.
  11. Minimum Pile Thickness: 0.101 inch according to ASTM D 685.
  12. Minimum Pile Density: 5,035 oz. per cu. yd.
  13. Minimum Sustainable Carpet Assessment Standard: NSF/ANSI Gold.
  14. Minimum Modification Ratio: 2.0.
  15. Minimum Carpet Texture Appearance Retention Rating: No less than 3.0 per CRI TM 101.
- B. Color Selections: If specific colors or patterns are not preselected, Architect will make initial color selections from manufacturer’s full range in the specified pattern(s) for each type of exposed finish product.
1. A maximum of six (6) colors will be selected.

#### 2.02 Modular Carpet Tile:

- A. Provide one of the following modular carpet products:
1. Manufacturer: Interface
    - a. “Raw” collection.
    - b. Backing System: GlasBac® RE
    - c. Size: 50 cm by 50 cm
  2. Manufacturer: Shaw Contract Group
    - a. “Dressed to Kill” collection
    - b. “Float” pattern
    - c. Backing System: ecoworx®
    - d. Size: 24 inch by 24 inch
  3. Manufacturer: Lees
    - a. For LGI and Music Rooms: “First Day if Spring” pattern
    - b. For Admin and Media Center Rooms: “Nature’s Collage” pattern
    - c. Backing System: ITC-RC fiberglass reinforced thermoplastic composite
    - d. Size: 24 inch by 24 inch
- B. Colors: Up to two colors to be selected altogether.

#### 2.03 Installation Accessories:

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by the carpet manufacturer.

- C. Adhesives: VOC-compliant, water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and that is recommended by the carpet manufacturer.
- D. Seaming Cement: VOC-compliant, adhesive sealer product recommended by carpet manufacturer for butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- E. Resilient Edge Strips: Extruded solid color rubber edge moldings, having approximately 1 in. to 1-1/2 in. exposed width, of height required to protect exposed edge of carpet and transition to adjoining floor material, and of maximum lengths to minimize running joints.

### PART-3 EXECUTION

#### 3.01 Inspection and Preparation of Subfloors:

- A. Existing floors to receive new carpeting shall have existing floor coverings removed, unless indicated otherwise. Existing walls and other surfaces to receive new resilient wall base shall have existing wall base removed.
- B. Inspect substrates before commencement of work. Clean and prepare substrates to satisfactory conditions to receive carpet and wall base. Check floor for moisture content. Installer shall notify Contractor, in writing, of any conditions that will prevent satisfactory finished work.
  - 1. Remove from substrates all adhesive, curing and sealing compounds, hardeners, coatings and other substances, such as those that contain soap, wax, oil, or silicone, that will cause uneven finish or that may be incompatible with new adhesives or that may otherwise interfere with adhesive bond. Use removal methods recommended by new adhesive and carpet manufacturers; **solvents are not permitted**. Prepared substrates shall be smooth, clean and dry.
  - 2. Cracks 1/8 in. or more, holes, and unevenness shall be filled with latex-based floor filler.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected. Proceeding with installation of flooring materials shall be an indication of acceptance of the subfloors, and the subcontractor shall assume the responsibility for any unacceptable finished work caused by subfloor conditions.

#### 3.02 Installation:

- A. Comply with manufacturer's recommendations and CRI 104, Section 8 for Direct Glue-Down Installation.
- B. Apply floor primer to areas to be carpeted, as recommended by manufacturer or the referenced CRI standard. Primer must be compatible with adhesive, and approved by carpet manufacturer.
- C. Apply adhesive uniformly with a 1/8 in. notched trowel, starting in the center of the area and working toward the outer edges. Brush out any air bubbles trapped under the carpet.
  - 1. At riser and tread installations, apply contractor-grade, VOC-compliant, contact cement acceptable to, and in accordance with, carpet manufacturer's instructions.
- D. Following installation, a minimum of 24 hours curing time must be allowed before subjecting installation to heavy traffic, particularly a rolling load.

- E. Install resilient edge strips at points where top surface of carpet terminates at a different level than adjoining finish flooring materials. Where adjoining resilient flooring, coordinate with transition/reducer strips provided under Division 9 Section "Resilient Flooring."
- F. Do not bridge building floor-to-floor expansion joints with carpet. Accommodate existing and new floor outlets, expansion joint covers, and the like.

### 3.03 Clean-Up:

- A. Upon completion of installation, remove waste and excess materials, tools and equipment, and carefully and thoroughly vacuum clean the entire floor surface with an upright beater-bar type vacuum cleaner. Carpet shall be free of any spots and protruding face yarn.
- B. Usable pieces of carpet not necessary to complete the work are to be left on the job Site and placed in an orderly manner in an area designated by the Owner.

### 3.04 Protection:

- A. Provide protective methods and materials needed to ensure that carpeting will be without deterioration or damage at the time of Substantial Completion of each phase.

END OF SECTION

SECTION 09 9000 - PAINTINGPART-1 GENERAL1.01 Summary:

- A. This Section includes, but is not limited to, the surface preparation and field painting or finishing of the following exposed elements or surfaces, unless factory-finished or indicated as being field-finished otherwise:
1. New and existing interior construction as called for in Room and Stair Finish Schedules to receive "Paint," "Glazed Paint" (Gl. Paint), or "Epoxy Paint" finish, or by similar notation.
  2. New unscheduled gypsum board, concrete masonry, hollow metal doors and frames, door vision panel trim, metal astragals and similar door edge trim, other ferrous metal items, and millwork.
  3. Existing unscheduled interior plaster, gypsum board, glass-reinforced gypsum fabrications, concrete walls, concrete masonry, exposed steel structure, hollow metal doors and frames, door vision panel trim, metal astragals and similar door edge trim, other ferrous metal items, and millwork that is disturbed by the new Work.
  4. New and existing unscheduled interior non-insulated piping, ductwork, conduit, metal raceways, and their supports where exposed in finished spaces except for utility or equipment rooms, janitor closets, storage rooms, and the like.
  5. Graphics, as indicated (e.g. Wildcat logo on wall).
  6. New exterior ferrous metal items.
  7. Other selective elements or surfaces indicated elsewhere to be painted.
- B. Examine the specifications for other trades and become thoroughly familiar with provisions regarding the painting of work specified in those sections. Surfaces left unfinished by the requirements of other specification sections shall be painted or finished as a part of this Contract.
- C. Related Work Specified in Other Sections:
1. Division 08 for pre-finished wood doors and nonferrous metals.
  2. Factory-finished casework specified in Division 12.
  3. Divisions 21, 22, 23, 26, 27 and 28 for painting of plumbing, heating and electrical equipment, and related piping or conduit, installed in mechanical or electrical rooms.
- D. Painter shall be responsible for inspecting the work of others prior to the application of paint or finishing materials. If a surface to be finished cannot be put in proper condition for finishing by customary cleaning, sanding, and puttying operations, the Painter shall notify immediately the General Contractor, in writing, or assume responsibility for, and rectify, resulting unsatisfactory finishes.

1.02 Submittals:

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

- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

#### 1.03 Quality Assurance:

- A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a five-year record of successful in-service performance.
- B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Field-applied finishes shall meet federal, state and local VOC (volatile organic compound) requirements, including the 2005 OTC (Ozone Transport Commission) regulations. Interior field-applied finishes shall also comply with Division 01 requirements pertaining to LEED® for Schools.

#### 1.04 Delivery, Handling, and Storage:

- A. Deliver materials in original containers, with seals unbroken and labels intact.
- B. Store painting materials used on the job in their original containers with manufacturer's label, in a single place designated by Architect. Such storage place shall be kept neat and clean, and damage thereto or to its surroundings shall be made good. Remove soiled or used rags, waste, etc. from the building every night and take every precaution to avoid danger of fire.

#### 1.05 Project Conditions:

- A. For interior painting, building shall be properly enclosed and ventilated, and the ambient temperature maintained at not less than 60 degrees F for the duration of the Work.

#### 1.06 Extra Materials:

- A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents, including indication of where the paint type and color was applied. Deliver extra materials to the Owner.
- B. Quantity: Furnish the Owner with 2 gallons extra paint material for each color applied.

## **PART-2 PRODUCTS**

### 2.01 Materials:

- A. Painting materials shall be products of well-known and reputable manufacturer.
- B. Painting materials shall be used only as specified by the manufacturer's directions on the container label.

- C. Painting materials, such as linseed oil, shellac, turpentine, etc., shall be pure, of highest quality.
- D. Colors, including deep tones, shall be selected by the Architect. The number of colors to be used on the job shall be determined by the Architect. If required, panels for finish and color shall be prepared in advance, with the materials as specified, for the review of the Architect.
1. Refer to Drawings, Room Finish Schedule and Stair Finish Schedule for number of colors to be used.
- E. Paints shall be from paint manufacturer's listed "best line" or top grade and of the type recommended by the manufacturer for the purpose used and shall be products of the following manufacturers/brands, or accepted substitute:
- |                          |   |
|--------------------------|---|
| Sherwin Williams Company | MAB Paints                                |
| Pratt & Lambert, Inc.    | PPG Industries                            |
| Duron                    | Glidden Professional (formerly ICI/Dulux) |

## 2.02 Performance Criteria:

- A. Paint Sheens (Gloss Readings):
1. Full Gloss: 90% or more at 60 deg. meter.
  2. Semi-Gloss: 60% plus or minus 5% at 60 deg. meter.
  3. Satin: 40% plus or minus 5% at 60 deg. meter.
  4. Eggshell: 15% plus or minus 5% at 60 deg. meter.
  5. Flat: 10% plus or minus 5% at 85 deg. meter.
- B. Visual Quality:
1. Leveling: Apply finish with proper consistency and quantity, so that paint flows out to a level surface, free of brush and roller marks, bubbles, dust, runs, sags, and holidays. Spread coatings evenly.
  2. Appearance: Provide uniform color, texture, and sheen.
  3. Neatness: Do not smear, spatter, or run coatings over adjoining colors or materials. Cut-in lines shall be straight.
- C. Paint Thickness: Provide the following minimum dry film thickness per coat:
1. Exterior Paints:
    - a. Primer on Metal: 2 mils
    - b. Primer on Concrete, Plaster, or Masonry: 1.5 mils
    - c. Finish Coats: 1.5 mils
  2. Interior Paints:
    - a. Block Filler/Primer: 12 mils
    - b. Metal Primer: 2.0 mils
    - c. Other Primers: 1.5 mils
    - d. Finish Coats: 1.5 mils
  3. Thickness Test: Use visual observation gauge that measures V-shape scratch.
  4. For specific paint applications, where greater thicknesses are recommended by paint manufacturer or indicated in PART-3 of this Section, the greater of such thicknesses shall prevail over the above-stated minimums.

- D. Compatibility of Paint Types: Verify the compatibility of each type of finish coat with shop primers and between field coats. When necessary, switch paint types or use a block coat to avoid interference between paint types.

### PART-3 EXECUTION

#### 3.01 Preparation and Workmanship:

- A. Workmanship shall be the best. Only skilled mechanics shall be employed. Results of each application shall be in keeping with standards of good practice and manufacturer's recommendations and subject to review of the Architect. Unless more stringent requirements are specified, surfaces to be painted shall be prepared, and paint shall be applied, in accordance with manufacturer's recommendations for each different type of substrate.
- B. Exterior painting shall not be done while the surface is damp; during cold, rainy, or frosty weather; or, when the temperature is likely to drop to freezing. Avoid painting surfaces while they are exposed to hot sun.
- C. Surfaces to be painted shall be clean before painting. Knots, pitch streaks, and sappy spots shall be touched-up with shellac before priming. Necessary puttying of nail holes, cracks, etc. shall be done after the first coat, with putty of a color to match that of the finish. Putty shall be brought flush with the adjoining surface in a neat and workman-like manner.
- D. Remove rust or scale by wire-brushing or sanding clean before painting. Shop coats of paint that become marred shall be cleaned and touched-up with a good quality metal primer.
- E. Apply materials under adequate illumination, evenly spread, and smoothly flowed-on, without runs or sags. Coats shall be thoroughly dry before applying succeeding coats. Architect reserves the right to review the work, where a coat of material has been applied, before application of the succeeding coat(s), at no increase in cost. Woodwork to be finished with enamel or varnish shall be sanded smooth and the surface cleaned before proceeding with the application of the first coat.
- F. Suction spots or "hot spots" in plaster surfaces and openings adjoining trim shall be cut-out as required, then filled with a spackling compound or approved patching plaster, flush with adjoining plaster surface, and, when dry, shall be sanded smooth and sealed before application of priming coat.
- G. Enamel or varnish finish applied to wood or metal shall be sanded with fine sandpaper and then cleaned between coats to produce an even, smooth finish.
- H. Galvanized metal surfaces shall be chemically-treated with an approved compound to ensure paint bond.
- I. Existing exterior metal and cast iron trim shall have loose paint, dirt, and rust removed before painting.
- J. Closets and the interior of cabinets shall be finished the same as adjoining rooms, unless otherwise specified. All other surfaces shall be finished the same as nearest or adjoining surfaces, unless otherwise instructed by the Architect. Metal doors shall be finished on all faces and edges. Interior painted trim shall be back-primed before installation. Exterior trim shall be primed on all surfaces before installation.

- K. Protect newly finished surfaces during progress of the Work. Protect adjacent work and surfaces by drop cloths and masking, or other suitable covering, during progress of the Work.
- L. When spraying, mask surfaces not to be painted and remove loose items from the area. Upon completion of the Work, remove paint and varnish spots from the floors, glass, and other surfaces. Remove from the premises waste and accumulated materials caused by this trade and leave the work in clean and orderly condition.

### 3.02 Application:

- A. Secure color schedules from the Architect for rooms before applying any paint or finish. Prime and under coats shall be tinted to approximate the shade of final coat.
- B. Method of application shall be as indicated in the schedule in this Section. Substitute methods shall be employed only with the consent of the Architect.
  - 1. Except as otherwise specified, the various surfaces shall be finished in accordance with the schedule included in this Section.
  - 2. Shop coats specified under other headings are in addition to coats specified hereinafter.
  - 3. Unless otherwise indicated, trade names of Sherwin-Williams products are used herein as indication of type and kind of material required in the Work.
  - 4. Refer to paint system schedules in Part 3 of this Section for specific products for each application. Additional manufacturers and products may be listed if the above-named manufacturers' recommended system includes such products. Unless indicated otherwise, all coats indicated in paint system schedules are full coats over each applicable substrate.

### 3.03 Exterior Systems:

#### Exterior Galvanized Metal:

One Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series (2-4 mils dry)

Two Coats: Pro Industrial High Performance Acrylic Gloss, B66-610 series (6 mils wet, 2.5 mils dry per coat)

#### All Other Exterior Metal:

One Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series (2-4 mils dry)

Two Coats: Pro Industrial High Performance Acrylic Gloss, B66-610 series (6 mils wet, 2.5 mils dry per coat)

### 3.04 Interior Systems:

#### “Glazed Paint” for Interior Concrete Masonry:

One Coat: PrepRite Block Filler, B25W25 (16 mils wet, 8 mils dry)

Two Coats: Pro Industrial High Performance Acrylic Semi-Gloss, B66-650 (6 mils wet, 2.5 mils dry per coat)

#### All Other Interior Masonry and Concrete:

One Coat: PrepRite Block Filler, B25W25 (16 mils wet, 8 mils dry)

Two Coats: ProMar 200 Zero VOC Latex Eg-Shel, B20W2650 (4 mils wet, 1.6 mils dry per coat)

**Interior Galvanized Metal:**

- One Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series (2-4 mils dry)
- Two Coats: Pro Industrial High Performance Acrylic Eg-Shel, B66-660 series (6 mils wet, 2.5 mils dry per coat)

**All Other Interior Metals (High Gloss):**

- One Coat: Pro Industrial Pro-Cryl Universal Primer, B66-310 Series (2-4 mils dry)
- Two Coats: Pro Industrial High Performance Acrylic Gloss, B66-610 series or Semi-Gloss, B66-650 series (6 mils wet, 2.5 mils dry per coat).

**Interior Wood (Painted):**

- One Coat: Multi-Purpose Interior/Exterior Latex Primer/Sealer, B51-450 series (4 mils wet, 1.3 mils dry per coat)
- Two Coats: Pro Industrial High Performance Acrylic Semi-Gloss, B66-350 Series (6 mils wet, 2.5 mils dry per coat)

**Interior Wood (Natural / Transparent Finish):**

- One Coat: Min-Wax 250 VOC Stain
- Filler Coat (for Open-Grained Wood): SherWood® Natural Filler, D70T1
- Two Coats: Wood Classics® Polyurethane Varnish A68 Series Waterborne; Satin A68-F90 or Gloss A68-V91.

**Interior Plaster Ceilings, Soffits and Bulkheads 8'-0" high or higher (Flat Finish):**

- One Coat: Multi-Purpose Int./Ext. Latex Primer/Sealer, B51-450
- Two Coats: ProMar® 200 Zero VOC Interior Latex Flat, B30W2650 Series

**All Other Interior Plaster:**

- One Coat: Multi-Purpose Int./Ext. Latex Primer/Sealer, B51-450
- Two Coats: ProMar® 200 Zero VOC Interior Latex Eg-Shel, B20W2650 Series

**Interior Drywall Ceilings, Soffits and Bulkheads 8'-0" high or higher (Flat Finish):**

- One Coat: ProMar 200 Zero VOC Latex Primer, B28W2600 (4 mils wet, 1.3 mils dry per coat)
- Two Coats: ProMar 200 Zero VOC Latex Flat B30W2650 (4 mils wet, 1.6 mils dry per coat)

**All Other Interior Drywall:**

- One Coat: ProMar 200 Zero VOC Interior Latex Primer, B28W2600 (4 mils wet, 1.3 mils dry per coat)
- Two Coats: ProMar 200 Zero VOC Latex Eg-Shel, B20W2650 (4 mils wet, 1.6 mils dry per coat)

**3.05 Refinishing Systems:**

- A. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete refinishing of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
- B. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

- C. Clean and prepare surfaces to be refinished in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

3.06 Touching-Up:

- A. Clean up and remove, every night, all dirt, rags, or waste materials generated by painting activities.
- B. At the completion of other branches of work, all painted and finished work shall be touched-up and restored where damaged or defaced, and the entire work left free from blemishes. Contractor shall go over the entire building and clean-off all paint or varnish spots from walls, floors, hardware, glass, etc.; leave all doors and sashes free to move; and, leave all paint and other finishes clean and acceptable condition.

END OF SECTION



## SECTION 101100 – VISUAL DISPLAY UNITS

### PART-1 GENERAL

#### 1.01 Summary:

- A. This Section includes the following:
1. Framed, porcelain enamel markerboards.
  2. Framed, cork-faced tackboards.

#### 1.02 Submittals:

- A. Product Data: For each type of visual display board and other product indicated. Include information on accessories for display rails, for selection by Owner.
1. Markerboard Material Certification / Data: Manufacturer's letter certifying that the markerboard face material is PolyVision p3 or e3 porcelain steel. If alternative porcelain steel face is proposed, submit manufacturer's supporting detailed data and comparative samples.
- B. Shop Drawings: For each type of visual display board and unit required.
1. Show layout, size, type, construction and installation details, gauges, finishes, service characteristics, capacities, fittings or accessories, and other pertinent information.
  2. Include dimensioned elevations. Show location of joints between individual panels where unit dimensions exceed maximum panel length.
  3. Include sections of typical trim members.
  4. Show anchors, grounds, and reinforcement.
- C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors and textures available for the following:
1. Markerboards: Actual sections of porcelain enamel finish for each type of markerboard required.
- D. Samples for Verification: Upon request of Architect, submit components or complete assemblies for review.
1. Markerboard Sample: If alternative to PolyVision p3 or e3 porcelain steel markerboard face material is proposed, submit two 12" x 12" samples of proposed markerboard for comparative examination and testing.

#### 1.03 Quality Assurance:

- A. Source Limitations: Obtain markerboards and tackboards through one source from a single manufacturer.

#### 1.04 Project Conditions:

- A. Field Measurements: Where necessary to coordinate with other work, new or existing, verify field measurements before preparation of Shop Drawings and before fabrication to ensure proper fitting and accessible pathway to rooms in which boards are to be installed. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating visual display boards without field measurements. Coordinate wall construction to ensure actual dimensions correspond to established dimensions.

#### 1.05 Warranty:

- A. Porcelain Enamel Board Warranty: Submit a written warranty executed by manufacturer agreeing to replace porcelain enamel boards that do not retain their original writing and erasing qualities, become slick and shiny, or exhibit crazing, cracking, or flaking within the specified warranty period, provided the manufacturer's written instructions for handling, installation, protection, and maintenance have been followed.

1. Warranty Period: **50 years** from date of Substantial Completion.

### PART-2 PRODUCTS

#### 2.01 Manufacturer:

- A. Markerboard, Tackboard, and Tackstrip Manufacturer: Subject to compliance with requirements, provide products by one of the following:
  1. Claridge Products, (Basis of Design).
  2. Aywon.
  3. Marsh Industries, Inc.
  4. Platinum Visual Systems, Div. of ABC School Equipment.
  5. American Visual Display.
  6. AARCO
  7. Caron Products
- B. Named product specifications are used to establish the design, quality, sizes, functions, and accessories required for Project. Subject to review and acceptance, minor variations in products by the other named manufacturers will be considered as long as other work is unaffected.

#### 2.02 Panel Materials:

- A. Porcelain Enamel Boards: Balanced, high-pressure-laminated, porcelain enamel boards of 3-ply construction consisting of face sheet, core material, and backing.
  1. Face Sheet: Enameling grade steel of manufacturer's standard thickness not less than 0.013-inch thick (28 gage) and specially processed for temperatures used in coating porcelain. Coat exposed face and edges with a 3-coat process consisting of primer, ground coat, and color cover coat. Coat concealed face with a 2-coat process consisting of primer and ground coat. Fuse cover and ground coats to steel at manufacturer's standard firing temperatures, but not less than 1,400 deg F for markerboards.
    - a. Markerboard Cover Coat: Provide light-colored, special writing surface, as follows, with gloss finish intended for use with erasable dry markers.
      - (1) PolyVision p3 or e3 Ceramicsteel surface.
      - (2) Surface material matching Architect's sample will be considered. Submit supporting documentation and samples demonstrating a surface equal to or better than the specified surface, in the sole judgment of the Architect.
    - b. Color(s) of writing surfaces will be selected from manufacturer's standards.

2. Core: 7/16-inch-thick particleboard, complying with ANSI A 208.1, Grade 1-M-1.
  3. Backing Sheet: 0.005 inch thick aluminum foil backing sheet.
- B. Cork-Faced Tackboards: Natural cork sheet, 1/8 inch thick, factory laminated to 3/8 inch thick fiberboard backing. Cork shall be seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with a flame-spread rating of 75 or less when tested according to ASTM E 84.

#### 2.03 Manufactured Visual Display Boards:

- A. Fixed Visual Display Boards: Claridge Series 1 (Basis of Design).
1. Markerboards: Porcelain Enamel.
  2. Tackboards: Cork faced; dimensions as shown on Drawings.
  3. Board Trim: Clear anodized aluminum frames.
  4. Display Rail: With cork insert and aluminum end caps; continuous across top of all boards.
  5. Marker Tray: Continuous at bottom of markerboards, integral part of frame. Provide end closure caps on all marker trays.
  6. Provide four accessories per each 8 linear feet of display rail, selected by Architect/Owner from manufacturer's standard components. All accessories shall be metal, not plastic.

#### 2.04 Accessories:

- A. Metal Trim and Accessories: Fabricate frames and trim of not less than 0.062-inch-thick, extruded-aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units. Keep joints to a minimum. Miter corners to a neat, hairline closure.
1. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.

#### 2.05 Fabrication:

- A. Assemble panels from manufacturer's standard components complying with specifications in Article "Panel Materials."
- B. Porcelain Enamel Markerboards: Laminate facing sheet and backing sheet to core material under pressure with manufacturer's recommended flexible, waterproof adhesive.
- C. Assembly: Provide factory-assembled framed markerboard and tackboard units, unless field-assembled units are required, fabricated as individual and combination units of nominal heights and lengths indicated.
1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
  2. Provide flush butt vertical joint system between abutting panels of the same type, with concealed splines to maintain surface alignment.
  3. Provide manufacturer's standard mullion trim at joints between markerboards and tackboards.

2.06 Aluminum Finishes:

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
- B. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Aluminum Finishes: Class II, clear anodic finish, AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 607.1.

PART-3 EXECUTION3.01 Examination and Preparation:

- A. Examine wall surfaces, with Installer present, for compliance with requirements and other conditions affecting installation. Surfaces shall be free of dirt, scaling paint, and projections or depressions that would affect smooth, finished surfaces of visual display units.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 Installation:

- A. Deliver factory-built visual display units completely assembled in one piece without joints, where possible. If dimensions exceed maximum single panel or unit size, provide 2 or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site. Use splines at joints between like panels to maintain surface alignment.
- B. Install visual display units at locations and mounting heights indicated, anchoring components firmly in place, according to accepted shop drawings and manufacturer's recommendations. Keep perimeter lines straight, plumb, and level. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation. Join parts with a neat, precision fit.

3.03 Adjusting and Cleaning:

- A. Verify that accessories required for each unit have been properly installed and that operating units function properly.
- B. Clean units according to manufacturer's written instructions.
- C. Protection and Repair: Protect units and replace any new surfaces damaged prior to Substantial Completion.

END OF SECTION

SECTION 12 2413 - ROLLER WINDOW SHADESPART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Manually operated roller shades with single rollers.
  - a. At designated exterior windows.

## B. Related Requirements:

1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
2. Section 01 2300 "Alternates" for roller shades for window openings added by alternate.

## 1.2 ACTION SUBMITTALS

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

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

## B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

## C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

## D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

## E. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

## F. Roller-Shade Schedule: Use same designations indicated on Drawings.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material, signed by product manufacturer.
- C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roller shades to include in maintenance manuals.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable

glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. DFB Sales.
  2. Draper Inc.
  3. Hunter Douglas Contract.
  4. MechoShade Systems, Inc.
  5. OEM Shades Inc.
  6. Shade Techniques, LLC.
- B. Source Limitations: Obtain roller shades from single source from single manufacturer.

### 2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
  1. Bead Chains: Nickel-plated metal.
    - a. Loop Length: Full length of roller shade.
    - b. Limit Stops: Provide upper and lower ball stops.
    - c. Chain-Retainer Type: Chain tensioner, jamb mounted.
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
  1. Roller Drive-End Location: Right side of inside face of shade.
  2. Direction of Shadeband Roll: Regular, from back of roller.
  3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- E. Shadebands:
  1. Shadeband Material: Light-filtering fabric.

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material.
    - b. Color and Finish: As selected by Architect from manufacturer's full range.
- F. Installation Accessories:
1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
    - a. Shape: L-shaped.
    - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 4 inches.
  2. Endcap Covers: To cover exposed endcaps.
  3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

### 2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
  1. Source: Roller-shade manufacturer.
  2. Type: Acrylic-coated fiberglass.
  3. Weave: Mesh.
  4. Thickness: 0.020 inches.
  5. Weight: 12.30 oz./sq. yd. .
  6. Roll Width: 72 inches.
  7. Orientation on Shadeband: Up the bolt.
  8. Openness Factor: 1 or 3 percent; Architect's option.
  9. Color: As selected by Architect from manufacturer's full range.

### 2.4 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
  1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:
  - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 ROLLER-SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
  - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

#### 3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

#### 3.4 CLEANING AND PROTECTION

- A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION



SECTION 12 3213 – WOOD CASEWORK AND RELATED EQUIPMENTPART-1 GENERAL1.01 Summary:

- A. This Section includes wood casework, countertops (plastic laminate), and items of equipment, most of which are identified by the “Basis of Design” manufacturer's catalog name and/or number on the Drawings or referenced in this Section, with all accessories and other appurtenant parts and components required to provide a complete, finished and operating installation, except for such services or work hereinafter specifically mentioned as furnished under other Sections. Work also includes, but is not limited to:
1. Wood casework, including countertops.
  2. Reception desks in Alternate Bid secure entry administration office area.
  3. Tack surface for installation on casework where indicated on the Drawings.
- B. The term "equipment" includes, but is not limited to, casework, components, accessories, etc. that are a part of this Section.
- C. Catalog numbers or names of the manufacturers’ indicated as the "Basis of Design" are referenced in the Contract Documents to establish the size, configuration, components and function required for the various items of casework and equipment covered by this Section.
1. Provide casework and equipment with the components and accessories listed or indicated in the referenced manufacturers’ specifications or catalog data, current at time of bidding, as "standard" or otherwise furnished with the equipment.
  2. Each item shall, in addition, be furnished with such optional accessories, special features, or modifications as are herein specified or called for on the Drawings. Size modifications on the Drawings are generally indicated by adding “(M)” to the manufacturer’s model number.
- D. Equipment shall be provided complete with Basis-of-Design manufacturer’s appurtenances and accessories that are incidental and necessary to the finished installation and intended use.
1. Provide all cutting of casework and equipment as needed for service lines and electrical devices, including those provided by the Electrical trades. Cutting shall be properly coordinated and performed in a workmanlike manner.
- E. Related Work of Other Sections:
1. Division 26 Sections for power wiring and final power connections.

1.02 Submittals:

- A. Product Data: Submit manufacturer’s technical data for each type of casework, equipment and component. Include certification of wood finish performance.
- B. Shop Drawings: For cabinets and countertops. Include plans, elevations, sections, details, and attachments to other work. Show materials, finishes, filler panels, other trim, hardware, edge and backslash profiles, cutouts for plumbing fixtures, and methods of joining countertops.
1. Show typical cabinet construction for each type of cabinet.
  2. Show all related equipment, including locations and types of service fittings, together with associated service supply and waste connections.
  3. Include details of utility spaces showing supports for conduits and piping.

4. Finish information shall indicate laminate grade and thickness for each surface.
5. Indicate locations of blocking and other supports required for installing casework.
6. Show adjacent walls, doors, windows, other building components, and other equipment. Indicate clearances from above items.
7. Include coordinated dimensions for equipment specified in other Sections.
8. If shop drawings are prepared and submitted prior to field verification of dimensions and conditions, indicate which dimensions and/ or conditions require field verification.

C. Coordination Drawings:

1. **Within 45 days after Award of Contract**, submit to the Architect equipment rough-in drawings showing the precise location and size of each utility service (i.e., water, electric, et al.) required to each piece of equipment.
2. Coordination drawings shall also show any additional framing, reinforcement, or other constructional requirements which must be built into the work or otherwise provided to accommodate the equipment in its final location.
3. Such drawings shall be submitted in at least eight copies. Any additional costs incurred due to the nonsubmission of such rough-in drawings within the time allotted shall be borne by this Contractor.

D. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material exposed to view.

E. Samples for Verification: Submit minimum 6 in. x 6 in. samples of exposed finishes, including top materials. Samples will be reviewed by Architect for color, texture, and pattern only. Compliance with other specified requirements is exclusive responsibility of Contractor.

F. Full-Size Samples: Upon request by Architect, submit full-size, finished samples of cabinets and service fixtures to the location stipulated. Cabinet unit samples shall be complete with hardware, doors, shelves and drawers without finish top. Acceptable sample units will be used for comparison inspections at project. Unless otherwise directed, acceptable sample units at job site may be incorporated in the Work. Notify Architect of their exact locations. If not incorporated in the Work, retain acceptable sample units in building until completion of work. Remove non-used sample units from premises when directed by Architect.

1.03 Quality Assurance:

- A. Installer Qualifications: Manufacturer's authorized personnel who are trained and approved for installation of units required for this Project.
- B. Source Limitations for Casework-Related Equipment: Obtain each type of equipment related to casework and furnished under this Section, including tops, sinks, service fittings, and accessories, through one source from a single manufacturer or dealer.
- C. Product specifications incorporated herein are used to establish the quality intended and required for the various items of casework and equipment included in this Section.
- D. Catalog numbers of manufacturer(s) referenced and used in the Drawings are used to establish the size, design, and function intended and required for the various items of casework and equipment included in this Section.

1.04 Delivery, Storage and Handling:

- A. Deliver manufactured wood casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.
- B. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with polyethylene film or other protective covering.

1.05 Project Conditions:

- A. Field Measurements: Carefully check all dimensions and conditions in the field that may affect fabrication, layout or installation of casework and equipment. Perform field verification of conditions before fabrication and indicate measurements on Shop Drawings.
  - 1. Where casework is indicated to fit to other construction, establish dimensions for areas where casework is to fit. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Provide fillers and scribes to allow for trimming and fitting.
  - 2. Countertops: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.
  - 3. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Environmental Limitations: Do not deliver or install laboratory casework until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels through remainder of construction period as recommended by casework manufacturer.

1.06 Coordination:

- A. Coordinate layout and installation of metal framing and reinforcement in gypsum board assemblies for support of casework.

1.07 Special Warranties:

- A. Provide casework manufacturer's standard warranty form in which manufacturer agrees to repair or replace components of manufactured wood casework that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Delamination of components or other failures of glue bond.
    - b. Warping of components.
    - c. Failure of operating hardware.
    - d. Deterioration of finishes.
  - 2. Warranty Period: **Two years** from date of Substantial Completion.

PART-2 PRODUCTS2.01 Manufacture:

- A. The Specifications are used to establish the minimum quality required for the various items of equipment covered by this Section of the Work. Where requirements are not specified, manufacturer's standard construction will generally be acceptable.

- B. Wood Casework: Subject to compliance with requirements, provide wood casework and equipment by one of the following:
1. Wood-Metal Industries, Div. of Wood-Mode, Inc. (Basis of Design)
  2. Campbell-Rhea Institutional Casework, Inc.
  3. American Millwork & Cabinetry, Emmaus, PA
  4. Diversified Woodcrafts, Inc.
  5. CiF Lab Solutions
  6. Cabinets by Design, Duluth, GA
  7. Stevens Industries

## 2.02 Materials:

- A. Exposed or Semi-Exposed Solid Wood: Rotary cut White Maple lumber, clear and free from defects. All lumber shall be thoroughly and properly air dried to a uniform moisture content of 4%-6% by weight, tempered to 7%-8% during fabrication.
- B. Exposed or Semi-Exposed Plywood: White Maple plywood of thickness specified herein, faced with surface veneer secured with highly water-resistant glue. Veneer shall be plain sliced, 0.050" face to meet ANSI-HPVA HP-1. Maple veneer shall be "Grade C-2" or better, face smooth, tight cut and full length of exposed face.
- C. Unexposed Woods:
1. Solid Lumber: Dry, sound, and selected to eliminate appearance defects. Any species of hardwood similar in color and grain to exposed portions.
  2. Plywood: Uniform hardwood face veneer with .050" face to meet ANSI-HPVA HP-1.
- D. Hardboard: Tempered hardboard, composed of wood fibers and resinous binder compressed under heat and pressure.
- E. The use of woods allowing knots, repaired knots, worm holes, etc. will not be accepted in any portion of the construction of cabinetry.
- F. Solid Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with the material and performance requirements of ANSI Z124.3, Type 5 or 6, without a precoated finish.
1. Products: Subject to compliance with requirements, provide products by one of the following:
    - a. Corian, DuPont Polymers (Basis of Design).
    - b. Avonite, Avonite, Inc.
    - c. Formica Solid Surfacing, Formica Corporation
  2. Color: As selected by Architect from manufacturer's Essential Collection.
- G. Metal Laminate: Conforming to NEMA LD-3 standard.
1. Manufacturer: Formica.
  2. Style: DecoMetal Collection, 4744, Pewter Debossed Aluminum.
  3. Application: Accent reveals at desk fronts.
  4. Grade 86 with phenolic back.

### 2.03 Cabinet Construction:

#### A. Definition of Surface Exposure:

1. Exposed Surfaces:
  - a. Surfaces visible when drawers (if any) and opaque doors (if any) are closed.
  - b. Surfaces visible when behind clear glass doors.
  - c. Bottoms of cabinets if 42 in. or more above finish floor.
  - d. Tops of cabinets if less than 72 in. above finish floor.
  - e. Interior surfaces of all open cabinets.
2. Semi-Exposed Surfaces:
  - a. Surfaces which become visible when opaque doors are open or drawers are extended, including backs of doors.
  - b. Bottoms and backs of cabinets more than 30 in., but less than 42 in. above finish floor.
  - c. Tops of cabinets 72 in. or more above finished floor when visible from an upper level.
3. Concealed Surfaces:
  - a. Surfaces not normally visible after installation.
  - b. Bottoms of cabinets less than 30 in. above finish floor.
  - c. Tops of cabinets 72 in. or more above finish floor and not visible from an upper level.
  - d. Web frames, dust panels, stretchers, blocking, and backs behind drawers.

#### B. Style of Construction: Flush overlay design with slightly radiused edges.

1. Drawer fronts and hinged doors shall have square edges, flush overlay design and shall overlap openings on all edges.
2. Exposed edges of end panels, partitions, shelves, aprons and backsplashes shall be edged with solid Maple, **1/16-inch thick minimum**, except as otherwise noted.

#### C. Cases: Flush front construction, solidly joined, reinforced, assembled and glued together making each unit rigid and self-supporting for use interchangeably in an assembly or for single unit use. The following case construction requirements are standard minimum requirements. Other named manufacturers' case construction and joinery, as standard with their product lines most similar to these Specifications, will be acceptable.

1. Tops of Base Cabinets: 4-sided frame of solid hardwood front, rear and cross rails.
2. Bottoms of Base Cabinets: 1/2-inch thick plywood on 2-sided frame of solid hardwood front and rear rails, except at sink cabinets.
3. Bottoms of Sink Cabinets: 1/4-inch thick hardboard on 4-sided frame of solid hardwood front, rear and cross rails. Bottom plywood panel shall be removable but secured with a minimum of two screws each at front and rear.
4. Tops and Bottoms of Upper and Tall Cabinets: 1/2-inch thick plywood on 2-sided frames of solid hardwood front and back rails.
5. Provide solid wood intermediate rails between drawers/drawers and drawers/doors.
6. Cabinet End Panels: Minimum 3/4" thick plywood.
7. Vertical Partitions: Minimum 3/4" thick plywood.
8. Security Panels: Provide 1/4" thick hardboard security panel between drawers/drawers and drawers/doors when base cabinet is to have locks that are keyed differently.

9. Cabinet Backs:
- a. Exposed – Minimum 1/4" thick plywood.
  - b. Unexposed – Minimum 1/4" thick hardboard or plywood; removable at sink cabinets.
- D. Shelves: Where shelf lengths are 24 inches or less, provide minimum 3/4-inch thick plywood shelves; for greater lengths, provide minimum 1-inch thick plywood shelves.
1. Shelves shall be adjustable on 1-1/4" centers.
  2. Support each shelf on four heavy-duty (minimum 300 lb. rating each) double pin-and-socket type supports with anti-tip shelf-retention clips to prevent shelf from lifting upward after shelf installation. Metal shelf supports will not be acceptable unless anti-tipping design is incorporated.
- E. Hinged & Sliding Doors:
1. Base and Wall Cabinets: 3/4" thick, full overlay.
  2. Tall Cabinets: Minimum 3/4" thick, full overlay
  3. Framed Glass (if any): Minimum 3/4" thick solid wood, machined to receive glass panels. Glass shall be set into opening and held in place by plastic retainers.
- F. Drawers: Box design, solidly joined, reinforced, assembled and glued together making each unit rigid.
1. Fronts: 3/4" thick solid wood or plywood with solid wood edges.
  2. Body: Back, sides, and front shall be 1/2" thick. Bottom panel shall be 1/4" thick plywood, set in groove all around, pinned and glued.
  3. Slides:
    - a. At file drawers, slides shall be full-extension 3-part progressive opening, with minimum 100-lb. load rating. Provide body mounted molded rails for hanging file system for legal or letter size as indicated by Basis-of-Design cabinet manufacturer's model number. Cutting or machining of drawer body/face not allowed.
    - b. Provide same full-extension slides where otherwise noted or part of the Basis-of-Design cabinet construction.
    - c. All other drawer slides shall be full-extension epoxy powder-coated, cold-rolled steel, featuring a captive roller system with in-and-out stop and out-position keeper. Side and bottom mounted with minimum 100-lb. load rating per ANSI/BHMA test procedure.
- G. Provide filler strips and scribe strips, finished to match casework, for trimming and fitting to adjoining surfaces.
- H. Cabinet Sub-Base: Provide continuous sections of "ladder" type configuration (front, back, side and intermediate support rails), separate from cabinets, constructed with water-resistant exterior grade plywood, with concealed fastening to cabinet bottoms. Cabinet body sides shall **not** extend to floor. Sub-base shall provide a secure and level platform to which cabinets attach. Sub-base at exposed cabinet end panels shall be recessed 1/8 inch from face of finished end, for flush installation of finished base material by other trades.
- I. Wood Finish:
1. General: Finishes shall comply with SEFA-8 resistance standard acceptable levels for casework surfaces. **Provide written certification** from an independent third party testing facility establishing that final finish has no more than three SEFA-8 "Level 3" conditions.

2. Exposed wood parts of all equipment shall be finished in stain color selected by the Architect from the manufacturer's full color range.
3. All parts shall be carefully sanded and buffed in preparation for the finishing processes. The first coat shall be a stain and sealer coat of synthetic resin. The product shall then be cured at elevated temperatures. After the first sealer coat, the product shall be sanded, wiped clean and then two (2) more coats of a chemical resisting synthetic resin shall be applied and cured at elevated temperatures. Unexposed interior surfaces shall receive one (1) sealer coat and one (1) coat of a chemical resisting synthetic resin.
4. Cabinet Finish Performance: Submit certification that finish meets the following performance requirements, with no visible effect other than slight discoloration, change of gloss or temporary softening of film:
  - a. Resistance to Chemical Reagents - withstand one hour contact with ten drops (1/2 ml.) covered by watch glass, convex side down in center of pool to prevent evaporation.
    - Acetic Acid, all concentrations
    - Ammonium Hydroxide, 28%
    - Hydrochloric Acid, 37%
    - Nitric Acid, 30%
    - Phosphoric Acid, 75%
    - Sodium Hydroxide, all concentrations
    - Sulfuric Acid, 50%
    - Zinc Chloride, saturated
  - b. Resistance to Solvents - withstand contact with ten drops (1/2 ml.) placed on surface until evaporated.
 

Benzene	Methyl Alcohol
Toluene	Ethyl Alcohol
Chloroform	Ethyl Ether
Carbon Tetrachloride	Acetone
Naphtha	
  - c. Heat Resistance - Hot water (190-205 degrees) trickled down surface (tilted 45 degrees) for five minutes.
  - d. Moisture Resistance - Cellulose sponge (2" x 3" x 1") soaked with water and placed on finish for 100 hours and kept constantly wet.
  - e. Fade Resistance - 100 hours exposure to Sylvania 275 R.S. sun lamp placed 10" above surface.

#### 2.04 Casework Hardware and Accessories:

- A. Hinges: Institutional type, five-knuckle, with pins of not less than 0.177" in diameter and leaves of not less than 0.072" thick. Hinges shall be wrought steel with satin chrome-colored epoxy-powder coating or satin-finished stainless steel. Two (2) hinges shall be provided on doors under 36" in height and three (3) hinges for doors 36" and over.
  1. Physical properties: Hinge must be capable of supporting 150 lbs. placed 12" from hinge center with door open 90 degrees.
- B. Pulls: Solid metal, wire type, 4" long, mounted with two (2) screws fastened from back. Pulls shall be satin chrome colored epoxy powder-coated to match hinges or satin anodized aluminum or satin stainless steel. Provide two (2) pulls for drawers over 24" wide.

- C. Door Catches: Provide two (2), top and bottom, complete with steel catch plates. Dual, self-aligning magnetic type. Type with nylon-roller and spring mechanism may be acceptable. Include on sample base cabinet for review.
- D. Elbow Catches: Brass with latch held by coiled compressing spring. Catch plates of 16 gauge plated steel.
- E. Three-Point Latch: Provide on tall cases with hinged doors.
- F. Leg Shoes: Molded vinyl or rubber, black, coved bottom type to match radius of base molding.
- G. Glass (if any): Provide ASTM C 1048, Type I (transparent flat glass), Class I (clear), Quality-Q3, Kind FT (fully tempered) float for all tall cabinet glazed doors, other glazed doors taller than 48 inches, and other glazed doors where recommended by manufacturer. Otherwise, glass may be ASTM C 1036, Type I (transparent flat glass), Class I (clear), Quality-Q3, annealed float.
- H. Locks: All cabinets shall be equipped with built-in locks as indicated on the Drawings, each separate area keyed alike and master-keyed. All teachers' wardrobe units and all file drawers shall be lockable. Unless otherwise specified, provide 5-disc tumbler type, die cast zinc alloy plated cylinder. Positive tumbler operation for unlocking is accomplished by the action of a heavy brass key. Provide four keys for each room and four master keys.
- I. Tack Surfaces: Where indicated, provide tackable surfaces. Face material shall be 1/4" thick self-healing, pliable, linoleum resilient homogenous tackable material, equal to Claridge Bulletin Board or Forbo colored cork. Surface shall be impervious to water, glue, chalk, and crayon, and shall be washable.

#### 2.05 Countertops:

- A. Plastic Laminate Tops: Base cabinets shall have tops continuous over the entire bank of units, wall-to-wall, including filler and other void spaces. Tops shall be of type indicated. Unless otherwise indicated, provide complete with 4-inch high backsplash along all walls and 4-inch high splash returns at ends where tops terminate against walls.
  - 1. Unless indicated otherwise, countertops shall be plastic laminate on minimum 1 inch thick solid particleboard-core construction. Backsplashes shall be on 3/4-inch thick particleboard. Underside shall be properly balanced with heavy gauge backing sheet.
  - 2. At tops and splashes in which sinks occur, core material shall be water-resistant particleboard, with a 24-hour thickness swell factor of 5% or less and a 24-hour water absorption factor of 10% or less, or shop-sanded exterior grade A-B veneer core plywood.
  - 3. Unless indicated otherwise, front edge of tops shall be matching plastic laminate self-edge.
  - 4. Provide tops and splashes in continuous lengths as long as practical. Provide field glued splines at joints. No joints shall be located closer than 24 inches on either side of sink cutouts.
  - 5. Mobile cabinet tops shall be high-pressure plastic laminate on exterior and high-pressure cabinet-liner on underside. Edges shall be high-impact 3 mm PVC/ABS.
  - 6. Bottom edge of splashes shall receive laminate and be set in a continuous bead of clear silicone sealant. 4-inch high splashes shall be screw-attached to the tops. After top and splash installation, apply continuous cove bead of clear silicone sealant to exposed joint between tops and splashes.

- B. Solid Surface Countertops: Base and sink cabinets shall have tops continuous over the entire bank of units, wall-to-wall, including filler and other void spaces. Unless otherwise indicated, provide complete with 4-inch high backsplash along all walls and 4-inch high splash returns at ends where tops terminate against walls.
1. Unless indicated otherwise, countertops shall be 1/2-inch solid surface material on 3/4-inch thick solid particleboard-core construction.
  2. At tops and splashes in which sinks occur, core material shall be water-resistant particleboard, with a 24-hour thickness swell factor of 5% or less and a 24-hour water absorption factor of 10% or less, or shop-sanded exterior grade A-B veneer core plywood.
  3. Unless indicated otherwise, front edge of tops and backsplashes shall be matching solid surface material self-edge.
  4. Provide tops and splashes in continuous lengths as long as practical. Provide field welds at joints.
  5. Mobile cabinet tops (if any) shall be solid surface material on 3/4-inch solid particleboard-core with self edge.
  6. Splashes shall be set in a continuous bead of clear silicone sealant. 4-inch high splashes shall be screw-attached to the tops. After top and splash installation, apply continuous cove bead of clear silicone sealant to exposed joint between tops and splashes.
- C. Wire Management Accessories:
1. Provide grommets in countertops as indicated. Minimum 2-inch diameter, with closeable cap and wire slot. Color to be selected.
  2. In knee spaces under counters, provide wire management accessories consisting of (a) U-shaped solid trough at back wall of knee space and (b) open wire containment baskets at underside of counter surfaces capable of storing bundled wires and multi-outlet extension power cord.

### PART-3 EXECUTION

#### 3.01 Coordination:

- A. Verify site dimensions of cabinet locations in building prior to fabrication.
- B. Coordinate Work of this Section with related work of other sections as necessary to obtain proper installation of all items.
- C. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcement, and other conditions affecting installation and performance of casework and related equipment installation. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.02 Installation:

- A. Workmen: Install casework under the supervision of the manufacturer's representative with factory-trained mechanics authorized by manufacturer.
- B. Install casework plumb, level, straight and true; shim as required, using concealed shims. Install without distortion so doors and drawers fit openings and are aligned. Where abutting other finished work, apply filler strips and scribe for close, accurate fit, with fasteners concealed where practical.
  1. Securely anchor in place.
  2. Cut and fit work to accommodate sinks, fittings, pipes, ducts, etc.

3. Install all items complete.
- C. Install casework and countertops level and plumb to a tolerance of 1/8 inch in 8 feet.
- D. Install other equipment and accessories according to approved Shop Drawings and manufacturer's written instructions. Securely fasten in place to supporting substrates.

3.03 Adjusting, Cleaning and Protecting:

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Adjust casework and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.
- C. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.
- D. Remove all cartons, debris, sawdust, scraps, etc. Leave casework free from defects and ready for Owner's use.
- E. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at minimum of 48 inches o.c. Unless otherwise instructed by Architect, remove protective covering immediately prior to Substantial Completion.

END OF SECTION

**SECTION 21 05 00**  
**COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe, fittings, valves, and connections for sprinkler, standpipe and fire hose, and combination sprinkler and standpipe systems.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 09 90 00 - Painting and Coating: Preparation and painting of fire protection piping systems.
- C. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment: Piping identification.
- D. Section 21 12 00 - Fire-Suppression Standpipes: Standpipe design.
- E. Section 21 13 00 - Fire Suppression Sprinklers: Sprinkler systems design.
- F. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Piping identification.

**1.03 REFERENCE STANDARDS**

- A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications; The American Society of Mechanical Engineers.
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers.
- C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; The American Society of Mechanical Engineers.
- D. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers (ANSI/ASME B16.5).
- F. ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers.
- G. ASME B16.11 - Forged Steel Fittings, Socket-welding and Threaded; The American Society of Mechanical Engineers.
- H. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers (ANSI B16.18).
- I. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- J. ASME B16.25 - Buttwelding Ends; The American Society of Mechanical Engineers.
- K. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers.
- L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- M. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- N. ASTM A536 - Standard Specification for Ductile Iron Castings.
- O. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

- P. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- Q. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- R. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
- S. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- T. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.
- U. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association (ANSI/AWWA C105/A21.5).
- V. AWWA C606 - Grooved and Shouldered Joints (ANSI/AWWA C606).
- W. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association.
- X. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; National Fire Protection Association.
- Y. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc..
- Z. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc..
- AA. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc..

#### **1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers catalogue information. Indicate valve data and ratings.
- C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- D. Project Record Documents: Record actual locations of components and tag numbering.
- E. Operation and Maintenance Data: Include installation instructions and spare parts lists.
- 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 Valve Stem Packings: Two for each type and size of valve.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified this section.
  1. Minimum three years experience.
  2. Approved by manufacturer.
- C. Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

#### **1.06 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.

## **PART 2 PRODUCTS**

### **2.01 FIRE PROTECTION SYSTEMS**

- A. Sprinkler Systems: Conform work to NFPA 13.
- B. Standpipe and Hose Systems: Conform to NFPA 14.
- C. Welding Materials and Procedures: Conform to ASME BPVC-IX.

### **2.02 BURIED PIPING**

- A. Steel Pipe: ASTM A53/A53M Schedule 40 or ASTM A795 Standard Weight, black, with AWWA C105 polyethylene jacket, or double layer, half-lapped polyethylene tape.
  - 1. Steel Fittings: ASME B16.9, wrought steel, buttwelded or ASTM A234/A234M, wrought carbon steel or alloy steel; with double layer, half-lapped polyethylene tape.

### **2.03 ABOVE GROUND PIPING**

- A. Steel Pipe: ASTM A795 Schedule 10, black.
- B. CPVC Pipe: ASTM F442/F442M, SDR 13.5.
  - 1. Fittings: ASTM F438 Schedule 40, or ASTM F439 schedule 80, CPVC.
  - 2. Joints: Solvent welded, using ASTM F493 cement.

### **2.04 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. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- F. Vertical Support: Steel riser clamp.
- G. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

### **2.05 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 conforming to ASTM A536.
  - 4. Housing Coating: Factory applied orange enamel or \_\_\_\_\_.
  - 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

### **2.06 GATE VALVES**

- A. Up to and including 2 inches:
  - 1. Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.
- B. Over 2 inches:
  - 1. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid rubber covered bronze or cast iron wedge, flanged ends.

- C. Over 4 inches:
  1. Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

## **2.07 GLOBE OR ANGLE VALVES**

- A. Up to and including 2 inches:
  1. Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity repackable under pressure.
- B. Over 2 inches:
  1. Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

## **2.08 BALL VALVES**

- A. Up to and including 2 inches:
  1. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, threaded ends with union.
- B. Over 2 inches:
  1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle or gear drive handwheel for sizes 10 inches and over, flanged.

## **2.09 BUTTERFLY VALVES**

- A. Bronze Body:
  1. Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.
- B. Cast or Ductile Iron Body
  1. Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC.

## **2.10 CHECK VALVES**

- A. Up to and including 2 inches:
  1. Bronze body and swing disc, rubber seat, threaded ends.
- B. Over 2 inches:
  1. Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
- C. 4 inches and Over:
  1. Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

## **2.11 DRAIN VALVES**

- A. Compression Stop:
  1. Bronze with hose thread nipple and cap.
- B. Ball Valve:

## **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. Install standpipe piping, hangers, and supports in accordance with NFPA 14.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
  - 1. CPVC piping may only be used in concealed areas away from occupant access.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Group piping whenever practical at common elevations.
- F. Sleeve pipes passing through partitions, walls, and floors.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- I. 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.
  - 6. Provide copper plated hangers and supports for copper piping.
  - 7. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- J. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- K. 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. Refer to Section 09 90 00.
- L. Do not penetrate building structural members unless indicated.
- M. Provide sleeves when penetrating footings, floors, and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- N. 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.
- O. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

- P. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.
- Q. Provide gate valves for shut-off or isolating service.
- R. Provide drain valves at main shut-off valves, low points of piping and apparatus.

**END OF SECTION**

**SECTION 21 05 13****MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Single phase electric motors.
- B. Three phase electric motors.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.
- B. Section 26 29 13 - Enclosed Controllers.

**1.03 REFERENCE STANDARDS**

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc..
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers.
- C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association.

**1.04 SUBMITTALS**

- A. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- B. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- D. Operation Data: Include instructions for safe operating procedures.
- E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Conform to applicable electrical code, NFPA70, or local energy code.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

**1.07 WARRANTY**

- A. Provide five year manufacturer warranty for motors larger than 20 horsepower.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Lincoln Motors: [www.lincolnmotors.com](http://www.lincolnmotors.com).
- B. A. O. Smith Electrical Products Company: [www.aosmithmotors.com](http://www.aosmithmotors.com).
- C. Reliance Electric/Rockwell Automation: [www.reliance.com](http://www.reliance.com).
- D. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.02 GENERAL CONSTRUCTION AND REQUIREMENTS**

- A. Electrical Service: Refer to Section 26 27 17 for required electrical characteristics.
- B. Electrical Service:
  - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
  - 2. Motors Larger than 1/2 Horsepower: 460 volts, three phase, 60 Hz.
- C. Construction:
  - 1. Open drip-proof type except where specifically noted otherwise.
  - 2. Design for continuous operation in 40 degrees C environment.
  - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  - 4. Motors with frame sizes 254T and larger: Energy Efficient Type.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- F. Wiring Terminations:
  - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  - 2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

### **2.03 APPLICATIONS**

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.
- B. Single phase motors for centrifugal pumps: Split phase type.
- C. Single phase motors for pumps: Capacitor start type.
- D. Single phase motors for pumps: Capacitor start, capacitor run type.

### **2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS**

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

### **2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

- A. Starting Torque: Exceeding one fourth of full load torque.

- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

#### **2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS**

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

#### **2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 13.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 1.
- K. Part Winding Start Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- L. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
- M. Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

- N. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.

#### **3.02 SCHEDULES**

- A. NEMA Open Motor Service Factors.
  - 1. 1/6-1/3 hp:
    - a. 3600 rpm: 1.35.
    - b. 1800 rpm: 1.35.
    - c. 1200 rpm: 1.35.
    - d. 900 rpm: 1.35.
  - 2. 1/2 hp:
    - a. 3600 rpm: 1.25.
    - b. 1800 rpm: 1.25.
    - c. 1200 rpm: 1.25.
    - d. 900 rpm: 1.15.
  - 3. 3/4 hp:
    - a. 3600 rpm: 1.25.
    - b. 1800 rpm: 1.25.
    - c. 1200 rpm: 1.15.
    - d. 900 rpm: 1.15.
  - 4. 1 hp:
    - a. 3600 rpm: 1.25.
    - b. 1800 rpm: 1.15.
    - c. 1200 rpm: 1.15.
    - d. 900 rpm: 1.15.
  - 5. 1.5-150 hp:
    - a. 3600 rpm: 1.15.
    - b. 1800 rpm: 1.15.
    - c. 1200 rpm: 1.15.
    - d. 900 rpm: 1.15.
- B. Three Phase - Premium Efficiency, Open Drip-Proof Performance:
  - 1. 1200 rpm.
    - a. 1 hp:
      - 1) NEMA Frame: 145T.
      - 2) Minimum Percent Power Factor: 72.
      - 3) Minimum Percent Efficiency: 82.5
    - b. 1-1/2 hp:
      - 1) NEMA Frame: 182T.
      - 2) Minimum Percent Power Factor: 73.
      - 3) Minimum Percent Efficiency: 83.
    - c. 2 hp:
      - 1) NEMA Frame: 184T.
      - 2) Minimum Percent Power Factor: 75.
      - 3) Minimum Percent Efficiency: 85.

- d. 3 hp:
  - 1) NEMA Frame: 213T.
  - 2) Minimum Percent Power Factor: 60.
  - 3) Minimum Percent Efficiency: 86.
- e. 5 hp:
  - 1) NEMA Frame: 215T.
  - 2) Minimum Percent Power Factor: 65.
  - 3) Minimum Percent Efficiency: 87.
- f. 7-1/2 hp:
  - 1) NEMA Frame: 254T.
  - 2) Minimum Percent Power Factor: 73.
  - 3) Minimum Percent Efficiency: 89.
- g. 10 hp:
  - 1) NEMA Frame: 256T.
  - 2) Minimum Percent Power Factor: 74.
  - 3) Minimum Percent Efficiency: 89.
- h. 15 hp:
  - 1) NEMA Frame: 284T.
  - 2) Minimum Percent Power Factor: 77.
  - 3) Minimum Percent Efficiency: 90.
- i. 20 hp:
  - 1) NEMA Frame: 286T.
  - 2) Minimum Percent Power Factor: 78.
  - 3) Minimum Percent Efficiency: 90.
- j. 25 hp:
  - 1) NEMA Frame: 324T.
  - 2) Minimum Percent Power Factor: 74.
  - 3) Minimum Percent Efficiency: 91.
- k. 30 hp:
  - 1) NEMA Frame: 326T.
  - 2) Minimum Percent Power Factor: 78.
  - 3) Minimum Percent Efficiency: 91.
- l. 40 hp:
  - 1) NEMA Frame: 364T.
  - 2) Minimum Percent Power Factor: 77.
  - 3) Minimum Percent Efficiency: 93.
- m. 50 hp:
  - 1) NEMA Frame: 365T.
  - 2) Minimum Percent Power Factor: 79.
  - 3) Minimum Percent Efficiency: 93.
- n. 60 hp:
  - 1) NEMA Frame: 404T.
  - 2) Minimum Percent Power Factor: 82.
  - 3) Minimum Percent Efficiency: 93.
- o. 75 hp:
  - 1) NEMA Frame: 405T.
  - 2) Minimum Percent Power Factor: 80.
  - 3) Minimum Percent Efficiency: 93.
- p. 100 hp:
  - 1) NEMA Frame: 444T.
  - 2) Minimum Percent Power Factor: 80.

- 3) Minimum Percent Efficiency: 93.
- q. 125 hp:
  - 1) NEMA Frame: 444T.
  - 2) Minimum Percent Power Factor: 84.
  - 3) Minimum Percent Efficiency: 93.
- 2. 1800 rpm.
  - a. 1 hp:
    - 1) NEMA Frame: 143T.
    - 2) Minimum Percent Power Factor: 84.
    - 3) Minimum Percent Efficiency: 82.
  - b. 1-1/2 hp:
    - 1) NEMA Frame: 145T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 84.
  - c. 2 hp:
    - 1) NEMA Frame: 145T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 84.
  - d. 3 hp:
    - 1) NEMA Frame: 182T.
    - 2) Minimum Percent Power Factor: 86.
    - 3) Minimum Percent Efficiency: 86.
  - e. 5 hp:
    - 1) NEMA Frame: 184T.
    - 2) Minimum Percent Power Factor: 87.
    - 3) Minimum Percent Efficiency: 87.
  - f. 7-1/2 hp:
    - 1) NEMA Frame: 213T.
    - 2) Minimum Percent Power Factor: 86.
    - 3) Minimum Percent Efficiency: 88.
  - g. 10 hp:
    - 1) NEMA Frame: 215T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 89.
  - h. 15 hp:
    - 1) NEMA Frame: 256T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 91.
  - i. 20 hp:
    - 1) NEMA Frame: 256T.
    - 2) Minimum Percent Power Factor: 86.
    - 3) Minimum Percent Efficiency: 91.
  - j. 25 hp:
    - 1) NEMA Frame: 284T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 91.
  - k. 30 hp:
    - 1) NEMA Frame: 286T.
    - 2) Minimum Percent Power Factor: 88.
    - 3) Minimum Percent Efficiency: 92.
  - l. 40 hp:

- 1) NEMA Frame: 324T.
- 2) Minimum Percent Power Factor: 83.
- 3) Minimum Percent Efficiency: 92.
- m. 50 hp:
  - 1) NEMA Frame: 326T.
  - 2) Minimum Percent Power Factor: 88.
  - 3) Minimum Percent Efficiency: 93.
- n. 60 hp:
  - 1) NEMA Frame: 364T.
  - 2) Minimum Percent Power Factor: 88.
  - 3) Minimum Percent Efficiency: 93.
- o. 75 hp:
  - 1) NEMA Frame: 365T.
  - 2) Minimum Percent Power Factor: 88.
  - 3) Minimum Percent Efficiency: 93.
- p. 100 hp:
  - 1) NEMA Frame: 404T.
  - 2) Minimum Percent Power Factor: 83.
  - 3) Minimum Percent Efficiency: 93.
- q. 125 hp:
  - 1) NEMA Frame: 405T.
  - 2) Minimum Percent Power Factor: 86.
  - 3) Minimum Percent Efficiency: 93.
- r. 150 hp:
  - 1) NEMA Frame: 444T.
  - 2) Minimum Percent Power Factor: 85.
  - 3) Minimum Percent Efficiency: 93.
- s. 200 hp:
  - 1) NEMA Frame: 445T.
  - 2) Minimum Percent Power Factor: 85.
  - 3) Minimum Percent Efficiency: 94.
3. 3600 rpm.
  - a. 1-1/2 hp:
    - 1) NEMA Frame: 143T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 82.
  - b. 2 hp:
    - 1) NEMA Frame: 145T.
    - 2) Minimum Percent Power Factor: 87.
    - 3) Minimum Percent Efficiency: 82.
  - c. 3 hp:
    - 1) NEMA Frame: 145T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 84.
  - d. 5 hp:
    - 1) NEMA Frame: 182T.
    - 2) Minimum Percent Power Factor: 86.
    - 3) Minimum Percent Efficiency: 85.
  - e. 7-1/2 hp:
    - 1) NEMA Frame: 184T.
    - 2) Minimum Percent Power Factor: 88.

- 3) Minimum Percent Efficiency: 86.
- f. 10 hp:
  - 1) NEMA Frame: 213T.
  - 2) Minimum Percent Power Factor: 86.
  - 3) Minimum Percent Efficiency: 87.
- g. 15 hp:
  - 1) NEMA Frame: 215T.
  - 2) Minimum Percent Power Factor: 89.
  - 3) Minimum Percent Efficiency: 89.
- h. 20 hp:
  - 1) NEMA Frame: 254T.
  - 2) Minimum Percent Power Factor: 89.
  - 3) Minimum Percent Efficiency: 90.
- i. 25 hp:
  - 1) NEMA Frame: 256T.
  - 2) Minimum Percent Power Factor: 92.
  - 3) Minimum Percent Efficiency: 90.
- j. 30 hp:
  - 1) NEMA Frame: 284T.
  - 2) Minimum Percent Power Factor: 91.
  - 3) Minimum Percent Efficiency: 91.
- k. 40 hp:
  - 1) NEMA Frame: 286T.
  - 2) Minimum Percent Power Factor: 92.
  - 3) Minimum Percent Efficiency: 92.
- l. 50 hp:
  - 1) NEMA Frame: 324T.
  - 2) Minimum Percent Power Factor: 89.
  - 3) Minimum Percent Efficiency: 93.
- m. 60 hp:
  - 1) NEMA Frame: 326T.
  - 2) Minimum Percent Power Factor: 91.
  - 3) Minimum Percent Efficiency: 93.
- n. 75 hp:
  - 1) NEMA Frame: 364T.
  - 2) Minimum Percent Power Factor: 88.
  - 3) Minimum Percent Efficiency: 93.
- o. 100 hp:
  - 1) NEMA Frame: 365T.
  - 2) Minimum Percent Power Factor: 88.
  - 3) Minimum Percent Efficiency: 92.
- C. Three Phase - Energy Efficient, Totally Enclosed, Fan Cooled Performance:
  - 1. 1200 rpm.
    - a. 1 hp:
      - 1) NEMA Frame: 145T.
      - 2) Minimum Percent Power Factor: 72.
      - 3) Minimum Percent Efficiency: 81.
    - b. 1-1/2 hp:
      - 1) NEMA Frame: 182T.
      - 2) Minimum Percent Power Factor: 73.
      - 3) Minimum Percent Efficiency: 83.

- c. 2 hp:
  - 1) NEMA Frame: 184T.
  - 2) Minimum Percent Power Factor: 68.
  - 3) Minimum Percent Efficiency: 85.
- d. 3 hp:
  - 1) NEMA Frame: 213T.
  - 2) Minimum Percent Power Factor: 63.
  - 3) Minimum Percent Efficiency: 86.
- e. 5 hp:
  - 1) NEMA Frame: 215T.
  - 2) Minimum Percent Power Factor: 66.
  - 3) Minimum Percent Efficiency: 86.
- f. 7-1/2 hp:
  - 1) NEMA Frame: 254T.
  - 2) Minimum Percent Power Factor: 68.
  - 3) Minimum Percent Efficiency: 89.
- g. 10 hp:
  - 1) NEMA Frame: 256T.
  - 2) Minimum Percent Power Factor: 75.
  - 3) Minimum Percent Efficiency: 89.
- h. 15 hp:
  - 1) NEMA Frame: 284T.
  - 2) Minimum Percent Power Factor: 72.
  - 3) Minimum Percent Efficiency: 90.
- i. 20 hp:
  - 1) NEMA Frame: 286T.
  - 2) Minimum Percent Power Factor: 76.
  - 3) Minimum Percent Efficiency: 90.
- j. 25 hp:
  - 1) NEMA Frame: 324T.
  - 2) Minimum Percent Power Factor: 71.
  - 3) Minimum Percent Efficiency: 90.
- k. 30 hp:
  - 1) NEMA Frame: 326T.
  - 2) Minimum Percent Power Factor: 79.
  - 3) Minimum Percent Efficiency: 91.
- l. 40 hp:
  - 1) NEMA Frame: 364T.
  - 2) Minimum Percent Power Factor: 78.
  - 3) Minimum Percent Efficiency: 92.
- m. 50 hp:
  - 1) NEMA Frame: 365T.
  - 2) Minimum Percent Power Factor: 81.
  - 3) Minimum Percent Efficiency: 92.
- n. 60 hp:
  - 1) NEMA Frame: 404T.
  - 2) Minimum Percent Power Factor: 83.
  - 3) Minimum Percent Efficiency: 92.
- o. 75 hp:
  - 1) NEMA Frame: 405T.
  - 2) Minimum Percent Power Factor: 80.

- 3) Minimum Percent Efficiency: 92.
- p. 100 hp:
  - 1) NEMA Frame: 444T.
  - 2) Minimum Percent Power Factor: 83.
  - 3) Minimum Percent Efficiency: 93.
- q. 125 hp:
  - 1) NEMA Frame: 444T.
  - 2) Minimum Percent Power Factor: 85.
  - 3) Minimum Percent Efficiency: 93.
- 2. 1800 rpm.
  - a. 1 hp:
    - 1) NEMA Frame: 143T.
    - 2) Minimum Percent Power Factor: 84.
    - 3) Minimum Percent Efficiency: 82.
  - b. 1-1/2 hp:
    - 1) NEMA Frame: 145T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 84.
  - c. 2 hp:
    - 1) NEMA Frame: 145T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 84.
  - d. 3 hp:
    - 1) NEMA Frame: 182T.
    - 2) Minimum Percent Power Factor: 83.
    - 3) Minimum Percent Efficiency: 87.
  - e. 5 hp:
    - 1) NEMA Frame: 184T.
    - 2) Minimum Percent Power Factor: 83.
    - 3) Minimum Percent Efficiency: 88.
  - f. 7-1/2 hp:
    - 1) NEMA Frame: 213T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 89.
  - g. 10 hp:
    - 1) NEMA Frame: 215T.
    - 2) Minimum Percent Power Factor: 84.
    - 3) Minimum Percent Efficiency: 90.
  - h. 15 hp:
    - 1) NEMA Frame: 254T.
    - 2) Minimum Percent Power Factor: 86.
    - 3) Minimum Percent Efficiency: 91.
  - i. 20 hp:
    - 1) NEMA Frame: 256T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 91.
  - j. 25 hp:
    - 1) NEMA Frame: 284T.
    - 2) Minimum Percent Power Factor: 84.
    - 3) Minimum Percent Efficiency: 92.
  - k. 30 hp:

- 1) NEMA Frame: 286T.
- 2) Minimum Percent Power Factor: 86.
- 3) Minimum Percent Efficiency: 93.
- l. 40 hp:
  - 1) NEMA Frame: 324T.
  - 2) Minimum Percent Power Factor: 83.
  - 3) Minimum Percent Efficiency: 93.
- m. 50 hp:
  - 1) NEMA Frame: 326T.
  - 2) Minimum Percent Power Factor: 85.
  - 3) Minimum Percent Efficiency: 93.
- n. 60 hp:
  - 1) NEMA Frame: 364T.
  - 2) Minimum Percent Power Factor: 87.
  - 3) Minimum Percent Efficiency: 93.
- o. 75 hp:
  - 1) NEMA Frame: 365T.
  - 2) Minimum Percent Power Factor: 87.
  - 3) Minimum Percent Efficiency: 93.
- p. 100 hp:
  - 1) NEMA Frame: 405T.
  - 2) Minimum Percent Power Factor: 86.
  - 3) Minimum Percent Efficiency: 94.
- q. 125 hp:
  - 1) NEMA Frame: 444T.
  - 2) Minimum Percent Power Factor: 87.
  - 3) Minimum Percent Efficiency: 94.
- r. 150 hp:
  - 1) NEMA Frame: 445T.
  - 2) Minimum Percent Power Factor: 88.
  - 3) Minimum Percent Efficiency: 94.
- s. 200 hp:
  - 1) NEMA Frame: 447T.
  - 2) Minimum Percent Power Factor: 87.
  - 3) Minimum Percent Efficiency: 95.
3. 3600 rpm.
  - a. 1-1/2 hp:
    - 1) NEMA Frame: 143T.
    - 2) Minimum Percent Power Factor: 85.
    - 3) Minimum Percent Efficiency: 82.
  - b. 2 hp:
    - 1) NEMA Frame: 145T.
    - 2) Minimum Percent Power Factor: 87.
    - 3) Minimum Percent Efficiency: 82.
  - c. 3 hp:
    - 1) NEMA Frame: 182T.
    - 2) Minimum Percent Power Factor: 87.
    - 3) Minimum Percent Efficiency: 82.
  - d. 5 hp:
    - 1) NEMA Frame: 184T.
    - 2) Minimum Percent Power Factor: 88.

- 3) Minimum Percent Efficiency: 85.
- e. 7-1/2 hp:
  - 1) NEMA Frame: 213T.
  - 2) Minimum Percent Power Factor: 86.
  - 3) Minimum Percent Efficiency: 86.
- f. 10 hp:
  - 1) NEMA Frame: 215T.
  - 2) Minimum Percent Power Factor: 86.
  - 3) Minimum Percent Efficiency: 87.
- g. 15 hp:
  - 1) NEMA Frame: 254T.
  - 2) Minimum Percent Power Factor: 91.
  - 3) Minimum Percent Efficiency: 88.
- h. 20 hp:
  - 1) NEMA Frame: 256T.
  - 2) Minimum Percent Power Factor: 89.
  - 3) Minimum Percent Efficiency: 89.
- i. 25 hp:
  - 1) NEMA Frame: 284T.
  - 2) Minimum Percent Power Factor: 92.
  - 3) Minimum Percent Efficiency: 90.
- j. 30 hp:
  - 1) NEMA Frame: 286T.
  - 2) Minimum Percent Power Factor: 92.
  - 3) Minimum Percent Efficiency: 91.
- k. 40 hp:
  - 1) NEMA Frame: 324T.
  - 2) Minimum Percent Power Factor: 91.
  - 3) Minimum Percent Efficiency: 91.
- l. 50 hp:
  - 1) NEMA Frame: 326T.
  - 2) Minimum Percent Power Factor: 92.
  - 3) Minimum Percent Efficiency: 90.
- m. 60 hp:
  - 1) NEMA Frame: 364T.
  - 2) Minimum Percent Power Factor: 93.
  - 3) Minimum Percent Efficiency: 91.
- n. 75 hp:
  - 1) NEMA Frame: 365T.
  - 2) Minimum Percent Power Factor: 91.
  - 3) Minimum Percent Efficiency: 91.
- o. 100 hp:
  - 1) NEMA Frame: 405T.
  - 2) Minimum Percent Power Factor: 92.
  - 3) Minimum Percent Efficiency: 92.

**END OF SECTION**

**SECTION 21 05 48**  
**VIBRATION AND SEISMIC CONTROLS FOR EQUIPMENT**

**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Equipment support bases.
- B. Vibration isolators.
- C. Seismic restraints.

**1.02 SUBMITTALS**

- A. Product Data:
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate seismic control measures.
- C. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Isolation Technology, Inc: [www.isolationtech.com](http://www.isolationtech.com).
- B. Kinetics Noise Control, Inc: [www.kineticsnoise.com](http://www.kineticsnoise.com).
- C. Mason Industries: [www.mason-ind.com](http://www.mason-ind.com).

**2.02 PERFORMANCE REQUIREMENTS**

- A. General:
  - 1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.

**2.03 EQUIPMENT SUPPORT BASES****2.04 VIBRATION ISOLATORS**

- A. Open Spring Isolators:
  - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  - 2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
  - 3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
  - 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- B. Restrained Open Spring Isolators:
  - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  - 2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
  - 3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
  - 4. Restraint: Provide heavy mounting frame and limit stops.
  - 5. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

- C. Closed Spring Isolators:
  - 1. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
  - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  - 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
  - 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- D. Restrained Closed Spring Isolators:
  - 1. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
  - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  - 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
  - 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- E. Spring Hanger:
  - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  - 2. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
  - 3. Misalignment: Capable of 20 degree hanger rod misalignment.
  - 4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- F. Neoprene Pad Isolators:
  - 1. Rubber or neoprene waffle pads.
    - a. Hardness: 30 durometer.
    - b. Thickness: Minimum 1/2 inch.
    - c. Maximum Loading: 50 psi.
    - d. Rib Height: Maximum 0.7 times width.
  - 2. Configuration: Single layer.
  - 3. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.
- G. Rubber Mount or Hanger: Molded rubber designed for 0.4 inch deflection with threaded insert.
- H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.
- I. Seismic Snubbers:
  - 1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
  - 2. Elements: Replaceable neoprene, minimum of 0.75 inch thick with minimum 1/8 inch air gap.
  - 3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
  - 4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Comply with the requirements of NFPA 13.
- C. Bases:
  - 1. Set steel bases for one inch clearance between housekeeping pad and base.
  - 2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
  - 3. Adjust equipment level.
- D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- F. Provide seismic snubbers for all equipment, piping, and ductwork mounted on isolators. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post-disaster use to 0.05 inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.
- G. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.
  - 1. Up to 4 Inches Pipe Size: First three points of support.
  - 2. 5 to 8 Inches Pipe Size: First four points of support.
  - 3. 10 inches Pipe Size and Over: First six points of support.
  - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

### **3.02 FIELD QUALITY CONTROL**

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect isolated equipment after installation and submit report. Include static deflections.

### **3.03 SCHEDULES**

- A. Pipe Isolation Schedule.
  - 1. 1 Inch Pipe Size: Isolate 120 diameters from equipment.
  - 2. 2 Inch Pipe Size: Isolate 90 diameters from equipment.
  - 3. 3 Inch Pipe Size: Isolate 80 diameters from equipment.
  - 4. 4 Inch Pipe Size: Isolate 75 diameters from equipment.
  - 5. 6 Inch Pipe Size: Isolate 60 diameters from equipment.
  - 6. 8 Inch Pipe Size: Isolate 60 diameters from equipment.
  - 7. 10 Inch Pipe Size: Isolate 54 diameters from equipment.
  - 8. 12 Inch Pipe Size: Isolate 50 diameters from equipment.
  - 9. 16 Inch Pipe Size: Isolate 45 diameters from equipment.
  - 10. 24 Inch Pipe Size: Isolate 38 diameters from equipment.
  - 11. Over 24 Inch Pipe Size: As indicated.

**END OF SECTION**



**SECTION 21 05 53**  
**IDENTIFICATION FOR FIRE SUPP. PIPING AND EQUIPMENT**

**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe Markers.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 90 00 - Painting and Coating: Identification painting.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.

**1.04 SUBMITTALS**

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- E. Project Record Documents: Record actual locations of tagged valves.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- B. Champion America, Inc: [www.Champion-America.com](http://www.Champion-America.com).
- C. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).
- D. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 NAMEPLATES**

- A. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/4 inch.
  - 3. Background Color: Black.

**2.03 TAGS**

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

**2.04 STENCILS**

- A. Stencils: With clean cut symbols and letters of following size:
  - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.

2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
  3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
  4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
  5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
  6. Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

## 2.05 PIPE MARKERS

- A. Color: Conform to 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. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

## 2.06 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.

## 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 90 00 for stencil painting.

### 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 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify pumps and valves with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Tag automatic controls, instruments, and relays. Key to control schematic.
- L. Identify piping, concealed or exposed, with plastic pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and

align with axis of piping. 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.

- M. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION**



**SECTION 21 07 19**

**FIRE SUPPRESSION PIPING INSULATION**

**PART 2 PRODUCTS**

**1.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION**

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

**END OF SECTION**



**SECTION 21 13 00**  
**FIRE SUPPRESSION SPRINKLERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.

**1.02 RELATED REQUIREMENTS**

- A. Section 28 31 00 - Fire Detection and Alarm.
- B. Section 21 05 00 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.
- C. Section 21 05 48 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- D. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment.
- E. Section 21 30 00 - Fire Pumps.
- F. Section 21 12 00 - Fire-Suppression Standpipes.
- G. Section 14 91 00 - Facility Chutes: Sprinkler heads inside chutes.
- H. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- I. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- J. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. FM P7825 - Approval Guide; Factory Mutual Research Corporation.
- B. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc..
- C. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association.
- D. NFPA 13R - Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height; National Fire Protection Association.
- E. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc..

**1.04 SUBMITTALS**

- A. 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.
- B. 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. Indicate system controls.
  - 3. Submit shop drawings and hydraulic calculations to authority having jurisdiction and Fire Marshall for approval. Submit proof of approval to Architect.
- C. Samples: Submit one of each style of sprinkler specified.
- D. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.

- F. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  1. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
  2. Sprinkler Wrenches: For each sprinkler type.

#### **1.05 QUALITY ASSURANCE**

- A. Maintain one copy of referenced design and installation standard on site.
- B. Conform to UL requirements.
- C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum three years experience approved by manufacturer.
- F. Equipment and Components: Provide products that bear UL label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

#### **1.06 MOCK-UP**

- A. Provide components for installation in mock-up.
- B. Mock-up may not remain as part of the Work.

#### **1.07 PRE-INSTALLATION MEETING**

- A. Convene one week before starting work of this section.

#### **1.08 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.

#### **1.09 EXTRA MATERIALS**

- A. Provide extra sprinklers of type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
- B. Provide suitable wrenches for each sprinkler type.
- C. Provide metal storage cabinet located adjacent to alarm valve.

### **PART 2 PRODUCTS**

#### **2.01 SPRINKLER SYSTEM**

- A. Sprinkler System: Provide coverage for building areas noted.
- B. Occupancy: comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.
  1. Revise design when test data available prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections where indicated.
- F. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

## 2.02 SPRINKLERS

- A. Suspended Ceiling Type: Standard, Semi-recessed, Recessed or Concealed pendant type with matching push on, clamp on or screw on escutcheon plate.
  - 1. Finish: Brass or Chrome plated.
    - a. Within Standard Acoustical Tile Ceilings: White with White Estuccheon Plate
    - b. Within Wooden Finish Acoustical Clouds: Chrome Plated with Chrome Plated Estuccheon Plate
  - 2. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- B. Exposed Area Type: Standard upright type with guard.
  - 1. Finish: Chrome plated.
  - 2. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Sidewall Type: Standard, Semi-recessed or Recessed horizontal sidewall type with matching push on escutcheon plate and guard.
  - 1. Finish: Chrome plated.
  - 2. Escutcheon Plate Finish: Chrome plated.
  - 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- D. Dry Sprinklers: Standard, Recessed or Exposed pendant type with matching push on escutcheon plate.
  - 1. Finish: Chrome plated.
  - 2. Escutcheon Plate Finish: Chrome plated.
  - 3. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- E. Guards: Finish to match sprinkler finish.
- F. Spray Nozzles: Brass with solid cone discharge, 30 degrees of arc with blow-off dust cap.

## 2.03 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.
- B. Flooding Deluge Valve: Gate type valve with rubber faced disc actuated manually with water motor alarm and electric alarm, with alarm testing trim.
- C. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy chrome plated gong and motor housing, nylon bearings, and inlet strainer.
- D. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
- E. 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.
- F. Fire Department Connections:
  - 1. Type: Flush mounted wall type with brass finish.
  - 2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
  - 3. Drain: 3/4 inch automatic drip, outside.
  - 4. Label: "Sprinkler - Fire Department Connection".
- G. Supervisory Switches:
- H. Water Level Supervisory Switches:
- I. Tank Temperature Supervisory Switches:
- J. Room Temperature Supervisory Switches:

**2.04 PRESSURE MAINTENANCE PUMP**

- A. Type: Close coupled motor and positive displacement pump unit.
- B. Construction: Bronze with stainless steel shafts, carbon bearings.
- C. Motor: Open drip proof, permanently lubricated.
- D. Electrical Characteristics:
  - 1. 0.33 hp.
  - 2. 115 volts, single phase, 60 Hz.
- E. Accessories: Include flexible hose connections, inlet strainer, and relief valve.
- F. Operation: Manual or Automatic with pressure switch actuation.

**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. Place pipe runs to minimize obstruction to other work.
- D. Place piping in concealed spaces above finished ceilings.
- E. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- 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. Install and connect to fire pump system in accordance with Section 21 30 00.
- H. Flush entire piping system of foreign matter.
- I. Install guards on sprinklers where indicated.
- J. Hydrostatically test entire system.
- K. Require test be witnessed by Fire Marshal and authority having jurisdiction.

**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 05 13**  
**COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT**  
**SEE SPECIFICATION SECTION 23 05 13 FOR MOTOR REQUIREMENTS**  
**END OF SECTION**



**SECTION 22 05 19**  
**METERS AND GAGES FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Positive displacement meters.
- B. Pressure gages and pressure gage taps.
- C. Thermometers and thermometer wells.
- D. Static pressure gages.
- E. Filter gages.

**1.02 REFERENCE STANDARDS**

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; The American Society of Mechanical Engineers.
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers.
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- E. AWWA C700 - Cold Water Meters -- Displacement Type, Bronze Main Case; American Water Works Association (ANSI/AWWA C700).
- F. AWWA C701 - Cold Water Meters -- Turbine Type, for Customer Service; American Water Works Association.
- G. AWWA C702 - Cold Water Meters -- Compound Type; American Water Works Association.
- H. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold Water Meters; American Water Works Association (ANSI/AWWA C706).
- I. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; American Water Works Association.
- J. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Underwriters Laboratories Inc..

**1.03 SUBMITTALS**

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Operation and Maintenance Data: .

**1.04 FIELD CONDITIONS**

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

**1.05 EXTRA MATERIALS**

- A. Supply two bottles of red gage oil for static pressure gages.
- B. Supply two pressure gages with pulsation damper or dial thermometers.

**PART 2 PRODUCTS**

**2.01 PRESSURE GAGES**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com](http://www.dwyer-inst.com).

2. Moeller Instrument Co., Inc: [www.moellerinstrument.com](http://www.moellerinstrument.com).
  3. Omega Engineering, Inc: [www.omega.com](http://www.omega.com).
- B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: Steel with brass bourdon tube.
  2. Size: 4-1/2 inch diameter.
  3. Size: 2 inch diameter.
  4. Mid-Scale Accuracy: One percent.
  5. Scale: Psi.

## 2.02 PRESSURE GAGE TAPPINGS

- A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass or Stainless Steel, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- D. Syphon: Steel, Schedule 40, 1/4 inch angle or straight pattern.

## 2.03 STEM TYPE THERMOMETERS

- A. Manufacturers:
  1. Dwyer Instruments, Inc: [www.dwyer-inst.com](http://www.dwyer-inst.com).
  2. Omega Engineering, Inc: [www.omega.com](http://www.omega.com).
  3. Weksler Glass Thermometer Corp: [www.wekslerglass.com](http://www.wekslerglass.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
  1. Size: 9 inch scale.
  2. Window: Clear Lexan.
  3. Size: 9 inch scale.
  4. Window: Clear glass or Lexan.
  5. Accuracy: 2 percent, per ASTM E77.
  6. Calibration: Degrees F.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
  1. Size: 9 inch scale.
  2. Window: Clear Lexan.
  3. Size: 9 inch scale.
  4. Window: Clear glass or Lexan.
  5. Stem: 3/4 inch NPT brass.
  6. Accuracy: 2 percent, per ASTM E77.
  7. Calibration: Degrees F.

## 2.04 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

## 2.05 TEST PLUGS

- A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapters with 1/8 inch probes, two 1 inch dial thermometers.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.
- D. Install pressure gages with pulsation dampers. Provide gage cock or needle valve to isolate each gage. Extend nipples and siphons to allow clearance from insulation.
- E. 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.
- F. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 09 43.
- G. Coil and conceal excess capillary on remote element instruments.
- H. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- I. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- J. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- K. Locate test plugs adjacent thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, adjacent to control device sockets or where indicated.

### 3.02 SCHEDULES

- A. Positive Displacement Meters, Location:
  - 1. Domestic cold water.
  - 2. Expansion tank make-up.
- B. Pressure Gages, Location and Scale Range:
  - 1. Pumps, 0 to 100 psi.
  - 2. Expansion tanks, 0 to 100 psi.
  - 3. Sprinkler system, 0 to 100 psi.
  - 4. Backflow preventers, 0 to 100 psi.
- C. Pressure Gage Tappings, Location:
  - 1. Control valves 3/4 inch & larger - inlets and outlets.
  - 2. Major coils - inlets and outlets.
  - 3. Heat exchangers - inlets and outlets.
- D. Stem Type Thermometers, Location and Scale Range:
  - 1. Domestic hot water supply and recirculation, 0 to 220 degrees F.

**END OF SECTION**



**SECTION 22 05 48**

**VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT**

**SEE SPECIFICATION SECTION 23 05 48**

**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 RELATED REQUIREMENTS**

- A. Section 09 90 00 - Painting and Coating: Identification painting.
- B. Section 22 60 05 - Medical Air, Gas, and Vacuum Systems: Supply of pipe labels for placement under this section.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.

**1.04 SUBMITTALS**

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Samples: Submit two labels; tags in size.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- B. Champion America, Inc: [www.Champion-America.com](http://www.Champion-America.com).
- C. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).
- D. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 NAMEPLATES**

- A. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: Black.
  - 2. Letter Height: 1/2 inch.
  - 3. Background Color: Yellow.

**2.03 TAGS**

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter or square.
- B. Metal Tags: Brass, aluminum, or stainless steel with stamped letters; tag size minimum 1-1/2 inch diameter or square with smooth edges.
- C. Chart: Typewritten letter size list in anodized aluminum frame.

## 2.04 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
  1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.
  2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
  3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
  4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
  5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
  6. Ductwork and Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

## 2.05 PIPE MARKERS

- A. 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. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

## 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. Plumbing Valves: Green.
  4. Heating/Cooling Valves: Blue.

## 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 90 00 for stencil painting.

### 3.02 INSTALLATION

- A. Install plastic 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 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates or stencil painting. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.
- J. Identify valves in main and branch piping with tags.
- K. Identify air terminal units and radiator valves with numbered tags.
- L. Tag automatic controls, instruments, and relays. Key to control schematic.
- M. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. 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.
- N. Identify ductwork with plastic nameplates or stenciled painting. 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.
- O. 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 22 07 16**  
**PLUMBING EQUIPMENT INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Equipment insulation.
- B. Covering.
- C. Breeching insulation.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 90 00 - Painting and Coating: Painting insulation covering.
- B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- C. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.
- D. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- E. Section 23 21 14 - Hydronic Specialties.

**1.03 REFERENCE STANDARDS**

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- F. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- G. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- J. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

**1.04 SUBMITTALS**

- A. See Gilbane Project Manual.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.
- C. Samples: Submit two samples of any representative size illustrating each insulation type.
- D. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

**1.05 QUALITY ASSURANCE**

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

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

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labeled 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.

#### **1.07 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 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION**

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

#### **2.02 GLASS FIBER, FLEXIBLE**

- A. Manufacturers:
  1. Knauf Insulation; : [www.knaufusa.com](http://www.knaufusa.com).
  2. Johns Manville Corporation; : [www.jm.com](http://www.jm.com).
  3. Owens Corning Corp; : [www.owenscorning.com](http://www.owenscorning.com).
  4. CertainTeed Corporation; : [www.certainteed.com](http://www.certainteed.com).
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible.
  1. 'K' Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
  2. Maximum Service Temperature: 450 degrees F, 850 degrees F, 1000 degrees F or 1200 degrees F.
  3. Maximum Water Vapor Sorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film or Vinyl.
  1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  2. Secure with self-sealing longitudinal laps and butt strips.
  3. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- E. Vapor Barrier Lap Adhesive:
  1. Compatible with insulation.
- F. Insulating Cement/Mastic:
  1. ASTM C195; hydraulic setting on mineral wool.

#### **2.03 GLASS FIBER, RIGID**

- A. Manufacturer:
  1. Knauf Insulation: [www.knaufusa.com](http://www.knaufusa.com).
  2. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
  3. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
  4. CertainTeed Corporation; [www.certainteed.com](http://www.certainteed.com).

5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
  1. 'K' Value: 0.25 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.
  2. Maximum Service Temperature: 850 degrees F or 1200 degrees F.
  3. Maximum Water Vapor Sorption: 5.0 percent by weight.
  4. Maximum Density: 8.0 lb/cu ft or 12.0 lb/cu ft.
- C. Vapor Barrier Jacket:
  1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film or Vinyl.
  2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  3. Secure with self-sealing longitudinal laps and butt strips.
  4. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Facing: 1 inch galvanized steel hexagonal wire mesh stitched on one face of insulation.
- E. Vapor Barrier Lap Adhesive:
  1. Compatible with insulation.
- F. Insulating Cement/Mastic:
  1. ASTM C195; hydraulic setting on mineral wool.

#### 2.04 CELLULAR GLASS

- A. Manufacturer:
  1. Pittsburgh Corning Corporation: [www.foamglasinsulation.com](http://www.foamglasinsulation.com).
  2. Substitutions: See Gilbane Project Manual.
- B. Insulation: ASTM C552, Grade 2.
  1. 'K' Value: 0.41 at 100 degrees F.
  2. Service Temperature: Up to 900 degrees F.
  3. Water Vapor Permeability: 0.005 perm inch.
  4. Water Absorption: 0.2 percent by volume, maximum.
  5. Density: Minimum 6.80 lb/cu ft.

#### 2.05 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
  1. Armacell LLC; \_\_\_\_\_: [www.armacell.us](http://www.armacell.us).
  2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C 534 Grade 3, Grad 2 or Grade 1, in sheet form.
  1. Minimum Service Temperature: -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.

#### 2.06 JACKETS

- A. PVC Plastic:
  1. Manufacturers:
    - a. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
    - b. Substitutions: See Gilbane Project Manual.
  2. Jacket: Sheet material, off-white color.
    - a. Minimum Service Temperature: -40 degrees F.
    - b. Maximum Service Temperature: 150 degrees F.

- c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 10 mil.
    - e. Connections: Brush on welding adhesive or Pressure sensitive color matching vinyl tape.
  - 3. Covering Adhesive Mastic:
    - a. Compatible with insulation.
- B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
  - 1. Lagging Adhesive:
    - a. Compatible with insulation.
- C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
  - 1. Thickness: 0.016 inch, 0.020 inch, 0.025 inch, 0.032 inch or 0.040 inch sheet.
  - 2. Finish: Smooth.
  - 3. Joining: Longitudinal slip joints and 2 inch laps.
  - 4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
  - 5. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- D. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
  - 1. Thickness: 0.010 inch, 0.016 inch or 0.018 inch.
  - 2. Finish: Smooth.
  - 3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that equipment 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. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- H. For hot equipment containing fluids 140 degrees F or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- I. For hot equipment containing fluids over 140 degrees F, insulate flanges and unions with removable sections and jackets.
- J. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- K. Inserts and Shields:
  - 1. Application: Equipment 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel or Steel between hangers and inserts.
  3. Insert location: Between support shield and equipment 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.
- L. Finish insulation at supports, protrusions, and interruptions.
- M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

### **3.03 SCHEDULES**

- A. Equipment: Domestic hot-water storage tanks, solar hot water tanks, heat exchangers, and expansion tanks, not factory insulated.
1. Operating Temperature: 55 to 140 degrees F.
  2. Insulation Material: Glass Fiber
  3. Insulation Thickness: 2 inch.
  4. Field-Applied Jacket: PVC
  5. Vapor Retarder Required: No
  6. Finish: None.

**END OF SECTION**



**SECTION 22 07 19**  
**PLUMBING PIPING INSULATION**

**PART 2 PRODUCTS**

**1.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION**

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

**END OF SECTION**



**SECTION 22 10 05  
PLUMBING PIPING**

**PART 2 PRODUCTS**

**1.01 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.

**END OF SECTION**



**SECTION 22 10 06**  
**PLUMBING PIPING SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Roof and floor drains.
- B. Cleanouts.
- C. Hydrants.
- D. Backflow preventers.
- E. Water hammer arrestors.
- F. Interceptors.
- G. Thermostatic mixing valves.
- H. Catch basins and manholes.

**1.02 RELATED REQUIREMENTS**

- A. Section 33 05 13 - Manholes and Structures.
- B. Section 03 30 00 - Cast-in-Place Concrete: Manhole bottoms.
- C. Section 22 10 05 - Plumbing Piping.
- D. Section 22 40 00 - Plumbing Fixtures.
- E. Section 22 30 00 - Plumbing Equipment.
- F. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. ASME A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; The American Society of Mechanical Engineers.
- C. ASSE 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering (ANSI/ASSE 1011).
- D. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; American Society of Sanitary Engineering (ANSI/ASSE 1012).
- E. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers; American Society of Sanitary Engineering.
- F. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering (ANSI/ASSE 1019).
- G. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
- H. ASTM C478M - Standard Specification for Precast Reinforced Concrete Manhole Sections [Metric].
- I. PDI-WH 201 - Water Hammer Arresters; Plumbing and Drainage Institute.

**1.04 SUBMITTALS**

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- C. Certificates: Certify that grease or oil interceptors meet or exceed specified requirements.
- D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

- E. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors, \_\_\_\_\_.
- F. Operation Data: Indicate frequency of treatment required for interceptors.
- G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

### 1.05 QUALITY ASSURANCE

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

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

### 1.07 EXTRA MATERIALS

- A. Supply for Owner's use in maintenance of project:
  1. Two loose keys for outside hose bibbs.
  2. Two hose end vacuum breakers for hose bibbs.

## PART 2 PRODUCTS

### 2.01 DRAINS

- A. Manufacturers:
  1. Josam Company: [www.josam.com](http://www.josam.com).
  2. Jay R. Smith Manufacturing Company: [www.jayrsmith.com](http://www.jayrsmith.com).
  3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Roof Drains:
  1. Assembly: ASME A112.6.4.
  2. Body: Lacquered cast iron with sump.
  3. Strainer: Removable polyethylene, cast metal, cast bronze, or cast iron dome with vandal proof screws.
  4. Accessories: Coordinate with roofing type.
    - a. Membrane flange and membrane clamp with integral gravel stop.
    - b. Adjustable under deck clamp.
    - c. Roof sump receiver.
    - d. Waterproofing flange.
    - e. Controlled flow weir.
    - f. Leveling frame.
    - g. Adjustable extension sleeve for roof insulation.
    - h. Perforated or slotted ballast guard extension for inverted roof.
    - i. Perforated stainless steel ballast guard extension.
- C. Parapet Drains:
  1. Lacquered or Galvanized cast iron body with aluminum flashing clamp collar and epoxy coated or nickel bronze sloping grate.
- D. Canopy and Cornice Drains:
  1. Lacquered or Galvanized cast iron body with aluminum flashing clamp collar and epoxy coated or nickel bronze flat strainer.
- E. Roof Overflow Drains:
  1. Lacquered or Galvanized cast iron body and clamp collar and bottom clamp ring; pipe extended to above flood elevation.
- F. Downspout Nozzles:
  1. Bronze round with straight bottom section.

- G. Area Drains:
  1. Assembly: ASME A112.6.4.
  2. Body: Lacquered cast iron with sump.
  3. Strainer: Round nickel-bronze.
  4. Accessories: Membrane flange and membrane clamp with integral gravel stop, with adjustable under deck clamp, roof sump receiver, waterproofing flange, levelling frame, adjustable extension sleeve (for insulation), and perforated stainless steel ballast guard extension.
- H. Floor Drain:
  1. Round, type 304 stainless steel adjustable floor drain with anchor flange and medium-duty vertically adjustable satin finish top.

## 2.02 CLEANOUTS

- A. Manufacturers:
  1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com](http://www.jayrsmith.com).
  2. Josam Company: [www.josam.com](http://www.josam.com).
  3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
  4. 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.

## 2.03 HYDRANTS

- A. Manufacturers:
  1. Arrowhead Brass Company: [www.arrowheadbrass.com](http://www.arrowheadbrass.com).
  2. Jay R. Smith Manufacturing Company: [www.jayrsmith.com](http://www.jayrsmith.com).
  3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
- B. Wall Hydrants: Exterior
  1. ASSE 1019; tamper-proof, freeze resistant, self-draining type with chrome plated wall plate hose thread spout, handwheel, and integral vacuum breaker.
- C. Roof Hydrant:
  1. Freezeless, cast iron support components. Drain connection, EPDM Boot.

## 2.04 BACKFLOW PREVENTERS

- A. Manufacturers:
  1. Conbraco Industries; Model \_\_\_\_\_: [www.apollovalves.com](http://www.apollovalves.com).
  2. Watts Regulator Company: [www.wattsregulator.com](http://www.wattsregulator.com).
  3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Reduced Pressure Backflow Preventers:
  1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

## 2.05 DOUBLE CHECK VALVE ASSEMBLIES

- A. Manufacturers:
  1. Conbraco Industries; Model \_\_\_\_\_: [www.apollovalves.com](http://www.apollovalves.com).
  2. Watts Regulator Company: [www.wattsregulator.com](http://www.wattsregulator.com).
  3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Double Check Valve Assemblies:
  1. ASSE 1012; Bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.

## 2.06 WATER HAMMER ARRESTORS

- A. Manufacturers:
  1. Jay R. Smith Manufacturing Company: [www.jayrsmith.com](http://www.jayrsmith.com).
  2. Watts Regulator Company: [www.wattsregulator.com](http://www.wattsregulator.com).
  3. Zurn Industries, Inc: [www.zurn.com](http://www.zurn.com).
  4. Souix Chief Company.
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Water Hammer Arrestors:
  1. Stainless steel construction, bellows or piston type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

## 2.07 MIXING VALVES

- A. Thermostatic Mixing Valves:
  1. Manufacturers:
    - a. ESBE: [www.esbe.se/en](http://www.esbe.se/en).
    - b. Leonard Valve Company: [www.leonardvalve.com](http://www.leonardvalve.com).
    - c. Honeywell Water Controls: <http://yourhome.honeywell.com>.
    - d. Substitutions: See Section 01 60 00 - Product Requirements.
  2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
  3. Accessories:
    - a. Check valve on inlets.
    - b. Volume control shut-off valve on outlet.
    - c. Stem thermometer on outlet.
    - d. Strainer stop checks on inlets.
  4. Cabinet: 16 gage, 0.0598 inch prime coated steel, for recessed mounting with keyed lock.

## 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. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved portable 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.
- F. Pipe relief from backflow preventer to nearest drain.
- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories, sinks, washing machines, toilets, urinal and any other quick closing valves .

**END OF SECTION**



**SECTION 23 05 13**  
**MOTOR REQUIREMENTS FOR HVAC AND PLUMBING EQUIP**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single phase electric motors.
- B. Three phase electric motors.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.
- B. Section 26 29 13 - Enclosed Controllers.

**1.03 REFERENCE STANDARDS**

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc..
- B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; Institute of Electrical and Electronic Engineers.
- C. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- D. NFPA 70 - National Electrical Code; National Fire Protection Association.
- E. National Grid "Motor-Up" Rebate Program/Initiative.

**1.04 SUBMITTALS**

- A. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements.
- B. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- C. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- D. Operation Data: Include instructions for safe operating procedures.
- E. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- B. Conform to applicable electrical code, NFPA 70 and local energy code.
- C. Provide certificate of compliance from authority having jurisdiction indicating approval of high efficiency motors.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

**1.07 WARRANTY**

- A. Provide five year manufacturer warranty for motors larger than 20 horsepower.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Lincoln Motors: [www.lincolnmotors.com](http://www.lincolnmotors.com).
- B. A. O. Smith Electrical Products Company: [www.aosmithmotors.com](http://www.aosmithmotors.com).
- C. Reliance Electric/Rockwell Automation: [www.reliance.com](http://www.reliance.com).

### **2.02 GENERAL CONSTRUCTION AND REQUIREMENTS**

- A. Electrical Service: Refer to Section 26 27 17 for required electrical characteristics.
- B. Electrical Service, General. See drawings for specific details:
  - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz
  - 2. Motors Larger than 1/2 Horsepower: 460 volts, three phase, 60 Hz.
- C. Construction:
  - 1. Open drip-proof type except where specifically noted otherwise.
  - 2. Design for continuous operation in 40 degrees C environment.
  - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
  - 4. Motors with frame sizes 254T and larger: Premium Efficiency Type.
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification, with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor.
- F. Wiring Terminations:
  - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
  - 2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

### **2.03 APPLICATIONS**

- A. Exception: Motors less than 250 watts, for intermittent service may be the equipment manufacturer's standard and need not conform to these specifications.
- B. Single phase motors for shaft mounted fans and centrifugal pumps: Split phase type.
- C. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type or electronically commutated (ECM) type. See schedules for requirements.
- D. Single phase motors for fans, pumps, and blowers: Capacitor start type.
- E. Single phase motors for fans, blowers, and pumps: Capacitor start, capacitor run type.
- F. Motors located in outdoors and in draw through cooling towers: Totally enclosed weatherproof epoxy-treated type.

### **2.04 SINGLE PHASE POWER - SPLIT PHASE MOTORS**

- A. Starting Torque: Less than 150 percent of full load torque.
- B. Starting Current: Up to seven times full load current.
- C. Breakdown Torque: Approximately 200 percent of full load torque.
- D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
- E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

**2.05 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS**

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.
- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

**2.06 SINGLE PHASE POWER - CAPACITOR START MOTORS**

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

**2.07 THREE PHASE POWER - SQUIRREL CAGE MOTORS**

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- H. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Section 26 29 13.
- I. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- J. Sound Power Levels: To NEMA MG 1.
- K. Part Winding Start Above 254T Frame Size: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
- L. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

- M. Nominal Efficiency: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- N. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. Provide detailed installation and purchase information for reimbursement by Utility for rebate program.

#### **3.02 SCHEDULE - PREMIUM EFFICIENCY**

- A. NEMA Open Motor Service Factors.
  - 1. 1/6-1/3 hp:
    - a. 3600 rpm: 1.35.
    - b. 1800 rpm: 1.35.
    - c. 1200 rpm: 1.35.
    - d. 900 rpm: 1.35.
  - 2. 1/2 hp:
    - a. 3600 rpm: 1.25.
    - b. 1800 rpm: 1.25.
    - c. 1200 rpm: 1.25.
    - d. 900 rpm: 1.15.
  - 3. 3/4 hp:
    - a. 3600 rpm: 1.25.
    - b. 1800 rpm: 1.25.
    - c. 1200 rpm: 1.15.
    - d. 900 rpm: 1.15.
  - 4. 1 hp:
    - a. 3600 rpm: 1.25.
    - b. 1800 rpm: 1.15.
    - c. 1200 rpm: 1.15.
    - d. 900 rpm: 1.15.
  - 5. 1.5-150 hp:
    - a. 3600 rpm: 1.15.
    - b. 1800 rpm: 1.15.
    - c. 1200 rpm: 1.15.
    - d. 900 rpm: 1.15.
- B. Three Phase - Premium Efficiency, Open Drip-Proof Performance:
  - 1. Ratings.
    - a. 1 hp:
      - 1) NEMA Frame: 145T.
      - 2) Minimum Percent Power Factor: 72.
      - 3) Minimum Percent Efficiency: 82.5% @ 1200 RPM, 85.5% @ 1800 RPM, 77% @ 3600 RPM
    - b. 1-1/2 hp:
      - 1) NEMA Frame: 182T.
      - 2) Minimum Percent Power Factor: 73.

- 3) Minimum Percent Efficiency: 86.5% @ 1200 RPM, 86.5% @ 1800 RPM, 84% @ 3600 RPM
- c. 2 hp:
  - 1) NEMA Frame: 184T.
  - 2) Minimum Percent Power Factor: 75.
  - 3) Minimum Percent Efficiency: 87.5% @ 1200 RPM, 86.5% @ 1800 RPM, 85.5% @ 3600 RPM
- d. 3 hp:
  - 1) NEMA Frame: 213T.
  - 2) Minimum Percent Power Factor: 60.
  - 3) Minimum Percent Efficiency: 88.5% @ 1200 RPM, 89.5% @ 1800 RPM, 85.5% @ 3600 RPM
- e. 5 hp:
  - 1) NEMA Frame: 215T.
  - 2) Minimum Percent Power Factor: 65.
  - 3) Minimum Percent Efficiency: 89.5% @ 1200 RPM, 89.5% @ 1800 RPM, 86.5% @ 3600 RPM
- f. 7-1/2 hp:
  - 1) NEMA Frame: 254T.
  - 2) Minimum Percent Power Factor: 73.
  - 3) Minimum Percent Efficiency: 90.2% @ 1200 RPM, 91% @ 1800 RPM, 88.5% @ 3600 RPM
- g. 10 hp:
  - 1) NEMA Frame: 256T.
  - 2) Minimum Percent Power Factor: 74.
  - 3) Minimum Percent Efficiency: 91.7% @ 1200 RPM, 91.7% @ 1800 RPM, 89.5% @ 3600 RPM
- h. 15 hp:
  - 1) NEMA Frame: 284T.
  - 2) Minimum Percent Power Factor: 77.
  - 3) Minimum Percent Efficiency: 91.7% @ 1200 RPM, 93% @ 1800 RPM, 90.2% @ 3600 RPM.
- i. 20 hp:
  - 1) NEMA Frame: 286T.
  - 2) Minimum Percent Power Factor: 78.
  - 3) Minimum Percent Efficiency: 92.4% @ 1200 RPM, 93% @ 1800 RPM, 91% @ 3600 RPM
- j. 25 hp:
  - 1) NEMA Frame: 324T.
  - 2) Minimum Percent Power Factor: 74.
  - 3) Minimum Percent Efficiency: 93% @ 1200 RPM, 93.6% @ 1800 RPM, 91.7% @ 3600 RPM
- k. 30 hp:
  - 1) NEMA Frame: 326T.
  - 2) Minimum Percent Power Factor: 78.
  - 3) Minimum Percent Efficiency: 93.6% @ 1200 RPM, 94.1% @ 1800 RPM, 91.7% @ 3600 RPM
- l. 40 hp:
  - 1) NEMA Frame: 364T.
  - 2) Minimum Percent Power Factor: 77.

- 3) Minimum Percent Efficiency: 94.1% @ 1200 RPM, 94.1 @ 1800 RPM, 92.4% @ 3600 RPM
  - m. 50 hp:
    - 1) NEMA Frame: 365T.
    - 2) Minimum Percent Power Factor: 79.
    - 3) Minimum Percent Efficiency: 94.1% @ 1200 RPM, 94.5% @ 1800 RPM, 93% @ 3600 RPM
  - n. 60 hp:
    - 1) NEMA Frame: 404T.
    - 2) Minimum Percent Power Factor: 82.
    - 3) Minimum Percent Efficiency: 93.
  - o. 75 hp:
    - 1) NEMA Frame: 405T.
    - 2) Minimum Percent Power Factor: 80.
    - 3) Minimum Percent Efficiency: 93.
  - p. 100 hp:
    - 1) NEMA Frame: 444T.
    - 2) Minimum Percent Power Factor: 80.
    - 3) Minimum Percent Efficiency: 93.
- C. Three Phase - Premium Efficiency, Totally Enclosed, Fan Cooled Performance:
- 1. 1200 rpm.
    - a. 1 hp:
      - 1) NEMA Frame: 145T.
      - 2) Minimum Percent Power Factor: 72.
      - 3) Minimum Percent Efficiency: 82.5% @ 1200 RPM, 85.5% @ 1800 RPM, 77% @ 3600 RPM
    - b. 1-1/2 hp:
      - 1) NEMA Frame: 182T.
      - 2) Minimum Percent Power Factor: 73.
      - 3) Minimum Percent Efficiency: 87.5% @ 1200 RPM, 86.5% @ 1800 RPM, 84% @ 3600 RPM
    - c. 2 hp:
      - 1) NEMA Frame: 184T.
      - 2) Minimum Percent Power Factor: 68.
      - 3) Minimum Percent Efficiency: 88.5% @ 1200 RPM, 86.5% @ 1800 RPM, 85.5% @ 3600 RPM
    - d. 3 hp:
      - 1) NEMA Frame: 213T.
      - 2) Minimum Percent Power Factor: 63.
      - 3) Minimum Percent Efficiency: 89.5% @ 1200 RPM, 89.5% @ 1800 RPM, 86.5% @ 3600 RPM
    - e. 5 hp:
      - 1) NEMA Frame: 215T.
      - 2) Minimum Percent Power Factor: 66.
      - 3) Minimum Percent Efficiency: 89.5% @ 1200 RPM, 89.5% @ 1800 RPM, 88.5% @ 3600 RPM
    - f. 7-1/2 hp:
      - 1) NEMA Frame: 254T.
      - 2) Minimum Percent Power Factor: 68.
      - 3) Minimum Percent Efficiency: 91% @ 1200 RPM, 91.7% @ 1800 RPM, 89.5% @ 3600 RPM

- g. 10 hp:
  - 1) NEMA Frame: 256T.
  - 2) Minimum Percent Power Factor: 75.
  - 3) Minimum Percent Efficiency: 91% @ 1200 RPM, 91.7% @ 1800 RPM, 90.2% @ 3600 RPM
- h. 15 hp:
  - 1) NEMA Frame: 284T.
  - 2) Minimum Percent Power Factor: 72.
  - 3) Minimum Percent Efficiency: 91.7% @ 1200 RPM, 92.4% @ 1800 RPM, 91% @ 3600 RPM
- i. 20 hp:
  - 1) NEMA Frame: 286T.
  - 2) Minimum Percent Power Factor: 76.
  - 3) Minimum Percent Efficiency: 91.7% @ 1200 RPM, 93% @ 1800 RPM, 91% @ 3600 RPM
- j. 25 hp:
  - 1) NEMA Frame: 324T.
  - 2) Minimum Percent Power Factor: 71.
  - 3) Minimum Percent Efficiency: 93% @ 1200 RPM, 93.6% @ 1800 RPM, 91.7% @ 3600 RPM
- k. 30 hp:
  - 1) NEMA Frame: 326T.
  - 2) Minimum Percent Power Factor: 79.
  - 3) Minimum Percent Efficiency: 93% @ 1200 RPM, 93.6% @ 1800 RPM, 91.7% @ 3600 RPM.
- l. 40 hp:
  - 1) NEMA Frame: 364T.
  - 2) Minimum Percent Power Factor: 78.
  - 3) Minimum Percent Efficiency: 94.1% @ 1200 RPM, 94.1% @ 1800 RPM, 92.4% @ 3600 RPM
- m. 50 hp:
  - 1) NEMA Frame: 365T.
  - 2) Minimum Percent Power Factor: 81.
  - 3) Minimum Percent Efficiency: 94.1% @ 1200 RPM, 94.5% @ 1800 RPM, 93% @ 3600 RPM
- n. Over 50 HP - Refer to National Grid "Motor Up" Energy Efficiency requirements for reimbursement.

**END OF SECTION**



**SECTION 23 05 19**  
**METERS AND GAGES FOR HVAC PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Positive displacement meters.
- B. Flow meters.
- C. Pressure gages and pressure gage taps.
- D. Thermometers and thermometer wells.
- E. Static pressure gages.
- F. Filter gages.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 09 23 - Direct-Digital Control System for HVAC.
- C. Section 23 09 93 - Sequence of Operations for HVAC Controls.

**1.03 REFERENCE STANDARDS**

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi; The American Society of Mechanical Engineers.
- C. ASTM E1 - Standard Specification for ASTM Thermometers.
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers.
- E. AWWA C700 - Cold Water Meters -- Displacement Type, Bronze Main Case; American Water Works Association (ANSI/AWWA C700).
- F. AWWA C701 - Cold Water Meters -- Turbine Type, for Customer Service; American Water Works Association.
- G. AWWA C702 - Cold Water Meters -- Compound Type; American Water Works Association.
- H. AWWA C706 - Direct-Reading, Remote-Registration Systems for Cold Water Meters; American Water Works Association (ANSI/AWWA C706).
- I. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; American Water Works Association.
- J. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Underwriters Laboratories Inc..
- K. UL 404 - Gages, Indicating Pressure, for Compressed Gas Service; Underwriters Laboratories Inc..

**1.04 SUBMITTALS**

- A. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- B. Project Record Documents: Record actual locations of components and instrumentation.
- C. Operation and Maintenance Data: Manufacturer's Standards and Operations and maintenance manuals and catalog cuts.

**1.05 FIELD CONDITIONS**

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

**1.06 EXTRA MATERIALS**

- A. Supply two bottles of red gage oil for static pressure gages.
- B. Supply two pressure gages with pulsation damper or dial thermometers.

**PART 2 PRODUCTS****2.01 POSITIVE DISPLACEMENT METERS (LIQUID)**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com](http://www.dwyer-inst.com).
  - 2. Venture Measurement Company: [www.venturemeasurement.com](http://www.venturemeasurement.com).
  - 3. McCrometer: [www.mccrometer.com](http://www.mccrometer.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. AWWA C700, positive displacement disc type suitable for fluid with bronze case and cast iron frost-proof, breakaway bottom cap, hermetically sealed register, remote reading to AWWA C706.
- C. Meter: Brass body turbine meter with magnetic drive register.
  - 1. Service: Cold water, 122 degrees F.
  - 2. Service: Hot water, 200 degrees F.
  - 3. Accuracy: 1-1/2 percent.
  - 4. Maximum Counter Reading: 10 million gallons.
  - 5. Size: 1/2 inch.

**2.02 PRESSURE GAGES**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com](http://www.dwyer-inst.com).
  - 2. Moeller Instrument Co., Inc: [www.moellerinstrument.com](http://www.moellerinstrument.com).
  - 3. Omega Engineering, Inc: [www.omega.com](http://www.omega.com).
- B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
  - 1. Case: Steel with brass bourdon tube.
  - 2. Size: 2-1/2 inch diameter.
  - 3. Mid-Scale Accuracy: One percent.
  - 4. Scale: Psi.

**2.03 PRESSURE GAGE TAPPINGS**

- A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.
- B. Needle Valve: Brass or Stainless Steel, 1/4 inch NPT for minimum 150 psi.
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch connections.
- D. Syphon: Steel, Schedule 40 or Brass, 1/4 inch angle or straight pattern.

**2.04 STEM TYPE THERMOMETERS**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com](http://www.dwyer-inst.com).
  - 2. Omega Engineering, Inc: [www.omega.com](http://www.omega.com).
  - 3. Weksler Glass Thermometer Corp: [www.wekslerglass.com](http://www.wekslerglass.com).

- B. Thermometers - Fixed Mounting: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish.
  1. Size: 7 inch scale.
  2. Window: Clear glass or Lexan.
  3. Stem: Brass.
  4. Accuracy: 2 percent, per ASTM E77.
  5. Calibration: Degrees F.
- C. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
  1. Size: 7 inch scale.
  2. Window: Clear glass or Lexan.
  3. Stem: 3/4 inch NPT brass.
  4. Accuracy: 2 percent, per ASTM E77.
  5. Calibration: Degrees F.

## 2.05 DIAL THERMOMETERS

- A. Manufacturers:
  1. Dwyer Instruments, Inc: [www.dwyer-inst.com](http://www.dwyer-inst.com).
  2. Omega Engineering, Inc: [www.omega.com](http://www.omega.com).
  3. Weksler Glass Thermometer Corp: [www.wekslerglass.com](http://www.wekslerglass.com).
- B. Thermometers - Fixed Mounting: Dial type bimetallic actuated; ASTM E1; stainless steel case, silicone fluid damping, white with black markings and black pointer, hermetically sealed lens, stainless steel stem.
  1. Size: 2-1/2 inch diameter dial.
  2. Lens: Clear glass or Lexan.
  3. Accuracy: 1 percent.
  4. Calibration: Degrees F.
- C. Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
  1. Size: 3 inch diameter dial.
  2. Lens: Clear glass or Lexan.
  3. Accuracy: 1 percent.
  4. Calibration: Degrees F.
- D. Thermometers: Dial type vapor or liquid actuated; ASTM E1; stainless steel case, with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.
  1. Size: 2-1/2 inch diameter dial.
  2. Lens: Clear glass or Lexan.
  3. Length of Capillary: Minimum 5 feet.
  4. Accuracy: 2 percent.
  5. Calibration: Degrees F.

## 2.06 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- B. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

**2.07 TEST PLUGS**

- A. Test Plug: 1/4 inch or 1/2 inch brass or stainless steel fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.
- B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch diameter pressure gages, one gage adapters with 1/8 inch probes, two 1 inch dial thermometers.

**2.08 STATIC PRESSURE GAGES**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com](http://www.dwyer-inst.com).
  - 2. Omega Engineering, Inc: [www.omega.com](http://www.omega.com).
  - 3. Weksler Glass Thermometer Corp: [www.wekslerglass.com](http://www.wekslerglass.com).
- B. 2-1/2 inch diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- C. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- D. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch diameter tubing.

**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gage per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.
- D. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Provide siphon on gages in steam systems. Extend nipples and siphons to allow clearance from insulation.
- E. 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.
- F. Install thermometers in air duct systems on flanges.
- G. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 09 43. Where thermometers are provided on local panels, duct or pipe mounted thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- H. Locate duct mounted thermometers minimum 10 feet downstream of mixing dampers, coils, or other devices causing air turbulence.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent thermometers and thermometer sockets, adjacent to pressure gages and pressure gage taps, adjacent to control device sockets or where indicated.

### 3.02 SCHEDULE

- A. Pressure Gages, Location:
  - 1. Pumps.
  - 2. Expansion tanks.
  - 3. Pressure tanks.
  - 4. Standpipe, highest points.
  - 5. Standpipe and sprinkler water supply connection.
  - 6. Sprinkler system.
  - 7. Pressure reducing valves.
  - 8. Backflow preventers.
- B. Pressure Gage Tappings, Location:
  - 1. Control valves 3/4 inch & larger - inlets and outlets.
  - 2. Major coils - inlets and outlets.
  - 3. Heat exchangers - inlets and outlets.
  - 4. Chiller - inlets and outlets.
  - 5. Boiler - inlets and outlets.
- C. Stem Type Thermometers, Location and Scale Range:
  - 1. Headers to central equipment.
  - 2. Coil banks - inlets and outlets.
  - 3. Heat exchangers - inlets and outlets.
  - 4. Boilers - inlets and outlets.
  - 5. Chiller - inlets and outlets.
  - 6. Water zone supply and return.
  - 7. After major coils.
  - 8. Domestic hot water supply and recirculation.
- D. Thermometer Sockets, Location:
  - 1. Control valves 1 inch & larger - inlets and outlets.
  - 2. Reheat coils - inlets and outlets.
  - 3. Cabinet heaters - inlets and outlets.
  - 4. Unit heaters - inlets and outlets.
- E. Dial Thermometers, Location and Scale Range:
  - 1. ERV Outside air.
  - 2. ERV Return air.
  - 3. ERV Exhaust air.
  - 4. ERV Supply air.
- F. Static Pressure and Filter Gages, Location and Scale Range:
  - 1. Built up filter banks.
  - 2. Unitary filter sections.
  - 3. Supply fan discharge.
  - 4. Building static.

**END OF SECTION**



**SECTION 23 05 48**  
**VIBRATION AND SEISMIC CON. FOR EQUIPMENT**

**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Equipment support bases.
- B. Vibration isolators.
- C. Inertia bases.
- D. Vibration isolators.
- E. Seismic restraints.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete.

**1.03 SUBMITTALS**

- A. Product Data: Provide schedule of vibration isolator type with location and load on each.
- B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate seismic control measures.
- C. Manufacturer's Instructions: Indicate installation instructions with special procedures and setting dimensions.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Isolation Technology, Inc: [www.isolationtech.com](http://www.isolationtech.com).
- B. Kinetics Noise Control, Inc: [www.kineticsnoise.com](http://www.kineticsnoise.com).
- C. Mason Industries: [www.mason-ind.com](http://www.mason-ind.com).

**2.02 PERFORMANCE REQUIREMENTS**

- A. General:
  - 1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
  - 2. Steel springs to function without undue stress or overloading.

**2.03 EQUIPMENT SUPPORT BASES****2.04 VIBRATION ISOLATORS****2.05 INERTIA BASES**

- A. Concrete Inertia Bases:
  - 1. Construction: Structural steel channel perimeter frame, with gusseted brackets and anchor bolts, reinforcing; concrete filled.
  - 2. Mass: Minimum of 1.5 times weight of isolated equipment.
  - 3. Connecting Point: Reinforced to connect isolators and snubbers to base.
  - 4. Concrete: Minimum 3000 psi concrete.

**2.06 VIBRATION ISOLATORS**

- A. Open Spring Isolators:
  - 1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  - 2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.

3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
  4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- B. Restrained Open Spring Isolators:
1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
  3. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
  4. Restraint: Provide heavy mounting frame and limit stops.
  5. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- C. Closed Spring Isolators:
1. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
  2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
  4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- D. Restrained Closed Spring Isolators:
1. Type : Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
  2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
  4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- E. Spring Hangers:
1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
  2. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
  3. Misalignment: Capable of 20 degree hanger rod misalignment.
  4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
- F. Neoprene Pad Isolators:
1. Rubber or neoprene waffle pads.
    - a. Hardness: 30 durometer.
    - b. Thickness: Minimum 1/2 inch.
    - c. Maximum Loading: 50 psi.
    - d. Rib Height: Maximum 0.7 times width.

2. Configuration: Single layer.
  3. Configuration: 1/2 inch thick waffle pads bonded each side of 1/4 inch thick steel plate.
- G. Rubber Mount or Hanger: Molded rubber designed for 0.4 inch deflection with threaded insert.
- H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.
- I. Seismic Snubbers:
1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
  2. Elements: Replaceable neoprene, minimum of 0.75 inch thick with minimum 1/8 inch air gap.
  3. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
  4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.
- J. Roof Mounting Curb: 14 inches high with rigid steel lower section containing adjustable spring pockets with restrained spring isolators, steel upper section to support rooftop equipment, and continuous elastomeric membrane extending from upper section for counterflashing over roofing. Provide acoustical package consisting of interior perimeter angles and cross members to support up to two layers of gypsum board.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's instructions.
- B. Bases:
1. Set steel bases for one inch clearance between housekeeping pad and base.
  2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
  3. Adjust equipment level.
- C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- E. Provide pairs of horizontal limit springs on fans with more than 6.0 inches WC static pressure, and on hanger supported, horizontally mounted axial fans.
- F. Provide seismic snubbers for all equipment, piping, and ductwork mounted on isolators. Each inertia base shall have minimum of four seismic snubbers located close to isolators. Snub equipment designated for post-disaster use to 0.05 inch maximum clearance. Other snubbers shall have clearance between 0.15 inch and 0.25 inch.
- G. Support piping connections to equipment mounted on isolators using isolators or resilient hangers as follows:
1. Up to 4 Inches Pipe Size: First three points of support.
  2. 5 to 8 Inches Pipe Size: First four points of support.
  3. 10 inches Pipe Size and Over: First six points of support.
  4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

### **3.02 FIELD QUALITY CONTROL**

- A. Inspect isolated equipment after installation and submit report. Include static deflections.

### 3.03 SCHEDULE

- A. Pipe Isolation Schedule.
  - 1. 1 Inch Pipe Size: Isolate 120 diameters from equipment.
  - 2. 2 Inch Pipe Size: Isolate 90 diameters from equipment.
  - 3. 3 Inch Pipe Size: Isolate 80 diameters from equipment.
  - 4. 4 Inch Pipe Size: Isolate 75 diameters from equipment.
  - 5. 6 Inch Pipe Size: Isolate 60 diameters from equipment.
  - 6. 8 Inch Pipe Size: Isolate 60 diameters from equipment.
  - 7. 10 Inch Pipe Size: Isolate 54 diameters from equipment.
  - 8. 12 Inch Pipe Size: Isolate 50 diameters from equipment.
  - 9. 16 Inch Pipe Size: Isolate 45 diameters from equipment.
  - 10. 24 Inch Pipe Size: Isolate 38 diameters from equipment.
  - 11. Over 24 Inch Pipe Size: As indicated.
- B. Equipment Isolation Schedule.
  - 1. Pumps.

**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.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 90 00 - Painting and Coating: Identification painting.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.

**1.04 SUBMITTALS**

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Samples: Submit two labels or tags 1/2 x 4 inch in size.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.
- F. Project Record Documents: Record actual locations of tagged valves.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- B. Champion America, Inc: [www.Champion-America.com](http://www.Champion-America.com).
- C. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).

**2.02 NAMEPLATES**

- A. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/2 inch.
  - 3. Background Color: Black.

**2.03 TAGS**

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.
- B. Metal Tags: Aluminum with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

**2.04 STENCILS**

- A. Stencils: With clean cut symbols and letters of following size:
  - 1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.

2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.
  3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.
  4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.
  5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.
  6. Ductwork and Equipment: 2-1/2 inch high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to ASME A13.1.

### **2.05 PIPE MARKERS**

- A. Color: Conform to 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. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

### **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.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

### **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 90 00.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- G. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- H. Identify control panels and major control components outside panels with plastic nameplates.
- I. Identify thermostats relating to terminal boxes or valves with nameplates.

- J. Identify valves in main and branch piping with tags.
- K. Identify air terminal units and radiator valves with numbered tags.
- L. Tag automatic controls, instruments, and relays. Key to control schematic.
- M. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers or stencilled painting. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. 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.
- N. Identify ductwork with plastic nameplates or stencilled painting. 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.
- O. Locate ceiling tacks to locate valves, units, 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 and refrigerating as applicable systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Sound measurement of equipment operating conditions.
- E. Vibration measurement of equipment operating conditions.
- F. Commissioning activities.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 08 00 - Commissioning of HVAC.

**1.03 REFERENCE STANDARDS**

- A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council.
- B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc..
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association.

**1.04 SUBMITTALS**

- A. See Section 01 33 00 - Administrative Requirements, for submittal procedures.
- B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.
- C. 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 the Commissioning Authority.
  - 2. Submit six weeks prior to starting the testing, adjusting, and balancing work.
  - 3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
  - 4. Include at least the following in the plan:
    - a. Preface: An explanation of the intended use of the control system.
    - b. 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.
    - c. Copy of final 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.
    - d. Identification and types of measurement instruments to be used and their most recent calibration date.
    - e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
    - f. Final test report forms to be used.

- g. Detailed step-by-step procedures for TAB work for each system and issue, including:
    - 1) Terminal flow calibration (for each terminal type).
    - 2) Diffuser proportioning.
    - 3) Branch/submain proportioning.
    - 4) Total flow calculations.
    - 5) Rechecking.
    - 6) Diversity issues.
  - h. Expected problems and solutions, etc.
  - i. Criteria for using air flow straighteners or relocating flow stations and sensors; analogous explanations for the water side.
  - j. 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.
  - k. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and methods to verify this.
  - l. Confirmation of understanding of the outside air ventilation criteria under all conditions.
  - m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
  - n. Method of checking building static and exhaust fan and/or relief damper capacity.
  - o. Proposed selection points for sound measurements and sound measurement methods.
  - p. Methods for making coil or other system plant capacity measurements, if specified.
  - q. Time schedule for TAB work to be done in phases (by floor, etc.).
  - r. Description of TAB work for areas to be built out later, if any.
  - s. Time schedule for deferred or seasonal TAB work, if specified.
  - t. False loading of systems to complete TAB work, if specified.
  - u. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
  - v. Interstitial cavity differential pressure measurements and calculations, if specified.
  - w. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
  - x. Procedures for formal progress reports, including scope and frequency.
  - y. Procedures for formal deficiency reports, including scope, frequency and distribution.
- D. Field Logs: Submit at least twice a week to Studio JAED; Commissioning Authority and HVAC Controls Contractor.
- E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- F. Progress Reports.
- G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
  - 1. Submit to the Commissioning Authority; Studio JAED and HVAC Controls Contractor within two weeks after completion of testing, adjusting, and balancing.
  - 2. Revise TAB plan to reflect actual procedures and submit as part of final report.
  - 3. 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.

4. Provide reports in hard cover letter size 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
  5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
  6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
  7. Units of Measure: Report data in I-P (inch-pound) units only.
  8. Include the following on the title page of each report:
    - a. Name of Testing, Adjusting, and Balancing Agency.
    - b. Address of Testing, Adjusting, and Balancing Agency.
    - c. Telephone number of Testing, Adjusting, and Balancing Agency.
    - d. Project name.
    - e. Project location.
    - f. Project Engineer.
    - g. Project altitude.
    - h. Report date.
- H. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

## **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 MN-1, AABC National Standards for Total System Balance.
  2. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
  3. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
  4. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. 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.aabchq.com](http://www.aabchq.com); upon completion submit AABC National Performance Guaranty.
    - b. NEBB, National Environmental Balancing Bureau: [www.nebb.org](http://www.nebb.org).
    - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: [www.tabbcertified.org](http://www.tabbcertified.org).
- E. TAB Supervisor Qualifications: Professional Engineer licensed in the State in which the Project is located.

### **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. Duct system leakage is minimized.
  12. Hydronic systems are flushed, filled, and vented.
  13. Pumps are rotating correctly.
  14. Proper strainer baskets are clean and in place.
  15. 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.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- C. Provide additional balancing devices as required.

### **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 5 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 5 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 5 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

### **3.05 RECORDING AND ADJUSTING**

- A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
  2. Discrepancies, deficient or uncompleted work by others.
  3. Contract interpretation requests.
  4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

### **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. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. 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.
- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. 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.
- O. On fan powered VAV boxes, adjust air flow switches for proper operation.

### **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 COMMISSIONING

- A. See Section 23 08 00 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
  1. Air side systems.
  2. Water side systems.
- D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- E. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 20 percent of the air handlers plus a random sample equivalent to 20 percent of the final TAB report data as directed by Commissioning Authority.
  1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
  2. Use the same test instruments as used in the original TAB work.
  3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
  4. For purposes of re-check, failure is defined as follows:
    - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
    - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
    - c. Temperatures: Deviation of more than one degree F.
    - d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
    - e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
  5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- F. In the presence of the Commissioning Authority, verify that:
  1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
  2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
  3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all

balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

### 3.09 SCOPE

- A. Test, adjust, and balance the following:
  - 1. Air Cooled Refrigerant Condensers
  - 2. Packaged Roof Top Heating/Cooling Units
  - 3. Air Coils
  - 4. Unit Ventilators
  - 5. Air Handling Units
  - 6. Fans
  - 7. Air Terminal Units
  - 8. Air Inlets and Outlets

### 3.10 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
  - 1. Manufacturer
  - 2. Model/Frame
  - 3. HP/BHP
  - 4. Phase, voltage, amperage; nameplate, actual, no load
  - 5. RPM
  - 6. Service factor
  - 7. Starter size, rating, heater elements
  - 8. Sheave Make/Size/Bore
- B. V-Belt Drives:
  - 1. Identification/location
  - 2. Required driven RPM
  - 3. Driven sheave, diameter and RPM
  - 4. Belt, size and quantity
  - 5. Motor sheave diameter and RPM
  - 6. Center to center distance, maximum, minimum, and actual
- C. Pumps:
  - 1. Identification/number
  - 2. Manufacturer
  - 3. Size/model
  - 4. Impeller
  - 5. Service
  - 6. Design flow rate, pressure drop, BHP
  - 7. Actual flow rate, pressure drop, BHP
  - 8. Discharge pressure
  - 9. Suction pressure
  - 10. Total operating head pressure
  - 11. Shut off, discharge and suction pressures
  - 12. Shut off, total head pressure
- D. Cooling Coils:
  - 1. Identification/number
  - 2. Location
  - 3. Service
  - 4. Manufacturer
  - 5. Air flow, design and actual
  - 6. Entering air DB temperature, design and actual

7. Entering air WB temperature, design and actual
  8. Leaving air DB temperature, design and actual
  9. Leaving air WB temperature, design and actual
  10. Water flow, design and actual
  11. Saturated suction temperature, design and actual
  12. Air pressure drop, design and actual
- E. Heating Coils:
1. Identification/number
  2. Location
  3. Service
  4. Manufacturer
  5. Air flow, design and actual
  6. Water flow, design and actual
  7. Water pressure drop, design and actual
  8. Entering water temperature, design and actual
  9. Leaving water temperature, design and actual
  10. Entering air temperature, design and actual
  11. Leaving air temperature, design and actual
  12. Air pressure drop, design and actual
- F. Air Moving Equipment:
1. Location
  2. Manufacturer
  3. Model number
  4. Serial number
  5. Arrangement/Class/Discharge
  6. Air flow, specified and actual
  7. Return air flow, specified and actual
  8. Outside air flow, specified and actual
  9. Total static pressure (total external), specified and actual
  10. Inlet pressure
  11. Discharge pressure
  12. Sheave Make/Size/Bore
  13. Number of Belts/Make/Size
  14. Fan RPM
- G. Return Air/Outside Air:
1. Identification/location
  2. Design air flow
  3. Actual air flow
  4. Design return air flow
  5. Actual return air flow
  6. Design outside air flow
  7. Actual outside air flow
  8. Return air temperature
  9. Outside air temperature
  10. Required mixed air temperature
  11. Actual mixed air temperature
  12. Design outside/return air ratio
  13. Actual outside/return air ratio
- H. 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
  10. Air correction factor
- I. Duct Leak Tests:
1. Description of ductwork under test
  2. Duct design operating pressure
  3. Duct design test static pressure
  4. Duct capacity, air flow
  5. Maximum allowable leakage duct capacity times leak factor
  6. Test apparatus
    - a. Blower
    - b. Orifice, tube size
    - c. Orifice size
    - d. Calibrated
  7. Test static pressure
  8. Test orifice differential pressure
  9. Leakage
- J. Air Monitoring Stations:
1. Identification/location
  2. System
  3. Size
  4. Area
  5. Design velocity
  6. Design air flow
  7. Test velocity
  8. Test air flow
- K. Flow Measuring Stations:
1. Identification/number
  2. Location
  3. Size
  4. Manufacturer
  5. Model number
  6. Serial number
  7. Design Flow rate
  8. Design pressure drop
  9. Actual/final pressure drop
  10. Actual/final flow rate
  11. Station calibrated setting
- L. 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
- M. 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
- N. Sound Level Reports:
1. Location
  2. Octave bands - equipment off
  3. Octave bands - equipment on
- O. Vibration Tests:
1. Location of points:
    - a. Fan bearing, drive end
    - b. Fan bearing, opposite end
    - c. Motor bearing, center (if applicable)
    - d. Motor bearing, drive end
    - e. Motor bearing, opposite end
    - f. Casing (bottom or top)
    - g. Casing (side)
    - h. Duct after flexible connection (discharge)
    - i. Duct after flexible connection (suction)
  2. Test readings:
    - a. Horizontal, velocity and displacement
    - b. Vertical, velocity and displacement
    - c. Axial, velocity and displacement
  3. Normally acceptable readings, velocity and acceleration
  4. Unusual conditions at time of test
  5. Vibration source (if non-complying)

**END OF SECTION**

**SECTION 23 07 13**  
**DUCT INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Duct insulation.
- B. Duct Lagging.
- C. Insulation jackets.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 90 00 - Painting and Coating: Painting insulation jackets.
- C. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- D. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- E. Section 23 31 00 - HVAC Ducts and Casings: Glass fiber ducts.

**1.03 REFERENCE STANDARDS**

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- C. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- D. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- F. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.
- G. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- J. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- K. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- L. SMACNA (DCS) - HVAC Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association.
- M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

**1.04 SUBMITTALS**

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

**1.06 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.

**1.07 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 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION**

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

**2.02 GLASS FIBER, FLEXIBLE**

- A. Manufacturer:
  - 1. Knauf Insulation: [www.knaufusa.com](http://www.knaufusa.com).
  - 2. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
  - 3. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
  - 4. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. "R" Value of 6 for indoor applications, 8 for exterior applications.
  - 2. Maximum Service Temperature: 450 degrees F.
  - 3. Maximum Water Vapor Sorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
  - 1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  - 2. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Outdoor Vapor Barrier Mastic:
  - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- F. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter.

**2.03 GLASS FIBER, RIGID**

- A. Manufacturer:
  - 1. Knauf Insulation: [www.knaufusa.com](http://www.knaufusa.com).
  - 2. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
  - 3. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
  - 4. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
- B. Insulation: ASTM C612; rigid, noncombustible blanket.

1. Maximum service temperature: 450 degrees F.
  2. "R" Value of 6 for indoor applications, 8 for exterior applications.
- C. Vapor Barrier Jacket:
1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
  2. Secure with pressure sensitive tape.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- E. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.
  2. Vinyl emulsion type acrylic, compatible with insulation, black color.

#### **2.04 JACKETS**

- A. Aluminum Jacket: ASTM B209 (ASTM B209M).
1. Thickness: 0.016 inch sheet.
  2. Finish: Smooth.
  3. Joining: Longitudinal slip joints and 2 inch laps.
  4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
  5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
  6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

#### **2.05 DUCT LAGGING**

- A. Manufacturers:
1. Sound Seal: [www.soundseal.com](http://www.soundseal.com)
  2. Kinetics Noise Control: [www.kineticsnoise.com](http://www.kineticsnoise.com).
  3. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Lagging: Loaded vinyl noise barrier with a scrim reinforced aluminum foil facing on one side with a 1" thick fiberglass decoupler.
1. Apparent Thermal Conductivity: Maximum of .25 at 75 degrees F
  2. Service Temperature: Up to 350 degrees F.
- C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that ducts have been tested before 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. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated ducts conveying air below ambient temperature:
  1. Provide insulation with vapor barrier jackets.
  2. Finish with tape and vapor barrier jacket.
  3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ducts conveying air above ambient temperature:
  1. Provide with or without standard vapor barrier jacket.

2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with with calked aluminum jacket with seams located on bottom side of horizontal duct section.
- F. 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.

### 3.03 SCHEDULES

- A. INDOOR DUCT AND PLENUM APPLICATION SCHEDULE
  1. NOTE: Apply duct lagging where indicated on drawings.
  2. Service: Round, supply-air ducts, concealed.
    - a. Material: Mineral-fiber blanket.
    - b. Thickness: 2 inches.
    - c. Jacket: Foil and paper.
    - d. Vapor Retarder Required: Yes.
  3. Service: Round, return-air ducts, concealed.
    - a. Material: Mineral-fiber blanket.
    - b. Thickness: 2 inch.
    - c. Jacket: Foil and paper.
    - d. Vapor Retarder Required: No.
  4. Service: Round, outside-air ducts, concealed.
    - a. Material: Mineral-fiber blanket
    - b. Thickness: 2 inches.
    - c. Jacket: Foil and paper.
    - d. Vapor Retarder Required: Yes.
  5. Service: Rectangular, supply-air ducts, concealed.
    - a. Material: Mineral-fiber blanket
    - b. Thickness: 2 inches.
    - c. Jacket: Foil and paper.
    - d. Vapor Retarder Required: Yes.
  6. Service: Rectangular, return-air ducts, concealed.
    - a. Material: Mineral-fiber blanket
    - b. Thickness: 2 inch.
    - c. Jacket: Foil and paper.
    - d. Vapor Retarder Required: No.
  7. Service: Rectangular, outside-air ducts, concealed.
    - a. Material: Mineral-fiber blanket
    - b. Thickness: 2 inches.
    - c. Jacket: Foil and paper.
    - d. Vapor Retarder Required: Yes.
  8. Service: Round, supply-air ducts, exposed.
    - a. Material: Mineral-fiber blanket
    - b. Thickness: 2 inches.
    - c. Jacket: Spiral-wound steel, paintable.

- d. Vapor Retarder Required: Yes.
  - 9. Service: Round, return-air ducts, exposed.
    - a. Material: Mineral-fiber board.
    - b. Thickness: 2 inch.
    - c. Jacket: Spiral-wound steel, paintable.
    - d. Vapor Retarder Required: No.
    - e. NOTE: Provide double-walled spiral ductwork in areas noted on drawings as defined in specification section 15890.
  - 10. Service: Round, outside-air ducts, exposed.
    - a. Material: Mineral-fiber board.
    - b. Thickness: 2 inches.
    - c. Jacket: Spiral-wound steel, paintable.
    - d. Vapor Retarder Required: Yes.
    - e. NOTE: Provide double-walled spiral ductwork in areas noted on drawings as defined in specification section 15890.
  - 11. Service: Rectangular, supply-air ducts, exposed.
    - a. Material: Mineral-fiber board.
    - b. Thickness: 2 inches.
    - c. Jacket: Aluminum, painted to architects specifications.
    - d. Vapor Retarder Required: Yes.
  - 12. Service: Rectangular, return-air ducts, exposed.
    - a. Material: Mineral-fiber board.
    - b. Thickness: 2 inch.
    - c. Jacket: Aluminum, painted to architects specifications
    - d. Vapor Retarder Required: No.
  - 13. Service: Rectangular, outside-air ducts, exposed.
    - a. Material: Mineral-fiber board.
    - b. Thickness: 2 inches.
    - c. Jacket: Aluminum, painted to architects specifications.
    - d. Vapor Retarder Required: Yes.
  - 14. Service: Rectangular, dishwasher exhaust ducts, concealed.
    - a. Material: Mineral-fiber blanket.
    - b. Thickness: 1/2 inch.
    - c. Jacket: Foil and Paper
    - d. Vapor Retarder Required: No.
  - 15. Service: Rectangular, dishwasher exhaust ducts, exposed.
    - a. Material: Mineral-fiber board.
    - b. Thickness: 1/2 inch.
    - c. Jacket: Aluminum
    - d. Vapor Retarder Required: No.
- B. OUTDOOR DUCT AND PLENUM APPLICATION SCHEDULE
- 1. Service: Round, supply-air ducts.
    - a. Material: Mineral-fiber board.
    - b. Thickness: 3 inches.
    - c. Field-Applied Jacket: aluminum
      - 1) Aluminum Thickness: 0.032 inch
    - d. Vapor Retarder Required: Yes.
  - 2. Service: Round, return-air ducts.
    - a. Material: Mineral-fiber board.
    - b. Thickness: 3 inches.
    - c. Field-Applied Jacket: aluminum

- 1) Aluminum Thickness: 0.032 inch
- d. Vapor Retarder Required: Yes.
- 3. Service: Rectangular, supply-air ducts.
  - a. Material: Mineral-fiber board.
  - b. Thickness: 3 inches.
  - c. Field-Applied Jacket: aluminum
    - 1) Aluminum Thickness: 0.032 inch
  - d. Vapor Retarder Required: Yes.
- 4. Service: Rectangular, return-air ducts.
  - a. Material: Mineral-fiber board.
  - b. Thickness: 3 inches.
  - c. Field-Applied Jacket: aluminum
    - 1) Aluminum Thickness: 0.032 inch
  - d. Vapor Retarder Required: Yes.

**END OF SECTION**

**SECTION 23 07 19**  
**HVAC PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 09 90 00 - Painting and Coating: Painting insulation jacket.
- C. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.
- D. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.
- E. Section 23 23 00 - Refrigerant Piping: Placement of inserts.

**1.03 REFERENCE STANDARDS**

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- D. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
- E. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
- F. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
- G. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- H. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
- I. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- J. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
- K. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
- L. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- M. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- N. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
- O. ASTM C610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
- P. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- Q. ASTM D1056 - Standard Specification for Flexible Cellular Materials--Sponge or Expanded Rubber.
- R. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.

- S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- T. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- U. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- V. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc..

#### **1.04 SUBMITTALS**

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum three years of experience.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

#### **1.07 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 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION**

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

#### **2.02 GLASS FIBER**

- A. Manufacturers:
  1. Knauf Insulation: [www.knaufusa.com](http://www.knaufusa.com).
  2. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
  3. Owens Corning Corp: [www.owenscorning.com](http://www.owenscorning.com).
  4. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
  1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
  2. Maximum service temperature: 850 degrees F.
  3. Maximum moisture absorption: 0.2 percent by volume.
- C. 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.
- D. 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.

- E. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- F. Vapor Barrier Lap Adhesive:
  - 1. Compatible with insulation.
- G. Insulating Cement/Mastic:
  - 1. ASTM C195; hydraulic setting on mineral wool.
- H. Fibrous Glass Fabric:
  - 1. Cloth: Untreated; 9 oz/sq yd weight.
  - 2. Blanket: 1.0 lb/cu ft density.
  - 3. Weave: 5x5.
- I. Indoor Vapor Barrier Finish:
  - 1. Cloth: Untreated; 9 oz/sq yd weight.
  - 2. Vinyl emulsion type acrylic, compatible with insulation, black color.
- J. Outdoor Vapor Barrier Mastic:
  - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- K. Outdoor Breather Mastic:
  - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- L. Insulating Cement:
  - 1. ASTM C449/C449M.

### 2.03 CELLULAR GLASS

- A. Manufacturers:
  - 1. Pittsburgh Corning Corporation: [www.foamglasinsulation.com](http://www.foamglasinsulation.com).
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C552, Type 1.
  - 1. Apparent Thermal Conductivity; 'K' value: Grade 6, 0.33 at 100 degrees F.
  - 2. Service Temperature: Up to 800 degrees F.
  - 3. Water Vapor Permeability: 0.005 perm inch.
  - 4. Water Absorption: 0.5 percent by volume, maximum.

### 2.04 EXPANDED POLYSTYRENE

- A. Insulation: ASTM C578; rigid closed cell.
  - 1. 'K' value: 0.23 at 75 degrees F.
  - 2. Maximum service temperature: 165 degrees F.
  - 3. Maximum water vapor permeance: 5.0 perms

### 2.05 EXPANDED PERLITE

- A. Manufacturers:
  - 1. Schundler Company: [www.schundler.com](http://www.schundler.com).
- B. Insulation: ASTM C610, molded.
  - 1. Maximum service temperature: 1200 degrees F.
  - 2. Maximum water vapor transmission: 0.1 perm.

### 2.06 HYDROUS CALCIUM SILICATE

- A. Manufacturers:
  - 1. Johns Manville Corporation: [www.jm.com](http://www.jm.com).
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: ASTM C533 and ASTM C795; rigid molded, asbestos free, gold color.
  - 1. 'K' value: ASTM C177 and C518; 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or ASTM C518.

2. Maximum service temperature: 1200 degrees F.
  3. Density: 15 lb/cu ft.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Insulating Cement:
1. ASTM C449/C449M.

## 2.07 POLYISOCYANURATE CELLULAR PLASTIC

- A. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
1. Dimension: Comply with requirements of ASTM C585.
  2. 'K' value: 0.18 at 75 degrees F, when tested in accordance with ASTM C518.
  3. Minimum Service Temperature: -70 degrees F.
  4. Maximum Service Temperature: 300 degrees F.
  5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842..
  6. Moisture Vapor Transmission: 4.0 perm in.
  7. Connection: Waterproof vapor barrier adhesive.

## 2.08 POLYETHYLENE

- A. Manufacturers:
1. Armacell LLC; Model \_\_\_\_\_: www.armacell.us.
  2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
1. 'K' value: ASTM C177; 0.25 at 75 degrees F.
  2. Maximum Service Temperature: 300 degrees F.
  3. Density: 2 lb/cu ft.
  4. Maximum Moisture Absorption: 1.0 percent by volume.
  5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.
  6. Connection: Contact adhesive.

## 2.09 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturer:
1. Armacell LLC; \_\_\_\_\_: www.armacell.us.
  2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 3; use molded tubular material wherever possible.
1. Minimum Service Temperature: -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.

## 2.10 JACKETS

- A. PVC Plastic.
1. Manufacturers:
    - a. Johns Manville Corporation: www.jm.com.
    - b. Substitutions: See Section 01 60 00 - Product Requirements.
  2. 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.
    - e. Connections: Brush on welding adhesive.
  - 3. Covering Adhesive Mastic:
    - a. Compatible with insulation.
- B. ABS Plastic:
  - 1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: -40 degrees F.
    - b. Maximum Service Temperature of 180 degrees F.
    - c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 30 mil.
    - e. Connections: Brush on welding adhesive.
- C. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.
  - 1. Lagging Adhesive:
    - a. Compatible with insulation.
- D. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.
  - 1. Thickness: 0.016 inch sheet.
  - 2. Finish: Smooth.
  - 3. Joining: Longitudinal slip joints and 2 inch laps.
  - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
  - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
  - 6. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- E. Stainless Steel Jacket: ASTM A666, Type 302 stainless steel.
  - 1. Thickness: 0.010 inch.
  - 2. Finish: Smooth.
  - 3. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.

## **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. 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: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. 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.

- F. 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.
- G. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.
- H. 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.
- I. 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.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 00.
- K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with canvas jacket sized for finish painting.
- L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.
- M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.
- N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

### 3.03 SCHEDULE

- A. PIPING INSULATION SCHEDULES
  - 1. General: Abbreviations used in the following schedules include:
    - a. Field Applied Jackets: P - PVC, K-Foil and Paper, A - Aluminum, SS - Stainless Steel.
    - b. Piping Sizes: NPS - Nominal Pipe Size.
- B. INTERIOR PIPING APPLICATION SCHEDULE
  - 1. Service: Condensate drain piping.
    - a. Operating Temperature: 35 to 75 deg F.
    - b. Insulation Material: Flexible elastomeric.
    - c. Insulation Thickness: 0.5 inch.
    - d. Jacket: None.
    - e. Vapor Retarder Required: Yes.
    - f. Finish: None.
- C. Service: Chilled-water and dual-temperature supply and return.

1. Operating Temperature: 35 to 250 deg F.
  2. Insulation Material: Mineral fiber or glass fiber
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Pipe, 1" or less: 1.0 inch.
    - b. Pipe, 1 ¼" and up: 1.5 inch.
  4. Jacket: PVC.
  5. Vapor Retarder Required: Yes.
  6. Finish: none
- D. Service: Refrigerant suction and hot-gas piping.
1. Operating Temperature: 35 to 140 deg F.
  2. Insulation Material: Flexible elastomeric.
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Pipe, 1" or less: 1.0 inch.
    - b. Pipe, 1-1/4" and up: 1.5 inch.
  4. Jacket: None.
  5. Vapor Retarder Required: No.
  6. Finish: None.
- E. Service: Heating hot-water supply and return.
1. Operating Temperature: 100 to 250 deg F.
  2. Insulation Material: Mineral fiber or glass fiber.
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Pipe, 1" or less: 1.0 inch.
    - b. Pipe, 1-1/4" to 4": 1.5 inch.
    - c. Pipe, 5" and up: 2.0 inch.
  4. Jacket: PVC.
  5. Vapor Retarder Required: No.
  6. Finish: None.
- F. EXTERIOR PIPING INSULATION APPLICATION SCHEDULE
- G. Service: Refrigerant suction.
1. Operating Temperature: 35 to 140 deg F.
  2. Insulation Material: Flexible elastomeric.
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Pipe, 1" or less: 1.0 inch.
    - b. Pipe, 1-1/4" to 2": 1.5 inch.
    - c. Pipe, 2-1/2" and up: 1.5 inch.
  4. Jacket: Aluminum.
  5. Vapor Retarder Required: Yes.
  6. Finish: None.
- H. Service: Chilled-water and dual temperature supply and return.
1. Operating Temperature: 35 to 250 deg F.
  2. Insulation Material: Cellular glass, with jacket.
  3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Pipe, Any pipe size: 2.0 inch.
  4. Field-Applied Jacket: Aluminum.
  5. Vapor Retarder Required: Yes.
  6. Finish: None.
- I. Service: Heating hot-water supply and return.
1. Operating Temperature: 100 to 250 deg F.
  2. Insulation Material: Mineral fiber

3. Insulation Thickness: Apply the following insulation thicknesses:
  - a. Pipe, Any pipe size: 2.0 inch.
4. Field-Applied Jacket: Aluminum.
5. Vapor Retarder Required: No.
6. Finish: None.

**END OF SECTION**

**SECTION 23 09 13**  
**INSTRUMENTATION AND CONTROL DEVICES FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Thermostats, Temperature Sensors.
- B. Control valves.
- C. Automatic dampers.
- D. Damper operators.
- E. Miscellaneous accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 21 13 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, gage taps.
- B. Section 23 33 00 - Air Duct Accessories: Installation of automatic dampers.
- C. Section 23 09 23 - Direct-Digital Control System for HVAC.
- D. Section 23 09 93 - Sequence of Operations for HVAC Controls.

**1.03 REFERENCE STANDARDS**

- A. AMCA 500-D - Laboratory Methods for Testing Dampers for Rating; Air Movement and Control Association International, Inc..
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- C. ASTM B32 - Standard Specification for Solder Metal.
- D. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- E. ASTM D1693 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association.

**1.04 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. Manufacturer's Instructions: Provide for all manufactured components.
- E. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
  - 1. Revise shop drawings to reflect actual installation and operating sequences.
- F. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

- G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

### 1.05 QUALITY ASSURANCE

- A. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State in which the Project is located.

## 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 CONTROL VALVES

- A. Globe Pattern:
  - 1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, screwed ends with backseating capacity repackable under pressure.
    - a. Product:
      - 1) Substitutions: See Section 01 60 00 - Product Requirements.
  - 2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc.
    - a. Product:
      - 1) Substitutions: See Section 01 60 00 - Product Requirements.
  - 3. Hydronic Systems:
    - a. Rate for service pressure of 125 psig at 250 degrees F.
    - b. Replaceable plugs and seats of stainless steel.
    - c. Size for 3 psig maximum pressure drop at design flow rate.
    - d. Two way valves shall have equal percentage characteristics, three way valves linear characteristics. Size two way valve operators to close valves against pump shut off head.
  - 4. Steam Systems:
    - a. Rate for service pressure of 125 psig at 250 degrees F.
    - b. Replaceable plugs and seats of stainless steel. Pressure drop across any steam valve at maximum flow shall be as shown on the Drawings.
    - c. Size for 10 psig inlet pressure and 5 psig pressure drop.
    - d. Valves shall have modified linear characteristics.
- B. Butterfly Pattern:
  - 1. Iron body, bronze disc, resilient replaceable seat for service to 180 degrees F wafer or lug ends, extended neck.
  - 2. Hydronic Systems:
    - a. Rate for service pressure of 125 psig at 250 degrees F.
    - b. Size for 1 psig maximum pressure drop at design flow rate.
- C. Electronic Actuators:
  - 1. 24 V powered, 4-20 mA proportional signal electronic actuator for valves and dampers.
  - 2. Actuators shall spring return to normal open position as indicated on freeze, fire, or temperature protection.
  - 3. Select operator for full shut off at maximum pump differential pressure.

### 2.03 DAMPERS

- A. Performance: Test in accordance with AMCA 500-D.

- B. Frames: Galvanized steel, welded or riveted with corner reinforcement, minimum 12 gage, 0.1046 inch.
- C. Blades: Galvanized steel, maximum blade size 8 inches wide, 48 inches long, minimum 22 gage, 0.0299 inch, attached to minimum 1/2 inch shafts with set screws.
- D. Blade Seals: Synthetic elastomeric inflatable mechanically attached, field replaceable.
- E. Jamb Seals: Spring stainless steel.
- F. Shaft Bearings: Oil impregnated sintered bronze.
- G. Linkage Bearings: Oil impregnated sintered bronze.
- H. Leakage: Less than one percent based on approach velocity of 2000 ft/min and 4 inches wg.
- I. Maximum Pressure Differential: 6 inches wg.
- J. Temperature Limits: -40 to 200 degrees F.

#### **2.04 DAMPER OPERATORS**

- A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
  - 1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
  - 2. Provide one operator for maximum 36 sq ft damper section.
- B. Electric Operators:
  - 1. Spring return, adjustable stroke motor having oil immersed gear train, with auxiliary end switch.

#### **2.05 INPUT/OUTPUT SENSORS**

- A. Temperature Sensors:
  - 1. Sensor range shall provide a resolution of no worse than .4°F (unless noted otherwise).
  - 2. Room temperature sensor shall be an element contained within a ventilated cover, suitable for wall mounting with digital output. Sensors located in mechanical areas, plenums, garages, gymnasiums, or designated institutional locations shall be a flat plate sensor with no possible adjustment or shall be provided with aesthetically-pleasing lockable protective cover. Security screws shall be used in institutional settings as deemed necessary by the design engineer. ATC contractor shall coordinate requirements with the design engineer during the submittal process. Provide insulated base. Following sensing elements are acceptable:
    - a. Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.
    - b. Units shall be capable of +/- 2 degrees (F) adjustment by the occupant, with display showing current temperature and setpoint.
  - 3. Single point duct temperature sensor shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A. Sensor probe shall be 316 stainless steel.
    - a. Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.
  - 4. Averaging duct temperature sensor shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide enough sensors to give one lineal foot of sensing element for each square foot of cooling coil face area. Temperature range as required for resolution indicated in paragraph A.
    - a. Sensing element - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point.

5. Liquid immersion temperature sensor shall include stainless steel thermowell, sensor and connection head for wiring connections.
  - a. Sensing element for chilled water applications - Platinum RTD, Thermistor, or integrated circuit, +/- 0.8°F accuracy at calibration point. Temperature range shall be as required for resolution indicated in paragraph A.
  - b. Sensing element for non-chilled water applications - Platinum RTD, +/- 0.2°F accuracy at calibration point. Temperature range shall be as required for resolution of no worse than 0.1°F.
- B. Equipment Operation Sensors:
  1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
  2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.
  3. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- C. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.
- D. Carbon Dioxide Level Sensors:
  1. Wall or duct-mounted as required by control sequence or plans.
  2. Demand-control ventilation sensor for measuring and transmitting CO2 levels ranging from 0-2,000 ppm.
  3. Single-beam, dual-wavelength design with five-year stability for calibration..
  4. Proportional output, 4-20 mA signal.

## 2.06 THERMOSTATS

- A. Line Voltage Thermostats:
  1. Integral manual On/Off/Auto selector switch, single or two pole as required.
  2. Dead band: Maximum 2 degrees F.
  3. Cover: Locking with set point adjustment, with thermometer.
  4. Rating: Motor load.
- B. Outdoor Reset Thermostat:
  1. Remote bulb or bimetal rod and tube type, proportioning action with adjustable throttling range, adjustable setpoint.
  2. Scale range: -10 to 70 degrees F.
- C. Immersion Thermostat:
  1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range.
- D. Airstream Thermostats:
  1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
  2. Averaging service remote bulb element: 7.5 feet.
- E. Electric Low Limit Duct Thermostat:
  1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint,
  2. Bulb length: Minimum 20 feet.
  3. Provide one thermostat for every 20 sq ft of coil surface.
- F. Electric High Limit Duct Thermostat:
  1. Snap acting, single pole, single throw, manual reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above setpoint,
  2. Bulb length: Minimum 20 feet.

3. Provide one thermostat for every 20 sq ft of coil surface.
- G. Fire Thermostats:
1. UL labeled, factory set in accordance with NFPA 90A.
  2. Normally closed contacts, manual reset.
- H. Heating/Cooling Valve Top Thermostats:
1. Proportional acting for proportional flow, molded rubber diaphragm, remote bulb liquid filled element, direct and reverse acting at differential pressure to 25 psig, cast housing with position indicator and adjusting knob.

## **2.07 TRANSMITTERS**

- A. Pressure Transmitters:
1. One pipe direct acting indicating type for gas, liquid, or steam service, range suitable for system, proportional electronic output.
- B. Temperature Transmitters:
1. One pipe, directly proportional output signal to measured variable, linearity within plus or minus 1/2 percent of range for 200 degree F span and plus or minus 1 percent for 50 degree F span, with 50 degrees F temperature range, compensated bulb, averaging capillary, or rod and tube operation on 20 psig input pressure and 3 to 15 psig output.

## **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 48 inches above floor. Align with lighting switches, CO2 sensors, and humidistats. Refer to Section 26 27 26.
- C. Mount freeze protection thermostats using flanges and element holders.
- D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
- E. Provide separable sockets for liquids and flanges for air bulb elements.
- F. Provide thermostats in aspirating boxes in front entrances.
- G. Provide guards on thermostats in entrances.
- H. Provide valves with position indicators and with pilot positioners where sequenced with other controls.

- I. Provide mixing dampers of opposed blade construction arranged to mix streams. Provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
- J. Provide isolation (two position) dampers of parallel blade construction.
- K. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
- L. 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.
- M. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- N. Provide conduit and electrical wiring in accordance with Section 26 27 17. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

### **3.03 MAINTENANCE**

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of control system for one year from Date of Substantial Completion.

**END OF SECTION**

**SECTION 23 09 23****DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC****.01 SECTION PROVIDED FOR BIDDING OF BUILDING AUTOMATION SYSTEM/CONTROLS PACKAGE.****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. System Description
- B. Operator Interface
- C. Controllers
- D. Power Supplies and Line Filtering
- E. System Software
- F. Controller Software
- G. HVAC Control Programs
- H. Control equipment.
- I. Software.

**1.02 RELATED REQUIREMENTS**

- A. Section 28 31 00 - Fire Detection and Alarm.
- B. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
- C. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.
- E. Section 27 52 23.50 - Educational Intercommunications and Programs - Education For Sustainability Systems

**1.03 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code; National Fire Protection Association.

**1.04 SYSTEM DESCRIPTION**

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units . No other vendors are acceptable.
- 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 all 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, power transformers and electrical feeds, 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.

**1.05 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. List connected data points, including connected control unit and input device.
  - 3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration diskette containing graphics.
  - 4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
  - 5. Indicate description and sequence of operation of operating, user, and application software.
- D. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- E. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
  - 1. Revise shop drawings to reflect actual installation and operating sequences.
  - 2. Include submittals data in final "Record Documents" form.
- F. 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.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

**1.06 QUALITY ASSURANCE**

- A. Perform work in accordance with NFPA 70.
- B. Design system software under direct supervision of a Professional Engineer experienced in design of this Work and licensed at the State in which the Project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 10 years documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section 5 years documented experience approved by manufacturer.
- E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

**1.07 PRE-INSTALLATION MEETING**

- A. Convene one week before starting work of this Section.
- B. Require attendance of parties directly affecting the work of this Section.

**1.08 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Substantial Completion.

- C. Provide five year manufacturer's warranty for field programmable micro-processor based units.

#### **1.09 MAINTENANCE SERVICE**

- A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.
- B. Provide four complete inspections per year, two 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 2 complete normal inspections of approximately 2 hours duration in addition to normal service calls to inspect, calibrate, and adjust controls, and submit written reports.

#### **1.10 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.

#### **1.11 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. Johnson Controls, Inc by Modern Controls
- B. BuildingLogix / Lynxspring / KMC Controls by Seiberlich Trane
- C. Substitutions: Not Permitted.

#### **2.02 SYSTEM DESCRIPTION**

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units with communications to the EXISTING Building Management System. This specification is intended to relay the need to MODIFY THE EXISTING BAS only, not provide a complete new system. Full integration with the existing equipment is required.
- B. 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.
- C. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

#### **2.03 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 required communication to District-wide NIAGRA - based (BACnet) BAS servers. Installation of new servers will not be acceptable for this project.
  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: Conform to 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.

## 2.04 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.

## 2.05 OPERATOR INTERFACE - DISTRICT WIDE

- A. Work Station:

1. Utilize existing workstations within the District for full access to the system.
- B. System Support: Full LAN interface units (desktop, laptop, tablet, etc.) connected to multi-user, multi-tasking environment with concurrent capability to:
  1. Access DDC network.
  2. Access or control same control unit.
  3. Access or modify same control unit data base.
  4. Archive data, alarms, and network actions to hard disk regardless of what application programs are being currently executed.
  5. Develop and edit data base.
  6. Implement and tune DDC control.
  7. Develop graphics.
  8. Control facility.

## 2.06 CONTROL UNITS

- A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.
- B. Battery Backup: For minimum of 48 hours for complete system including RAM without interruption, with automatic battery charger.
- C. Control Units Functions:
  1. Monitor or control each input/output point.
  2. Completely independent with hardware clock/calendar and software to maintain control independently.
  3. Acquire, process, and transfer information to operator station or other control units on network.
  4. Accept, process, and execute commands from other control unit's or devices or operator stations.
  5. Access both data base and control functions simultaneously.
  6. Record, evaluate, and report changes of state or value that occur among associated points. Continue to perform associated control functions regardless of status of network.
  7. Perform in stand-alone mode:
    - a. Start/stop.
    - b. Duty cycling.
    - c. Automatic Temperature Control.
    - d. Demand control via a sliding window, predictive algorithm.
    - e. Event initiated control.
    - f. Calculated point.
    - g. Scanning and alarm processing.
    - h. Full direct digital control.
    - i. Trend logging.
    - j. Global communications.
    - k. Maintenance scheduling.
- D. Global Communications:
  1. Broadcast point data onto network, making that information available to all other system control units.
  2. Transmit any or all input/output points onto network for use by other control units and utilize data from other control units.
- E. Input/Output Capability:
  1. Discrete/digital input (contact status).
  2. Discrete/digital output.
  3. Analog input.

4. Analog output.
  5. Pulse input (5 pulses/second).
  6. Pulse output (0-655 seconds in duration with 0.01 second resolution).
- F. Monitor, control, or address data points. Mix shall include analog inputs, analog outputs, pulse inputs, pulse outputs and discrete inputs/outputs, as required. Install control unit's with minimum 30 percent spare capacity.
  - G. Point Scanning: Set scan or execution speed of each point to operator selected time from 1 to 250 seconds.
  - H. Upload/Download Capability: Download from or upload to operator station. Upload/Download time for entire control unit database maximum 10 seconds on hard wired LAN, or 60 seconds over voice grade phone lines.
  - I. Test Mode Operation: Place input/output points in test mode to allow testing and developing of control algorithms on line without disrupting field hardware and controlled environment. In test mode:
    1. Inhibit scanning and calculation of input points. Issue manual control to input points (set analog or digital input point to operator determined test value) from work station.
    2. Control output points but change only data base state or value; leave external field hardware unchanged.
    3. Enable control actions on output points but change only data base state or value.
  - J. Local display and adjustment panel: Portable control unit, containing digital display, and numerical keyboard. Display and adjust:
    1. Input/output point information and status.
    2. Controller set points.
    3. Controller tuning constants.
    4. Program execution times.
    5. High and low limit values.
    6. Limit differential.
    7. Set/display date and time.
    8. Control outputs connected to the network.
    9. Automatic control outputs.
    10. Perform control unit diagnostic testing.
    11. Points in "Test" mode.

## **2.07 LOCAL AREA NETWORK (LAN)**

- A. Provide communication between control units over local area network (LAN).
- B. LAN Capacity: Not less than 100 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.

## **2.08 SYSTEM SOFTWARE**

- A. Operating System:

1. Concurrent, multi-tasking capability.
    - a. Common Software Applications Supported: Microsoft Excel.
  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 all system applications at the 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 can 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.

## 2.09 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.

## 2.10 OPERATING SYSTEM SOFTWARE

- A. Input/Output Capability From Operator Station:
  - 1. Request display of current values or status in tabular or graphic format.
  - 2. Command selected equipment to specified state.
  - 3. Initiate logs and reports.
  - 4. Change analog limits.
  - 5. Add, delete, or change points within each control unit or application routine.
  - 6. Change point input/output descriptors, status, alarm descriptors, and engineering unit descriptors.
  - 7. Add new control units to system.

8. Modify and set up maintenance scheduling parameters.
  9. Develop, modify, delete or display full range of color graphic displays.
  10. Automatically archive select data even when running third party software.
  11. Provide capability to sort and extract data from archived files and to generate custom reports.
  12. Support two printer operations.
    - a. Alarm printer: Print alarms, operator acknowledgements, action messages, system alarms, operator sign-on and sign-off.
    - b. Data printer: Print reports, page prints, and data base prints.
  13. Select daily, weekly or monthly as scheduled frequency to synchronize time and date in digital control units. Accommodate daylight savings time adjustments.
  14. Print selected control unit data base.
- B. Operator System Access: Via software password with minimum 30 access levels at work station and minimum 3 access levels at each control unit.
- C. Data Base Creation and Support: Changes shall utilize standard procedures. Control unit shall automatically check work station data base files upon connection and verify data base match. Minimum capability shall include:
1. Add and delete points.
  2. Modify any point parameter.
  3. Change, add, or delete English language descriptors.
  4. Add, modify, or delete alarm limits.
  5. Add, modify, or delete points in start/stop programs, trend logs, etc.
  6. Create custom relationship between points.
  7. Create or modify DDC loops and parameters.
  8. Create or modify override parameters.
  9. Add, modify, and delete any applications program.
  10. Add, delete, develop, or modify dynamic color graphic displays.
- D. Dynamic Color Graphic Displays:
1. Utilizes custom symbols or system supported library of symbols.
  2. Sixteen (16) colors.
  3. Sixty (60) outputs of real time, live dynamic data per graphic.
  4. Dynamic graphic data.
  5. 1,000 separate graphic pages.
  6. Modify graphic screen refresh rate between 1 and 60 seconds.
- E. Operator Station:
1. Accept data from LAN as needed without scanning entire network for updated point data.
  2. Interrogate LAN for updated point data when requested.
  3. Allow operator command of devices.
  4. Allow operator to place specific control units in or out of service.
  5. Allow parameter editing of control units.
  6. Store duplicate data base for every control unit and allow down loading while system is on line.
  7. Control or modify specific programs.
  8. Develop, store and modify dynamic color graphics.
  9. Provide data archiving of assigned points and support overlay graphing of this data utilizing up to four (4) variables.
- F. Alarm Processing:
1. Off normal condition: Cause alarm and appropriate message, including time, system, point descriptor, and alarm condition. Select alarm state/value and which alarms shall cause automatic dial-out.

2. Critical alarm or change-of-state: Display message, stored on disk for review and sort, or print.
  3. Print on line changeable message, up to 100 characters in length, for each alarm point specified.
  4. Display alarm reports on video. Display multiple alarms in order of occurrence.
  5. Define time delay for equipment start-up or shutdown.
  6. Allow unique routing of specific alarms.
  7. Operator specifies if alarm requires acknowledgement.
  8. Continue to indicate unacknowledged alarms after return to normal.
  9. Alarm notification:
    - a. Automatic print.
    - b. Display indicating alarm condition.
    - c. Selectable audible alarm indication.
- G. Event Processing: Automatically initiate commands, user defined messages, take specific control actions or change control strategy and application programs resulting from event condition. Event condition may be value crossing operator defined limit, change-of-state, specified state, or alarm occurrence or return to normal.
- H. Automatic Restart: Automatically restart field equipment on restoration of power. Provide time delay between individual equipment restart and time of day start/stop.
- I. Messages:
1. Automatically display or print user-defined message subsequent to occurrence of selected events.
  2. Compose, change, or delete any message.
  3. Display or log any message at any time.
  4. Assign any message to any event.
- J. Reports:
1. Manually requested with time and date.
  2. Long term data archiving to hard disk.
  3. Automatic directives to download to transportable media such as floppy diskettes for storage.
  4. Data selection methods to include data base search and manipulation.
  5. Data extraction with mathematical manipulation.
  6. Data reports shall allow development of XY curve plotting, tabular reports (both statistical and summary), and multi-point timed based plots with not less than four (4) variables displayed.
  7. Generating reports either normally at operator direction, or automatically under work station direction.
  8. Reports may either manually displayed or printed, or may be printed automatically on daily, weekly, monthly, yearly or scheduled basis.
  9. Include capability for statistical data manipulation and extraction.
  10. Provide capability to generate four types of reports: Statistical detail reports, summary reports, trend graphic plots, x-y graphic plots.
- K. Parameter Save/Restore: Store most current operating system, parameter changes, and modifications on disk or diskette.
- L. Data Collection:
1. Automatically collect and store in disk files.
  2. Daily electrical energy consumption, peak demand, and time of peak demand for up to electrical meters over 2 year period.
  3. Daily consumption for up to 30 meters over a 2 year period.

4. Daily billable electrical energy consumption and time for up to 1024 zones over a 10 year period.
  5. Provide archiving of stored data for use with system supplied custom reports.
- M. Graphic Display: Support graphic development on work station with software features:
1. Page linking.
  2. Generate, store, and retrieve library symbols.
  3. Single or double height characters.
  4. Sixty (60) dynamic points of data per graphic page.
  5. Pixel level resolution.
  6. Animated graphics for discrete points.
  7. Analog bar graphs.
  8. Display real time value of each input or output line diagram fashion.
- N. Maintenance Management:
1. Run time monitoring, per point.
  2. Maintenance scheduling targets with automatic annunciation, scheduling and shutdown.
  3. Equipment safety targets.
  4. Display of maintenance material and estimated labor.
  5. Target point reset, per point.
- O. Advisories:
1. Summary which contains status of points in locked out condition.
  2. Continuous operational or not operational report of interrogation of system hardware and programmable control units for failure.
  3. Report of power failure detection, time and date.
  4. Report of communication failure with operator device, field interface unit, point, programmable control unit.

## 2.11 LOAD CONTROL PROGRAMS

- A. General: Support inch-pounds and SI (metric) units of measurement.
- B. Demand Limiting:
1. Monitor total power consumption per power meter and shed associated loads automatically to reduce power consumption to an operator set maximum demand level.
  2. Input: Pulse count from incoming power meter connected to pulse accumulator in control unit.
  3. Forecast demand (kW): Predicted by sliding window method.
  4. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
  5. Demand Target: Minimum of 3 per demand meter; change targets based upon (1) time, (2) status of pre-selected points, or (3) temperature.
  6. Load: Assign load shed priority, minimum "ON" time and maximum "OFF" time.
  7. Limits: Include control band (upper and lower limits).
  8. Output advisory if loads are not available to satisfy required shed amount, advise shed requirements and requiring operator acknowledgement.
- C. Duty Cycling:
1. Periodically stop and start loads, based on space temperature, and according to various On/Off patterns.
  2. Modify off portion of cycle based on operator specified comfort parameters. Maintain total cycle time by increasing on portion of cycle by same amount that off portion is reduced.
  3. Set and modify following parameters for each individual load.
    - a. Minimum and maximum Off time.
    - b. On/Off time in one minute increments.

- c. Time period from beginning of interval until load can be cycled.
  - d. Manually override the DCC program and place a load in an On or Off state.
  - e. Cooling Target Temperature and Differential.
  - f. Heating Target Temperature and Differential.
  - g. Cycle off adjustment.
- D. Automatic Time Scheduling:
- 1. Self-contained programs for automatic start/stop/scheduling of building loads.
  - 2. Support up to seven (7) normal day schedules, seven (7) "special day" schedules and two (2) temporary day schedules.
  - 3. Special days schedule shall support up to 30 unique date/duration combinations.
  - 4. Any number of loads assigned to any time program; each load can have individual time program.
  - 5. Each load assigned at least 16 control actions per day with 1 minute resolution.
  - 6. Time schedule operations may be:
    - a. Start.
    - b. Optimized Start.
    - c. Stop.
    - d. Optimized Stop.
    - e. Cycle.
    - f. Optimized Cycle.
  - 7. Minimum of 30 holiday periods up to 100 days in length may be specified for the year.
  - 8. Create temporary schedules.
  - 9. Broadcast temporary "special day" date and duration.
- E. Start/Stop Time Optimization:
- 1. Perform optimized start/stop as function of outside conditions, inside conditions, or both.
  - 2. Adaptive and self-tuning, adjusting to changing conditions unattended.
  - 3. For each point under control, establish and modify:
    - a. Occupancy period.
    - b. Desired temperature at beginning of occupancy period.
    - c. Desired temperature at end of occupancy period.
- F. Night Setback/Setup Program: Reduce heating space temperature setpoint or raise cooling space temperature setpoint during unoccupied hours; in conjunction with scheduled start/stop and optimum start/stop programs.
- G. Calculated Points: Define calculations and totalization computed from monitored points (analog/digital points), constants, or other calculated points.
- 1. Employ arithmetic, algebraic, Boolean, and special function operations.
  - 2. Treat calculated values like any other analog value, use for any function that a "hard wired point" might be used.
- H. Event Initiated Programming: Event may be initiated by any data point, causing series of controls in a sequence.
- 1. Define time interval between each control action between 0 to 3600 seconds.
  - 2. Output may be analog value.
  - 3. Provide for "skip" logic.
  - 4. Verify completion of one action before proceeding to next. If not verified, program shall be able to skip to next action.
- I. Direct Digital Control: Each control unit shall provide Direct Digital Control software so that the operator may customize control strategies and sequences of operation by defining the appropriate control loop algorithms and choosing the optimum loop parameters.
- 1. Control loops: Defined using "modules" that are analogous to standard control devices.

2. Output: Paired or individual digital outputs for pulse-width modulation, and analog outputs, as required.
  3. Firmware:
    - a. PID with analog or pulse-width modulation output.
    - b. Floating control with pulse-width modulated outputs.
    - c. Two-position control.
    - d. Primary and secondary reset schedule selector.
    - e. Hi/Lo signal selector.
    - f. Single pole double throw relay.
    - g. Single pole double throw time delay relay with delay before break, delay before make and interval time capabilities.
  4. Direct Digital Control loops: Downloaded upon creation or on operator request. On sensor failure, program shall execute user defined failsafe output.
  5. Display: Value or state of each of the lines which interconnect DDC modules.
- J. Fine Tuning Direct Digital Control PID or floating loops:
1. Display information:
    - a. Control loop being tuned
    - b. Input (process) variable
    - c. Output (control) variable
    - d. Setpoint of loop
    - e. Proportional band
    - f. Integral (reset) Interval
    - g. Derivative (rate) Interval
  2. Display format: Graphic, with automatic scaling; with input and output variable superimposed on graph of "time" vs "variable".
- K. Trend logging:
1. Each control unit will store samples of control unit's data points.
  2. Update file continuously at discretely assignable intervals.
  3. Automatically initiate upload request and then store data on hard disk.
  4. Time synchronize sampling at operator specified times and intervals with sample resolution of one minute.
  5. Co-ordinate sampling with on/off state of specified point.
  6. Display trend samples on work station in graphic format. Automatically scale trend graph with minimum 60 samples of data in plot of time vs data.

## 2.12 HVAC CONTROL PROGRAMS

- A. General:
1. Support Inch-pounds and SI (metric) units of measurement.
  2. Identify each HVAC Control system.
- B. Optimal Run Time:
1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
  2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
  3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
  4. Use outside air temperature to determine early shut down with ventilation override.
  5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
  6. Operator commands:
    - a. Define term schedule

- b. Add/delete fan status point.
  - c. Add/delete outside air temperature point.
  - d. Add/delete mass temperature point.
  - e. Define heating/cooling parameters.
  - f. Define mass sensor heating/cooling parameters.
  - g. Lock/unlock program.
  - h. Request optimal run time control summary.
  - i. Request optimal run time mass temperature summary.
  - j. Request HVAC point summary.
  - k. Request HVAC saving profile summary.
7. Control Summary:
- a. HVAC Control system begin/end status.
  - b. Optimal run time lock/unlock control status.
  - c. Heating/cooling mode status.
  - d. Optimal run time schedule.
  - e. Start/Stop times.
  - f. Selected mass temperature point ID.
  - g. Optimal run time system normal start times.
  - h. Occupancy and vacancy times.
  - i. Optimal run time system heating/cooling mode parameters.
8. Mass temperature summary:
- a. Mass temperature point type and ID.
  - b. Desired and current mass temperature values.
  - c. Calculated warm-up/cool-down time for each mass temperature.
  - d. Heating/cooling season limits.
  - e. Break point temperature for cooling mode analysis.
9. HVAC point summary:
- a. Control system identifier and status.
  - b. Point ID and status.
  - c. Outside air temperature point ID and status.
  - d. Mass temperature point ID and point.
  - e. Calculated optimal start and stop times.
  - f. Period start.
- C. Supply Air Reset:
- 1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
  - 2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
    - a. Raising cooling temperatures to highest possible value.
    - b. Reducing heating temperatures to lowest possible level.
  - 3. Operator commands:
    - a. Add/delete fan status point.
    - b. Lock/unlock program.
    - c. Request HVAC point summary.
    - d. Add/Delete discharge controller point.
    - e. Define discharge controller parameters.
    - f. Add/delete air flow rate.
    - g. Define space load and load parameters.
    - h. Request space load summary.
  - 4. Control summary:
    - a. HVAC control system status (begin/end).

- b. Supply air reset system status.
  - c. Optimal run time system status.
  - d. Heating and cooling loop.
  - e. High/low limits.
  - f. Deadband.
  - g. Response timer.
  - h. Reset times.
5. Space load summary:
- a. HVAC system status.
  - b. Optimal run time status.
  - c. Heating/cooling loop status.
  - d. Space load point ID.
  - e. Current space load point value.
  - f. Control heat/cool limited.
  - g. Gain factor.
  - h. Calculated reset values.
  - i. Fan status point ID and status.
  - j. Control discharge temperature point ID and status.
  - k. Space load point ID and status.
  - l. Air flow rate point ID and status.
- D. Enthalpy Switchover:
1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
  2. Operator commands:
    - a. Add/delete fan status point.
    - b. Add/delete outside air temperature point.
    - c. Add/delete discharge controller point.
    - d. Define discharge controller parameters.
    - e. Add/delete return air temperature point.
    - f. Add/delete outside air dew point/humidity point.
    - g. Add/delete return air dew point/humidity point.
    - h. Add/delete damper switch.
    - i. Add/delete minimum outside air.
    - j. Add/delete atmospheric pressure.
    - k. Add/delete heating override switch.
    - l. Add/delete evaporative cooling switch.
    - m. Add/delete air flow rate.
    - n. Define enthalpy deadband.
    - o. Lock/unlock program.
    - p. Request control summary.
    - q. Request HVAC point summary.
  3. Control summary:
    - a. HVAC control system begin/end status.
    - b. Enthalpy switchover optimal system status.
    - c. Optimal return time system status.
    - d. Current outside air enthalpy.
    - e. Calculated mixed air enthalpy.
    - f. Calculated cooling coil enthalpy using outside air.
    - g. Calculated cooling coil enthalpy using mixed air.
    - h. Calculated enthalpy difference.
    - i. Enthalpy switchover deadband.

- j. Status of damper mode switch.

## 2.13 PROGRAMMING APPLICATION FEATURES

- A. Trend Point:
  1. Sample up to 150 points, real or computed, with each point capable of collecting 100 samples at intervals specified in minutes, hours, days, or month.
  2. Output trend logs as line graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique pattern, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.
- B. Alarm Messages:
  1. Allow definition of minimum of 100 messages, each having minimum length of 100 characters for each individual message.
  2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
  3. Output assigned alarm with "message requiring acknowledgement".
  4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.
- C. Weekly Scheduling:
  1. Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
  2. Provide program times for each day of week, per point, with one minute resolution.
  3. Automatically generate alarm output for points not responding to command.
  4. Provide for holidays, minimum of 366 consecutive holidays.
  5. Operator commands:
    - a. System logs and summaries.
    - b. Start of stop point.
    - c. Lock or unlock control or alarm input.
    - d. Add, delete, or modify analog limits and differentials.
    - e. Adjust point operation position.
    - f. Change point operational mode.
    - g. Open or close point.
    - h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
    - i. Begin or end point totalization.
    - j. Modify totalization values and limits.
    - k. Access or secure point.
    - l. Begin or end HVAC or load control system.
    - m. Modify load parameter.
    - n. Modify demand limiting and duty cycle targets.
  6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.
- D. Interlocking:
  1. Permit events to occur, based on changing condition of one or more associated master points.
  2. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.
  3. Operator commands:
    - a. Define single master/multiple master interlock process.
    - b. Define logic interlock process.
    - c. Lock/unlock program.
    - d. Enable/disable interlock process.

- e. Execute terminate interlock process.
- f. Request interlock type summary.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

#### **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 with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.
- D. Provide conduit and electrical wiring in accordance with Section 26 27 17. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- E. Ensure that all components necessary to execute the sequences of operation are coordinated and installed by all contractors.
- F. Contractor shall demolish and remove all existing control components, including but not limited to thermostats, pneumatic tabing, compressors, panels, and devices unless otherwise noted on the drawings. Demolition shall be coordinated on phased projects to maintain the existing system where needed until complete charge-over has been accomplished.

#### **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.
- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 2 day period.
- C. Provide basic operator training for 4 persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 8 hours dedicated instructor time. Provide training on site.

#### **3.04 DEMONSTRATION AND INSTRUCTIONS**

- A. Demonstrate complete and operating system to Owner.

#### **3.05 SCHEDULES**

- A. Input/Output Schedule:
  - 1. Point Description:
  - 2. Digital Input:
    - a. Demand Meter (kW):
    - b. Auxiliary Contact:
    - c. Switches:
      - 1) Switch Closing:
      - 2) Flow Switch:
      - 3) Optical:
    - d. Current:
    - e. Pressure:
  - 3. Digital Output:

- a. Control Relay:
- b. Solenoid:
- c. Contactor:
- 4. Analog Input:
  - a. Temperature:
  - b. Relative Humidity:
  - c. Pressure/Vacuum:
  - d. Filter:
  - e. Flow:
  - f. Current:
  - g. Liquid Level:
  - h. Photocell:
- 5. Analog Output:
  - a. Pneumatic Transducer:
  - b. 4-20 ma Module:
  - c. 0-16 v DC:
- 6. Alarm:
- B. Input/Output Schedule:
  - 1. Point Description:
  - 2. Inputs:
    - a. Temperature:
    - b. Relative Humidity:
    - c. Pressure:
    - d. Flow:
    - e. Level:
    - f. Position:
    - g. Energy:
    - h. Power:
  - 3. Outputs:
    - a. Status:
    - b. Alarm:
    - c. Pneumatic Position:
    - d. Electronic Position:
    - e. Set Point Adjust:
    - f. Start/Stop:
    - g. Off/Low/High:
  - 4. Software Features:
    - a. PID Control (DDC):
    - b. High Limit:
    - c. Low Limit:
    - d. Run Time Totalization:
    - e. Consumption Totalization:
    - f. Program Start/Stop:
    - g. Load Shed:
    - h. Duty Cycle:
    - i. Enthalpy Switchover:
    - j. Optimal Run Time:
    - k. Supply Air Reset:
    - l. O.A. Interlock:
    - m. O.A. Temperature Reset:
    - n. Free Cooling Mode:

- o. Warm-up Mode:
  - p. Boiler Interlock:
  - q. Chiller Sequencing:
  - r. Energy Calculation:
- C. Alarm Schedule:
- 1. High Limit: A1.
  - 2. Low Limit: A2.
  - 3. Run Time: A3.
  - 4. Maintenance: A4.
  - 5. Status: A5.
  - 6. Override: A6.
  - 7. Freeze: A7.
  - 8. Low Pressure: A8.

**END OF SECTION**



**SECTION 23 09 93**  
**SEQUENCE OF OPERATIONS FOR HVAC CONTROLS**

**1.01 PART 1 GENERAL**

**1.02 THIS SECTION DEFINES THE OPERATING PARAMETERS FOR THE BUILDIGN AUTOMATION SYSTEM EXPANSION, PURCHASED UNDER SEPARATE CONTRACT BY THE OWNER.**

**1.03 SECTION INCLUDES**

- A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.
- B. Sequence of operation for:
  - 1. Packaged Rooftop Outdoor Air Units - Multizone VAV
  - 2. Exhaust Fans
  - 3. Variable Refrigerant Flow (VRF) and associated ERV
  - 4. Radiation and convectors.
  - 5. Air Handling Units.
  - 6. Packaged Terminal Vertical Unit Ventilators.

**1.04 RELATED SECTIONS**

- A. Section 23 09 23 - Direct-Digital Control System for HVAC.
- B. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
- C. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.05 SYSTEM DESCRIPTION**

- A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other Sections.

**1.06 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
  - 1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
  - 2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
  - 3. Include at least the following sequences:
    - a. Start-up.
    - b. Warm-up mode.
    - c. Normal operating mode.
    - d. Unoccupied mode.
    - e. Shutdown.
    - f. Capacity control sequences and equipment staging.
    - g. Temperature and pressure control, such as setbacks, setups, resets, etc.
    - h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
    - i. Effects of power or equipment failure with all standby component functions.
    - j. Sequences for all alarms and emergency shut downs.

- k. Seasonal operational differences and recommendations.
    - l. Interactions and interlocks with other systems.
  - 4. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
  - 5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
  - 6. Include schedules, if known.
- C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
  - 1. Label with settings, adjustable range of control and limits.
  - 2. Include flow diagrams for each control system, graphically depicting control logic.
  - 3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
  - 4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
  - 5. Include all monitoring, control and virtual points specified in elsewhere.
  - 6. Include a key to all abbreviations.
- D. Points List: Submit list of all control points indicating at least the following for each point.
  - 1. Name of controlled system.
  - 2. Point abbreviation.
  - 3. Point description; such as dry bulb temperature, airflow, etc.
  - 4. Display unit.
  - 5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
  - 6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
  - 7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
  - 8. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.
- E. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

### **1.07 QUALITY ASSURANCE**

- A. Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State in which the Project is located.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 GENERAL SYSTEM DESIGN AND OPERATION STANDARDS**

- A. The BAS shall control the mechanical systems within the site based upon a zoned primary-secondary hydronic distribution system serving both existing and new hydronic terminal units, air-handling units, and radiant heating units. The new central plant will incorporate new condensing boilers for primary heat generation, the existing air-cooled chiller for primary cooling generation, and a gas-fired power generation system with heat recovery for utilization in heat

generation via heat-exchanger to the dual-temperature system as well as coupled absorption chillers for chilled water generation to the dual-temperature system. The absorption chillers will also be tied to a single roof-mounted closed-circuit fluid cooler for heat rejection.

- B. The new additions will be heated and cooled via chilled beams located in each space, with supplemental radiant heating provided along select window areas and in the floors of the elevated wing areas and along the curtain wall of the typical exterior rooms.
- C. Outdoor air to the additions will be provided via dedicated outdoor-air supply units utilizing gas-fired condensing burners for heating, direct-expansion cooling with hot-gas bypass and hot-gas reheat, and energy recovery sections. These units will control discharge air temperature and humidity.
- D. Each unit shall be controlled by an individual DDC Controller and all required sensors, control valves, and appurtenances required to complete the sequence of operation. Units shall include occupied/unoccupied control, night-setback, morning warm-up/cool-down, and enthalpy-based economizer functions.

### **3.02 VARIABLE REFRIGERANT VOLUME HEAT PUMP SYSTEMS**

- A. The variable refrigerant split system shall have a BAS DDC interface wired to the manufacturer factory central system controller to provide operation, configuration, and monitoring of the system. The manufacturer factory central controller shall operate in BACnet protocol, and be connected to manufacturer factory space temperature sensors as specified.
- B. Sequence of operation:
  - 1. Cooling Mode: Cooling mode shall be selected based on outdoor air temperatures or manually enabled or scheduled from the workstation. During the programmed occupied mode, the supply fan shall run continuously. On a rise in space temperature above the setpoint (75 degrees, adjustable), the manufacturer central controller shall energize the central compressor to provide cooling. The internal capacity control valve in the evaporator unit shall modulate to control the flow of refrigerant to maintain space temperature. On a fall in space temperature the refrigerant capacity control valve shall modulate closed.
  - 2. Heating Mode: Heating mode shall be selected based on outdoor air temperatures or manually enabled or scheduled from the workstation. During the programmed occupied mode, the supply fan shall run continuously. On a drop in space temperature below the setpoint (68 degrees, adjustable), the manufacturer central controller shall energize the central compressor to with the requisite reversing valve to provide heating to the evaporator unit as required. The internal capacity control valve in the evaporator unit shall modulate to control the flow of refrigerant to maintain space temperature. On a fall in space temperature the refrigerant capacity control valve shall modulate closed.
  - 3. The following items shall be accessible and displayed at the Operator's Terminal:
    - a. Space temperature setpoint at each fan-coil unit (user adjustable).
    - b. Actual space temperature of each fan-coil unit space.
    - c. Operational status of each fan-coil unit (heating, cooling, off, user adjustable).
    - d. Factory error codes from each unit.
    - e. Remote space temperature sensor override for each fan-coil unit (user adjustable to limit temperature adjustment range, heat/cool selection, fan speed).
    - f. Compressor Status
- C. Each terminal unit (fan coil) shall be controlled by the factory-provided wall-mounted controller. The controller shall be capable of allowing space temperature adjustment of +1 / -1 degrees (user adjustable).

### **3.03 SUPPLY AIR UNITS AND ENERGY RECOVERY VENTILATORS (ERV)**

- A. Supply air units and ERV's shall be scheduled for occupied and unoccupied cycles based on an operator adjustable time schedule. Units may also be manually enabled and disabled at the

operator workstation. Fan status shall be monitored by the BAS via the fans current sensing relay.

- B. The variable frequency drives shall be set by the balancer to deliver the minimum outdoor air to each associated terminal unit under fully-occupied conditions.
- C. When any heat pump in the area served by the heat recovery unit is in the occupied mode the unit shall be energized.
  - 1. The unit exhaust and outside air isolation dampers shall open.
  - 2. Provide proof of airflow for each fan and provide fan failure alarms.
  - 3. Provide temperature indication of the supply and exhaust inlet and leaving air.
  - 4. For units over 2,000 cfm a duct smoke detector shall be provided by the electrical contractor. Provide the interlock wiring to shut down the units upon activation.
  - 5. The electric heating coil shall be energized when required to maintain a minimum discharge air (supply air) temperature of 60 degrees to the units.
- D. The following items shall be displayed at the operators workstation:
  - 1. Discharge temperature.
  - 2. Return air temperature.
  - 3. Outside air temperature, humidity and enthalpy.
  - 4. Fan operational status via current sensor.
  - 5. Commanded status of fan.
  - 6. Commanded status of heating coils (as applicable).
  - 7. Commanded status of gas-train (as applicable).
  - 8. Commanded position of dampers.
  - 9. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system.

### **3.04 EXHAUST FANS**

- A. Exhaust Fans For Pressure Relief / Space Relief
  - 1. The exhaust fans shall be energized when the corresponding air handling unit is in operation and the outdoor air damper is open to the minimum position, and shall be de-energized when the air handler outdoor air damper is closed.
  - 2. Provide a current sensor for each fan to show operational status.
- B. Provide a current sensor for each fan to show operational status.
- C. The following items shall be displayed at the Operator's Terminal:
  - 1. Commanded status of fan.
  - 2. Operational status of fan via current sensor.

### **3.05 OFFICE MULTI-ZONE AHU WITH DX COOLING, GAS HEATING, AND VAV ZONE CONTROL UNITS WITH ELECTRIC TEMPERING**

- A. Each unit shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to a discharge air temperature sensor, damper motors, control valve, duct static pressure sensor, natural gas heating gas train, and condensing unit control relays. Each multizone unit shall also be provided with its own controller that shall be wired to general zone temperature sensor, electric heat contactor, and damper actuator.
- B. Sequence of operation:
  - 1. Cooling Mode: Cooling mode shall be selected based on outdoor air temperatures or manually enabled or scheduled from the workstation. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper open to the minimum position. The variable frequency drive shall modulate to maintain a given static pressure within the ductwork (0.25" wc, adjustable). The compressor(s) and hot-gas bypass system shall modulate to maintain a discharge air temperature of 55 degrees (adjustable). On a rise in zone temperature above the setpoint (75 degrees, adjustable),

the associated VAV terminal unit shall modulate open to allow greater airflow to meet the space setpoint. If the space temperature continues to rise more than 4 degrees (adjustable) above the setpoint, an alarm shall be generated at the workstation terminal noting "High Space Temperature." On a fall in space temperature the reverse shall occur. On a continued fall in more than one space temperature associated with the unit of more than 5 degrees (adjustable) below the setpoint the unit shall reset the discharge air to provide a 65 degree (adjustable) discharge air temperature. If the temperature space temperature continues to fall an alarm shall be generated at the workstation terminal noting "Low Space Temperature".

- a. For units equipped with an outdoor air economizer: The DDC Controller shall receive input from the Enthalpy Sensor. If the enthalpy of the outdoor air is lower than the defined minimum level (user adjustable) the mixing box economizer sequence shall be activated upon a call for cooling. The outside air damper shall never close past the minimum position called for by the outdoor airflow monitoring station during the occupied period.
2. Heating Mode: Heating mode shall be selected based on outdoor air temperatures or manually enabled or scheduled from the workstation. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper open to the minimum position. The variable frequency drive shall modulate to maintain a given static pressure within the ductwork (0.25" wc, adjustable). The natural gas primary heating section shall modulate to maintain a discharge air setpoint of 55 degrees (adjustable). The VAV unit's modulating air damper shall be in its minimum position. On a fall in space temperature below the setpoint (68 degrees, adjustable), the associated VAV terminal unit shall energize the associated electric heating coil at the lowest setting via the pulse-width modulation control, then ramp through the stages to maintain setpoint.. On a continued fall in space temperature of more than 4 degrees (adjustable) below setpoint, an alarm shall be generated at the workstation terminal noting "Low Space Temperature" and the supply air shall be reset to 60 degrees (adjustable). On a rise in space temperature, the reverse shall occur. On a continued rise in space temperature of over 4 degrees above setpoint (adjustable), an alarm shall be generated at the workstation noting "High Space Temperature".
    - a. Unoccupied Mode: During the programmed un-occupied mode, the fan, compressor, hot water valves, and mixing box dampers shall be cycled / modulated to maintain the un-occupied setpoints (80 degrees cooling, 60 degrees heating, adjustable). The VAV boxes shall be opened to their maximum position in unoccupied cooling mode, and minimum position in unoccupied heating mode. Unless required for economizer cycle, the outside air damper shall remain closed. The VAV boxes shall be opened to their maximum position in unoccupied mode.
  - C. Provide a current sensor on one phase of power feeding the supply fan, and compressor(s) for status indication at the Operator's Terminal.
  - D. Zone 2 shall be controlled by two (2) separate zone sensors as indicated on the drawings. The BAS shall poll these zones to meet the required airflow/temperature requirements for the zone that is the greatest deviation from the setpoint in each mode.
  - E. If the discharge temperature fails to rise to a programmed minimum temperature during a call for heating; a low temperature alarm shall be activated at the Operator's Terminal. If the discharge temperature fails to fall to a programmed minimum temperature on a call for mechanical cooling, a high temperature alarm shall be activated at the Operator's Terminal.
  - F. Duct smoke detectors shall be furnished, installed and wired to the fire alarm system as required by the electrical contractor. The duct smoke detector shall be provided with an auxiliary alarm contact which will be used by the BAS Contractor to de-energize the supply fan, mixing box damper actuators, chilled water, hot water control valve. When de-energized, the

mixing box damper actuators shall spring return the outside and relief air dampers closed, and an alarm shall be generated at the Operator's Terminal.

- G. The following items shall be displayed at the Operator's Terminal:
1. Zone temperature for each of the 4 zones, including both zone 2 sensors.
  2. Space temperature setpoint for each of the 4 zones.
  3. Low Space temperature alarm
  4. High Space temperature alarm
  5. Discharge temperature.
  6. Return air temperature.
  7. Outside air temperature, humidity and enthalpy.
  8. Fan operational status via current sensor.
  9. Commanded status of fan.
  10. Commanded status of compressor(s).
  11. Commanded status of gas train.
  12. Commanded status of electric terminal reheat coils.
  13. Commanded position of dampers.
  14. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system.

### **3.06 SPLIT SYSTEM DX COOLING / HOT WATER HEATING AIR HANDLING UNIT WITH OUTDOOR AIR ECONOMIZER AND CO2 CONTROLS.**

- A. Each unit shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to a space temperature sensor, discharge air temperature sensor, space CO2 sensor, return air temperature sensor, damper motors, control valve, condensing unit control relays, and a freeze stat.
- B. Cooling Mode:
1. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper open to the minimum position (10% outside air). The amount of outside air will be increased above the minimum setting on a rise in return air CO2 above the setpoint of 500 PPM (adjustable). On a return to setpoint the reverse occurs. Upon a rise in CO2 level above 1000 PPM, a high CO2 level will be displayed at the BAS workstation. Setpoints are adjustable at the BAS workstation.
  2. On a rise in temperature above the programmed cooling setpoint, the condensing unit shall energize the first compressor. The hot-gas bypass valve shall be modulated by the factory provided HGPB controls to provide part-load capacity. On a continued rise in space temperature, the second compressor shall be energized. On a fall in temperature the compressor(s) shall de-energize in stages as they were energized.
  3. For units equipped with an outdoor air economizer: The DDC Controller shall receive input from the Global Enthalpy Sensor. If the enthalpy of the outdoor air is lower than the defined minimum level (user adjustable) the mixing box economizer sequence shall be activated upon a call for cooling. The outside air damper shall never close past the minimum position during the occupied period.
- C. Heating Mode:
1. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper open to the minimum position (10% outdoor air). The amount of outside air will be increased above the minimum setting on a rise in return air CO2 above the setpoint of 500 PPM (adjustable). On a return to setpoint the reverse occurs. Upon a rise in CO2 level above 1000 PPM, a high CO2 level will be dis
  2. On a drop in temperature below the programmed heating setpoint, the modulating hot water control valve shall be modulated open towards the coil. On a rise in temperature the reverse shall occur.

- D. Unoccupied Mode:
  - 1. During the programmed un-occupied mode, the fan, hot water valve, DX compressors, and mixing box dampers shall be cycled / modulated to maintain the un-occupied setpoints. Unless required for economizer cycle, the outside air damper shall remain closed.
- E. Provide a current sensor on one phase of power feeding the supply fan and each compressor for status indication at the Operator's Terminal.
- F. If the discharge temperature fails to rise to a programmed minimum temperature during a call for heating; a low temperature alarm shall be activated at the Operator's Terminal. If the discharge temperature fails to fall to a programmed minimum temperature on a call for mechanical cooling, a high temperature alarm shall be activated at the Operator's Terminal.
- G. A serpentine freeze stat shall be furnished, installed and wired in the unit by the BAS contractor. When tripped, the freeze stat shall function to de-energize the supply fan, mixing box damper actuators, chilled water control valve and hot water control valve. When de-energized, the mixing box damper actuators shall spring return the outside and relief air dampers closed, the hot water or dual temperature water control valve shall spring return open to the coil and the chilled water valve shall spring return closed to the coil. When the freeze stat trips, an alarm shall be generated at the Operator's Terminal.
- H. A duct smoke detector shall be furnished, installed and wired to the fire alarm system as required by the electrical contractor. The duct smoke detector shall be provided with an auxiliary alarm contact which will be used by the BAS Contractor to de-energize the supply fan, mixing box damper actuators, chilled water, hot water control valve. When de-energized, the mixing box damper actuators shall spring return the outside and relief air dampers closed, and an alarm shall be generated at the Operator's Terminal.
- I. The following items shall be displayed at the Operator's Terminal:
  - 1. Space temperature.
  - 2. Space CO2 levels (ppm).
  - 3. Space temperature setpoint.
  - 4. Low Space temperature alarm
  - 5. High Space temperature alarm
  - 6. Discharge temperature.
  - 7. Outside air temperature, humidity and enthalpy.
  - 8. Return air temp sensor
  - 9. Freeze stat status.
  - 10. Smoke detector status.
  - 11. Fan operational status via current sensor.
  - 12. Commanded status of fan.
  - 13. Commanded status of compressor(s).
  - 14. Commanded position of hot water control valves.
  - 15. Commanded position of mixing box dampers.
  - 16. Kitchen exhaust fan(s) status.
  - 17. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system

### **3.07 PACKAGED DX COOLING UNIT VENTILATORS WITH HOT WATER HEATING, AND OUTDOOR AIR ECONOMIZER.**

- A. Each unit ventilator shall be controlled by an individual DDC Controller. The DDC Controller shall be wired to a space temperature sensor, discharge air temperature sensor, humidity sensor, damper motors, and the contacts to the factory-mounted unit control system controlling the compressor and hot water heating valve packages and freezestat.

- B. Cooling Mode:
  - 1. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper open to the minimum position. On a rise in temperature above the programmed cooling setpoint, the heat-pump compressor shall energize. On a fall in temperature the compressor shall de-energize.
  - 2. The hot-gas bypass and hot-gas reheat valves shall modulate to maintain the required discharge air temperature from the unit.
  - 3. For dehumidification, the hot-gas reheat circuit shall be engaged as required to maintain the given humidity setpoint (50% RH, adjustable).
- C. Heating Mode:
  - 1. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper open to the minimum position. On a drop in temperature below the programmed heating setpoint, the hot water control valve shall modulate towards the open position. On a rise in temperature the reverse shall occur.
- D. Unoccupied Mode:
  - 1. During the programmed un-occupied mode, the fan, compressor, hot water control valve, and mixing box dampers shall be cycled / modulated to maintain the un-occupied setpoints. Unless required for economizer cycle, the outside air damper shall remain closed.
- E. OA Damper Control:
  - 1. During the programmed occupied mode, the supply fan shall run continuously with the outside air damper open to the minimum position (10% outdoor air). The amount of outside air will be increased above the minimum setting on a rise in return air CO<sub>2</sub> above the setpoint of 500 PPM (adjustable). On a return to setpoint the reverse occurs. Upon a rise in CO<sub>2</sub> level above 1000 PPM, a high CO<sub>2</sub> level will be displayed at the BAS workstation. Setpoints are adjustable at the BAS workstation.
  - 2. For units equipped with an outdoor air economizer: The DDC Controller shall receive input from the Global Enthalpy Sensor. The outside air damper shall never close past the minimum position during the occupied period.
- F. Provide a current sensor on one phase of power feeding the supply fan and compressor unit for status indication at the Operator's Terminal.
- G. If the discharge temperature fails to rise to a programmed minimum temperature during a call for heating; a low temperature alarm shall be activated at the Operator's Terminal. If the discharge temperature fails to fall to a programmed minimum temperature on a call for mechanical cooling, a high temperature alarm shall be activated at the Operator's Terminal.
- H. A serpentine freeze stat shall be furnished, installed and wired in the unit by the BAS contractor. When tripped, the freeze stat shall function to de-energize the supply fan, mixing box damper actuators, chilled water control valve and hot water control valve. When de-energized, the mixing box damper actuators shall spring return the outside and relief air dampers closed, the hot water or dual temperature water control valve shall spring return open to the coil and the chilled water valve shall spring return closed to the coil. When the freeze stat trips, an alarm shall be generated at the Operator's Terminal.
- I. The following items shall be displayed at the Operator's Terminal:
  - 1. Space temperature.
  - 2. Space temperature setpoint.
  - 3. Low Space temperature alarm
  - 4. High Space temperature alarm
  - 5. Discharge temperature.
  - 6. Return air temperature.
  - 7. Outside air temperature, humidity and enthalpy.

8. Space relative humidity.
9. Hot gas reheat status.
10. Fan operational status via current sensor.
11. Commanded status of fan.
12. Commanded status of compressor.
13. Commanded position of hot water control valve.
14. Commanded position of dampers.
15. Freezestat status.
16. Diagram showing the layout of the unit with major components and dynamic temperatures shown where temperature sensors exist in the system.

**END OF SECTION**



**SECTION 23 21 13**  
**HYDRONIC PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Hydronic system requirements (Chilled water, hot water, dual temperature)
- B. Pipe and pipe fittings for:
  - 1. Dual Temperature water piping system.
  - 2. Equipment drains and overflows.
- C. Pipe hangers and supports.
- D. Unions, flanges, mechanical couplings, and dielectric connections.
- E. Valves:
  - 1. Gate valves.
  - 2. Globe or angle valves.
  - 3. Ball valves.
  - 4. Plug valves.
  - 5. Butterfly valves.
  - 6. Check valves.
- F. Flow controls.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 31 00 - Access Doors and Panels.
- B. Section 09 90 00 - Painting and Coating.
- C. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.
- D. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- E. Section 22 05 53 - Identification for Plumbing Piping and Equipment.
- F. Section 22 07 19 - Plumbing Piping Insulation.
- G. Section 22 05 16 - Expansion Fittings and Loops for Plumbing Piping.
- H. Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping.
- I. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- J. Section 23 05 53 - Identification for HVAC Piping and Equipment.
- K. Section 23 07 19 - HVAC Piping Insulation.
- L. Section 23 21 14 - Hydronic Specialties.
- M. Section 23 25 00 - HVAC Water Treatment: Pipe cleaning.
- N. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; The American Society of Mechanical Engineers.
- C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers (ANSI B16.18).

- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- F. ASME B31.9 - Building Services Piping (ANSI/ASME B31.9).
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- H. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers.
- I. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers (ANSI/ASME B31.9).
- J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- L. ASTM B32 - Standard Specification for Solder Metal.
- M. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- N. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- O. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- P. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- Q. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
- R. ASTM D2310 - Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- S. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- T. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- U. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite-Sewer Piping.
- V. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
- W. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- X. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- Y. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- Z. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
- AA. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding.
- AB. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
- AC. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.
- AD. AWS D1.1/D1.1M - Structural Welding Code - Steel.

- AE. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; American Water Works Association (ANSI/AWWA C105/A21.5).
- AF. AWWA C110/A21.10 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids; American Water Works Association.
- AG. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association (ANSI/AWWA C111/A21.11).
- AH. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association (ANSI/AWWA C151/A21.51).
- AI. AWWA C606 - Grooved and Shouldered Joints (ANSI/AWWA C606).
- AJ. AWWA C606 - Standard Specification for Grooved and Shouldered Joints; American Water Works Association.
- AK. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..

#### 1.04 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Use grooved mechanical couplings and fasteners in accessible locations.
- C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- D. Use non-conducting dielectric connections whenever jointing dissimilar metals.
- E. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.
- F. Use gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- G. Use globe or ball valves for throttling, bypass, or manual flow control services.
- H. Use spring loaded check valves on discharge of condenser water pumps.
- I. Use plug cocks for throttling service. Use non-lubricated plug cocks only when shut-off or isolating valves are also provided.
- J. Use only butterfly valves in chilled and condenser water systems for throttling and isolation service.
- K. Use lug end butterfly valves to isolate equipment.
- L. Use 3/4 inch gate or ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.

#### 1.05 SUBMITTALS

- A. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- B. Welders Certificate: Include welders certification of compliance with ASME (BPV IX).
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Project Record Documents: Record actual locations of valves.
- E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum three years of experience.
- C. Welder Qualifications: Certify in accordance with ASME (BPV IX).

**1.07 REGULATORY REQUIREMENTS**

- A. Conform to ASME B31.9 code for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

**1.08 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.

**1.09 FIELD CONDITIONS**

- A. Do not install underground piping when bedding is wet or frozen.

**1.10 EXTRA MATERIALS**

- A. Provide two repacking kits for each size and valve type.

**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, above acoustical ceilings, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
    - b. Use rigid joints unless otherwise indicated.
  4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
  5. Provide pipe hangers and supports in accordance with ASME B31.9 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.
2. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.

E. Welding Materials and Procedures: Conform to ASME (BPV IX).

## **2.02 DUAL TEMPERATURE, HEATING, & CHILLED 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 welded.
  2. Threaded Joints: ASME B16.3, malleable iron fittings.
  3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
  4. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.
  5. Joints: Threaded or AWS D1.1 welded.
- B. Steel Pipe Sizes 12 Inch and Over: ASTM A53/A53M, 0.375 inch wall, black; using one of the following joint types:
  1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1 welded.
  2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
  3. Joints: Welded in accordance with AWS D1.1.
- C. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), hard 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 A5.8/A5.8M BCuP copper/silver alloy.
  2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
  3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
  4. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

## **2.03 EQUIPMENT DRAINS AND OVERFLOWS**

- A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), 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; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
  2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.
- B. 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.
- B. Conform to ASME B31.9.
- C. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.
- D. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
- E. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

- F. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.
- G. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- H. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
- I. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
- J. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
- K. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- L. Vertical Support: Steel riser clamp.
- M. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- N. 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.
- O. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- P. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- Q. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- R. Inserts: Malleable iron case of 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.
- S. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

## **2.05 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS**

- A. Unions for Pipe 2 Inches and Under:
  - 1. Ferrous Piping: 150 psig malleable iron, threaded.
  - 2. Copper Pipe: Bronze, soldered joints.
- B. Flanges for Pipe Over 2 Inches:
  - 1. Ferrous Piping: 150 psig forged steel, slip-on.
  - 2. Copper Piping: Bronze.
  - 3. Gaskets: 1/16 inch thick preformed neoprene.
- 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. Housing Material: Malleable iron or ductile iron, galvanized.
  - 4. Housing Clamps: Malleable iron galvanized to engage and lock, designed to permit some angular deflection, contraction, and expansion.
  - 5. Gasket Material: EPDM suitable for operating temperature range from -30 degrees F to 230 degrees F.
  - 6. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
  - 7. When pipe is field grooved, provide coupling manufacturer's grooving tools.

- D. Dielectric Connections: Union or waterway fitting with water impervious isolation barrier and one galvanized or plated steel end and one copper tube end, end types to match pipe joint types used.

## 2.06 GATE VALVES

- A. Manufacturers:
  1. Conbraco Industries: [www.conbraco.com](http://www.conbraco.com).
  2. Nibco, Inc: [www.nibco.com](http://www.nibco.com).
  3. Milwaukee Valve Company: [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Up To and Including 2 Inches:
  1. Bronze body, bronze trim, screwed or union bonnet, non-rising stem, lockshield stem or handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, solder ends.
- C. Over 2 Inches:
  1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends.

## 2.07 GLOBE OR ANGLE VALVES

- A. Manufacturers:
  1. Conbraco Industries: [www.conbraco.com](http://www.conbraco.com).
  2. Nibco, Inc: [www.nibco.com](http://www.nibco.com).
  3. Milwaukee Valve Company: [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Up To and Including 2 Inches:
  1. Bronze body, bronze trim, screwed or union bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat, solder ends.
- C. Over 2 Inches:
  1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

## 2.08 BALL VALVES

- A. Manufacturers:
  1. Conbraco Industries: [www.conbraco.com](http://www.conbraco.com).
  2. Nibco, Inc: [www.nibco.com](http://www.nibco.com).
  3. Victaulic Company: [www.victaulic.com](http://www.victaulic.com).
  4. Milwaukee Valve Company: [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Up To and Including 2 Inches:
  1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.
- C. Over 2 Inches:
  1. Ductile iron body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, grooved ends or flanged, rated to 800 psi.
  2. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

## 2.09 PLUG VALVES

- A. Manufacturers:
  1. Conbraco Industries: [www.conbraco.com](http://www.conbraco.com).
  2. Nibco, Inc: [www.nibco.com](http://www.nibco.com).

3. Milwaukee Valve Company: [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Up To and Including 2 Inches:
1. Bronze body, bronze tapered plug, full port opening, non-lubricated, teflon packing, threaded ends.
  2. Operator: One plug valve wrench for every ten plug valves minimum of one.
- C. Over 2 Inches:
1. Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends.
  2. Operator: Each plug valve with a wrench with set screw.

## 2.10 BUTTERFLY VALVES

- A. Manufacturers:
1. Hammond Valve: [www.hammondvalve.com](http://www.hammondvalve.com).
  2. Crane Co.: [www.cranevalve.com](http://www.cranevalve.com).
  3. Milwaukee Valve Company: [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  4. Victaulic Company: [www.victaulic.com](http://www.victaulic.com).
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck.
- C. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.
- D. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.
- E. Disc: Aluminum bronze.
- F. Operator: 10 position lever handle.

## 2.11 SWING CHECK VALVES

- A. Manufacturers:
1. Hammond Valve: [www.hammondvalve.com](http://www.hammondvalve.com).
  2. Nibco, Inc: [www.nibco.com](http://www.nibco.com).
  3. Victaulic Company: [www.victaulic.com](http://www.victaulic.com).
  4. Milwaukee Valve Company: [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Up To and Including 2 Inches:
1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder ends.

## 2.12 SPRING LOADED CHECK VALVES

- A. Manufacturers:
1. Hammond Valve: [www.hammondvalve.com](http://www.hammondvalve.com).
  2. Crane Co.: [www.cranevalve.com](http://www.cranevalve.com).
  3. Milwaukee Valve Company: [www.milwaukeevalve.com](http://www.milwaukeevalve.com).
  4. Victaulic Company: [www.victaulic.com](http://www.victaulic.com).
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

## 2.13 FLOW CONTROLS

- A. Manufacturers:
1. ITT Bell & Gossett: [www.bellgossett.com](http://www.bellgossett.com).

2. Griswold Controls: [www.griswoldcontrols.com](http://www.griswoldcontrols.com).
  3. Taco, Inc: [www.taco-hvac.com](http://www.taco-hvac.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.
  - C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.
  - D. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

### **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. Refer to Section 23 25 00 for additional requirements.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install heating water, chilled water, dual-temperature, and condenser water piping to ASME B31.9 requirements.
- C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- D. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- E. Install piping to conserve building space and to avoid interfere with use of space.
- F. Group piping whenever practical at common elevations.
- G. Sleeve pipe passing through partitions, walls and floors.
- H. Slope piping and arrange to drain at low points.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.
- K. Inserts:
  1. Provide inserts for placement in concrete formwork.
  2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
- L. Pipe Hangers and Supports:
  1. Install in accordance with ASME B31.9.

2. Support horizontal piping as scheduled.
  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 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.
  8. Provide copper plated hangers and supports for copper piping.
  9. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.
- N. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.
- O. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00.
- P. Use eccentric reducers to maintain top of pipe level.
- Q. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- R. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 90 00.
- S. Install valves with stems upright or horizontal, not inverted.

### 3.03 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  4. 2-1/2 inch: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  5. 3 inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  6. 4 inch: Maximum span, 12 feet; minimum rod size, 1/2 inch.
  7. 6 inch: Maximum span, 14 feet; minimum rod size, 1/2 inch.
  8. 8 inch: Maximum span, 16 feet; minimum rod size, 5/8 inch.
  9. 10 inch: Maximum span, 18 feet; minimum rod size, 3/4 inch.
  10. 12 inch: Maximum span, 19 feet; minimum rod size, 7/8 inch.
- B. Hanger Spacing for Steel Piping.
1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
  6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  7. 4 inches: Maximum span, 14 feet; minimum rod size, 1/2 inch.
  8. 6 inches: Maximum span, 17 feet; minimum rod size, 1/2 inch.
  9. 8 inches: Maximum span, 19 feet; minimum rod size, 5/8 inch.

10. 10 inches: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. 12 inches: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. 14 inches: Maximum span, 25 feet; minimum rod size, 1 inch.
13. 16 inches: Maximum span, 27 feet; minimum rod size, 1 inch.
14. 18 inches: Maximum span, 28 feet; minimum rod size, 1-1/4 inch.
15. 20 inches: Maximum span, 30 feet; minimum rod size, 1-1/4 inch.

C. Hanger Spacing for Plastic Piping.

1. 1/2 inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
2. 3/4 inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
3. 1 inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
4. 1-1/4 inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
5. 1-1/2 inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.
6. 2 inches: Maximum span, 69 inches; minimum rod size, 3/8 inch.
7. 3 inches: Maximum span, 7 feet; minimum rod size, 3/8 inch.
8. 4 inches: Maximum span, 8 feet; minimum rod size, 1/2 inch.
9. 6 inches: Maximum span, 10 feet; minimum rod size, 1/2 inch.
10. 8 inches: Maximum span, 11 feet; minimum rod size, 5/8 inch.
11. 10 inches: Maximum span, 13 feet; minimum rod size, 3/4 inch.
12. 12 inches: Maximum span, 14 feet; minimum rod size, 7/8 inch.
13. 14 inches: Maximum span, 15 feet; minimum rod size, 1 inch.
14. 16 inches: Maximum span, 16 feet; minimum rod size, 1 inch.
15. 18 inches: Maximum span, 18 feet; minimum rod size, 1-1/4 inch.

**END OF SECTION**



**SECTION 23 23 00**  
**REFRIGERANT PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Check valves.
- G. Pressure relief valves.
- H. Filter-driers.
- I. Solenoid valves.
- J. Expansion valves.
- K. Receivers.
- L. Flexible connections.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 31 00 - Access Doors and Panels.
- B. Section 09 90 00 - Painting and Coating.
- C. Section 22 07 19 - Plumbing Piping Insulation.
- D. Section 22 07 16 - Plumbing Equipment Insulation.
- E. Section 23 54 00 - Furnaces.
- F. Section 23 61 00 - Refrigerant Compressors.
- G. Section 23 62 13 - Packaged Air-Cooled Refrigerant Compressor and Condenser Units.
- H. Section 23 63 13 - Air Cooled Refrigerant Condensers.
- I. Section 23 81 24 - Computer Room Air Conditioners - Floor Mounted.
- J. Section 23 82 16 - Air Coils.
- K. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- L. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI 495 - Performance Rating of Refrigerant Liquid Receivers; Air-Conditioning, Heating, and Refrigeration Institute.
- B. AHRI 710 - Performance Rating of Liquid-Line Driers; Air-Conditioning, Heating, and Refrigeration Institute.
- C. AHRI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Driers; Air-Conditioning, Heating, and Refrigeration Institute.
- D. AHRI 750 - Standard for Thermostatic Refrigerant Expansion Valves; Air-Conditioning, Heating, and Refrigeration Institute.
- E. AHRI 760 - Standard for Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; Air-Conditioning, Heating, and Refrigeration Institute.

- F. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ANSI/ASHRAE Std 15).
- G. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc..
- H. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers.
- I. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers.
- J. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.
- K. ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes; The American Society of Mechanical Engineers.
- L. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; The American Society of Mechanical Engineers.
- M. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers (ANSI/ASME B31.9).
- N. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- O. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- P. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
- Q. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric).
- R. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- S. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- T. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society.
- U. AWS D1.1/D1.1M - Structural Welding Code - Steel.
- V. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- W. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- X. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc..
- Y. UL 429 - Electrically Operated Valves; Underwriters Laboratories Inc..

#### **1.04 SYSTEM DESCRIPTION**

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with MSS SP-69 unless indicated otherwise.
- C. Liquid Indicators:
  1. Use line size liquid indicators in main liquid line leaving condenser.
  2. If receiver is provided, install in liquid line leaving receiver.

3. Use line size on leaving side of liquid solenoid valves.
- D. Valves:
1. Use service valves on suction and discharge of compressors.
  2. Use gage taps at compressor inlet and outlet.
  3. Use gage taps at hot gas bypass regulators, inlet and outlet.
  4. Use check valves on compressor discharge.
  5. Use check valves on condenser liquid lines on multiple condenser systems.
- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
1. Use line size strainer upstream of each automatic valve.
  2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
  3. On steel piping systems, use strainer in suction line.
  4. Use shut-off valve on each side of strainer.
- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- H. Filter-Driers:
1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
  2. Use a filter-drier on suction line just ahead of compressor.
  3. Use sealed filter-driers in lines smaller than 1/2 inch outside diameter.
  4. Use sealed filter-driers in low temperature systems.
  5. Use sealed filter-driers in systems utilizing hermetic compressors.
  6. Use replaceable core filter-driers in lines of 1/2 inch outside diameter or greater.
  7. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
  8. Use filter-driers for each solenoid valve.
- I. Solenoid Valves:
1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
  2. Use in liquid line of single or multiple evaporator systems.
  3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
- J. Receivers:
1. Use on systems five tons and larger, sized to accommodate pump down charge.
  2. Use on systems with long piping runs.
- K. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

### 1.05 SUBMITTALS

- A. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.
- B. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- C. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of leak test, acid test.
- E. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

- F. Submit welders certification of compliance with ASME (BPV IX) or AWS D1.1.
- G. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.
- H. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

#### **1.06 QUALITY ASSURANCE**

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.
- B. Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work.
- C. Design piping system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

#### **1.07 REGULATORY REQUIREMENTS**

- A. Conform to ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME (BPV IX) or AWS D1.1.
- D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

#### **1.09 MAINTENANCE PRODUCTS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Provide two refrigeration oil test kits each containing everything required to conduct one test.
- C. Provide two filter-dryer cartridges of each type.

### **PART 2 PRODUCTS**

#### **2.01 PIPING**

- A. Copper Tube: ASTM B280, H58 hard drawn .
  - 1. Fittings: ASME B16.22 wrought copper.
  - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
- B. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.
  - 1. Fittings: ASME B16.26 cast copper.
  - 2. Joints: Flared.
- C. Steel Pipe: ASTM A53/A53M, Schedule 40, black.
  - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
  - 2. Joints: Welded in accordance with AWS D1.1.
- D. Steel Pipe Sizes 12 Inch and Over: ASTM A53/A53M, 0.375 inch wall, black.
  - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
  - 2. Joints: Welded in accordance with AWS D1.1.

- E. Pipe Supports and Anchors:
1. Conform to ASTM F 708, MSS SP-58, MSS SP-69, and MSS SP-89.
  2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Carbon steel adjustable swivel, split ring.
  3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
  4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
  6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
  7. Vertical Support: Steel riser clamp.
  8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
  10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
  11. 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.

## 2.02 REFRIGERANT

- A. Refrigerant: See Schedules

## 2.03 MOISTURE AND LIQUID INDICATORS

- A. Manufacturers:
1. Henry Technologies: [www.henrytech.com](http://www.henrytech.com).
  2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com](http://www.parker.com).
  3. Sporlan Valve Company: [www.sporlan.com](http://www.sporlan.com).
- B. Indicators: Single or Doubleport type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

## 2.04 VALVES

- A. Manufacturers:
1. Hansen Technologies Corporation: [www.hantech.com](http://www.hantech.com).
  2. Henry Technologies: [www.henrytech.com](http://www.henrytech.com).
  3. Danfoss Flomatic: [www.flomatic.com](http://www.flomatic.com).
- B. Diaphragm Packless Valves:
1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- C. Packed Angle Valves:
1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.
- D. Ball Valves:
1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.
- E. Service Valves:
1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

## 2.05 STRAINERS

- A. Straight Line or Angle Line Type:
  - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.
- B. Straight Line, Non-Cleanable Type:
  - 1. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of 500 psi.

## 2.06 CHECK VALVES

- A. Manufacturers:
  - 1. Hansen Technologies Corporation: [www.hantech.com](http://www.hantech.com).
  - 2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com](http://www.parker.com).
  - 3. Sporlan Valve Company: [www.sporlan.com](http://www.sporlan.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Globe Type:
  - 1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 500 psi.
- C. Straight Through Type:
  - 1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

## 2.07 PRESSURE REGULATORS

- A. Manufacturers:
  - 1. Hansen Technologies Corporation: [www.hantech.com](http://www.hantech.com).
  - 2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com](http://www.parker.com).
  - 3. Sporlan Valve Company: [www.sporlan.com](http://www.sporlan.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Brass body, stainless steel diaphragm, direct acting, adjustable over 0 to 80 psi range, for maximum working pressure of 450 psi.

## 2.08 PRESSURE RELIEF VALVES

- A. Manufacturers:
  - 1. Hansen Technologies Corporation: [www.hantech.com](http://www.hantech.com).
  - 2. Henry Technologies: [www.henrytech.com](http://www.henrytech.com).
  - 3. Sherwood Valve/Harsco Corporation: [www.sherwoodvalve.com](http://www.sherwoodvalve.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 425 psi, adjusted to meet system requirements.

## 2.09 FILTER-DRIERS

- A. Manufacturers:
  - 1. Flow Controls Division of Emerson Electric: [www.emersonflowcontrols.com](http://www.emersonflowcontrols.com).
  - 2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com](http://www.parker.com).
  - 3. Sporlan Valve Company: [www.sporlan.com](http://www.sporlan.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Performance:

1. Flow Capacity - Liquid Line: As indicated in schedule, minimum, rated in accordance with AHRI 710.
  2. Flow Capacity - Suction Line: As indicated in schedule, minimum, rated in accordance with AHRI 730.
  3. Water Capacity: As indicated in schedule, rated in accordance with AHRI 710.
  4. Pressure Drop: 2 psi, As indicated in schedule, maximum, when operating at full connected evaporator capacity.
  5. Design Working Pressure: As indicated in schedule or 350 psi, minimum.
- C. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns; of construction that will not pass into refrigerant lines.
- D. Construction: UL listed.
1. Replaceable Core Type: Steel shell with removable cap.
  2. Sealed Type: Copper shell.
  3. Connections: As specified for applicable pipe type.

## 2.10 SOLENOID VALVES

- A. Manufacturers:
1. Flow Controls Division of Emerson Electric: [www.emersonflowcontrols.com](http://www.emersonflowcontrols.com).
  2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com](http://www.parker.com).
  3. Sporlan Valve Company: [www.sporlan.com](http://www.sporlan.com).
- B. Valve: AHRI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi.
- C. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.
- D. Electrical Characteristics: per drawings.

## 2.11 EXPANSION VALVES

- A. Manufacturers:
1. Flow Controls Division of Emerson Electric: [www.emersonflowcontrols.com](http://www.emersonflowcontrols.com).
  2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com](http://www.parker.com).
  3. Sporlan Valve Company: [www.sporlan.com](http://www.sporlan.com).
- B. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, mechanical pressure limit (maximum operating pressure MOP feature), adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb and remote bulb well.
- C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

## 2.12 ELECTRONIC EXPANSION VALVES

- A. Manufacturers:
1. Danfoss Automatic Controls: [www.danfoss.com](http://www.danfoss.com).
  2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com](http://www.parker.com).
  3. Sporlan Valve Company: [www.sporlan.com](http://www.sporlan.com).
- B. Valve:

1. Brass body with flared or solder connection, needle valve with floating needle and machined seat, stepper motor drive.
  2. Capacity: per drawings.
  3. Electrical Characteristics: per drawings.
- C. Evaporation Control System:
1. Electronic microprocessor based unit in enclosed case, proportional integral control with adaptive superheat, maximum operating pressure function, preselection allowance for electrical defrost and hot gas bypass.
  2. Electrical Characteristics: per drawings.
- D. Refrigeration System Control: Electronic microprocessor based unit in enclosed case, with proportional integral control of valve, on/off thermostat, air temperature alarm (high and low), solenoid valve control, liquid injection adaptive superheat control, maximum operating pressure function, night setback thermostat, timer for defrost control.

### 2.13 RECEIVERS

- A. Manufacturers:
1. Henry Technologies: [www.henrytech.com](http://www.henrytech.com).
  2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com](http://www.parker.com).
  3. Sherwood Valve/Harsco Corporation: [www.sherwoodvalve.com](http://www.sherwoodvalve.com).
- B. Internal Diameter 6 inch and Smaller:
1. AHRI 495, UL listed, steel, brazed; 400 psi maximum pressure rating, with tappings for inlet, outlet, and pressure relief valve.
- C. Internal Diameter Over 6 inch:
1. AHRI 495, welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); 400 psi with tappings for liquid inlet and outlet valves, pressure relief valve, and magnetic liquid level indicator.

### 2.14 FLEXIBLE CONNECTORS

- A. Manufacturers:
1. Circuit Hydraulics, Ltd: [www.circuit-hydraulics.co.uk](http://www.circuit-hydraulics.co.uk).
  2. Flexicraft Industries: [www.flexicraft.com](http://www.flexicraft.com).
  3. Penflex: [www.penflex.com](http://www.penflex.com).
- B. Corrugated stainless steel or bronze hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

## PART 3 EXECUTION

### 3.01 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.

### 3.02 INSTALLATION

- A. Install refrigeration specialties in accordance with manufacturer's instructions.
- B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- C. Install piping to conserve building space and avoid interference with use of space.
- D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
  1. Provide inserts for placement in concrete formwork.
  2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
  4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of or recessed into and grouted flush with slab.
- G. Pipe Hangers and Supports:
  1. Install in accordance with ASTM F 708 and MSS SP-89.
  2. Support horizontal piping as scheduled.
  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. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
  6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  7. Provide copper plated hangers and supports for copper piping.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings. Coordinate size and location of access doors with Section 08 31 00.
- K. Flood piping system with nitrogen when brazing.
- L. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- N. Insulate piping and equipment; refer to Section and Section 22 07 16.
- O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- T. Fully charge completed system with refrigerant after testing.
- U. Provide electrical connection to solenoid valves. Refer to Section 26 27 17.

### 3.03 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.

- B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using electronic leak detector. Test to no leakage.

### 3.04 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 3/8 inch.
  2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 3/8 inch.
  3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.
  9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- B. Hanger Spacing for Steel Piping.
1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  3. 1-1/2 inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  4. 2 inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  5. 2-1/2 inches: Maximum span, 11 feet; minimum rod size, 3/8 inch.
  6. 3 inches: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  7. 4 inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.

**END OF SECTION**

**SECTION 23 25 00**  
**HVAC WATER TREATMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Cleaning of piping systems.
- B. Chemical feeder equipment.
- C. Chemical treatment.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 21 13 - Hydronic Piping.
- B. Section 23 21 14 - Hydronic Specialties.
- C. Section 23 09 13 - Instrumentation and Control Devices for HVAC.
- D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate system schematic, equipment locations, and controls schematics, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.
- E. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- F. Certificate: Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.
- G. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- H. Operation and Maintenance Data: Include data on chemical feed pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs. Include step by step instructions on test procedures including target concentrations.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum ten years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience and approved by manufacturer.

**1.05 REGULATORY REQUIREMENTS**

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
- B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

**1.06 MAINTENANCE SERVICE**

- A. Furnish service and maintenance of treatment systems for one year from Date of Substantial Completion.
- B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
- C. Provide laboratory and technical assistance services during this maintenance period.
- D. Include four hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start up of systems.
- E. Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

**1.07 MAINTENANCE MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Supply sufficient chemicals for treatment and testing during warranty period.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. System Cleaner:
  - 1. Manufacturers:
    - a. AmSolv/Division of Amrep, Inc: [www.amsolv.com](http://www.amsolv.com).
    - b. GE Water Technologies: [www.gewater.com](http://www.gewater.com).
    - c. Nalco Company: [www.nalco.com](http://www.nalco.com).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.
  - 2. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products.
  - 3. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate).
  - 4. Ensure compatibility of chemicals with aluminum heat exchangers prior to use in the system.
- B. Closed System Treatment (Water):
  - 1. Manufacturers:
    - a. AmSolv/Division of Amrep, Inc: [www.amsolv.com](http://www.amsolv.com).
    - b. GE Water Technologies: [www.gewater.com](http://www.gewater.com).
    - c. Nalco Company: [www.nalco.com](http://www.nalco.com).
    - d. Substitutions: See Section 01 60 00 - Product Requirements.
  - 2. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
  - 3. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
  - 4. Conductivity enhancers; phosphates or phosphonates.
  - 5. Guarantee compliance with and maintain pH level as required by the manufacturer of the condensing boilers for use with aluminum heat exchangers.
- C. Condenser Water System Treatment (Cooling Towers):
  - 1. Manufacturers:
    - a. AmSolv/Division of Amrep, Inc: [www.amsolv.com](http://www.amsolv.com).
    - b. GE Water Technologies: [www.gewater.com](http://www.gewater.com).

- c. Nalco Company: [www.nalco.com](http://www.nalco.com).
- d. Substitutions: See Section 01 60 00 - Product Requirements.
- 2. Sequestering agent to inhibit scaling; phosphonates, sodium polyphosphates, lignin derivatives, synthetic polymer polyelectrolytes, or organic phosphates.
- 3. Acid to reduce alkalinity and pH; sulphuric acid.
- 4. Corrosion inhibitor; zinc-phosphate, phosphonate-phosphate, phosphonate-molybdate and phosphonate-silicate, sodium tolyltriazole, or low molecular weight polymers.
- 5. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quaternary ammonia compounds, tributyl tin oxide, methylene bis (thiocyanate).

## **2.02 BY-PASS (POT) FEEDER**

- A. Manufacturers:
  - 1. Griswold Controls: [www.griswoldcontrols.com](http://www.griswoldcontrols.com).
  - 2. J. L. Wingert Company: [www.jlwingert.com](http://www.jlwingert.com).
  - 3. Neptune Chemical Pump Company: [www.neptune1.com](http://www.neptune1.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. 6.0 gal quick opening cap for working pressure of 175 psi.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Verify that electric power is available and of the correct characteristics.

### **3.02 CLEANING SEQUENCE**

- A. Concentration:
  - 1. As recommended by manufacturer.
  - 2. One pound per 100 gallons of water contained in the system.
- B. Hot Water Heating Systems and Dual Temperature Systems:
  - 1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
  - 2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
  - 3. Circulate for 6 hours at design temperatures, then drain.
  - 4. Refill with clean water and repeat until system cleaner is removed.
- C. Chilled Water Systems:
  - 1. Circulate for 48 hours, then drain systems as quickly as possible.
  - 2. Refill with clean water, circulate for 24 hours, then drain.
  - 3. Refill with clean water and repeat until system cleaner is removed.
- D. Use neutralizer agents on recommendation of system cleaner supplier and approval of Construction Manager, Architect or Engineer of Record.
- E. Flush open systems with clean water for one hour minimum. Drain completely and refill.
- F. Remove, clean, and replace strainer screens.
- G. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

### **3.03 INSTALLATION**

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

**3.04 CLOSED SYSTEM TREATMENT**

- A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.
- B. Introduce closed system treatment through bypass feeder when required or indicated by test.
- C. Provide 3/4 inch water coupon rack around circulating pumps with space for 12 test specimens.

**3.05 CONDENSER WATER SYSTEMS (COOLING TOWERS)**

- A. Provide solution pumps to feed sequestering agent and corrosion inhibitor from solution tank into condenser water supply to tower. Provide agitator as required.
- B. Provide conductivity controller to sample condenser water and operate 1 inch solenoid bleed valve and solution pumps. Provide 1/4 inch solenoid valve and piping to blowdown controller sampler wired to open when condensing water pump is operating.
- C. Provide solution pump to feed diluted acid from solution tank into condenser water supply to tower.
- D. Introduce algicide to tower by intermittent slug feed or continuous feed solution pump or solenoid valve on tank (chlorine).
- E. Provide water meter in make-up water line to tower, to activate solution pumps for preset time when condenser water pumps are running.
- F. Provide liquid level switch in each solution tank to de- activate solution pump and agitator, and signal mechanical alarm system; refer to Section 23 09 13.
- G. Provide 3/4 inch water coupon rack around circulating pumps with space for 12 test specimens.

**3.06 CLOSEOUT ACTIVITIES**

- A. Training: Train Owner's personnel on operation and maintenance of chemical treatment system.
  - 1. Provide minimum of two hours of instruction for two people.
  - 2. Have operation and maintenance data prepared and available for review during training.
  - 3. Conduct training using actual equipment after treated system has been put into full operation.

**3.07 MAINTENANCE**

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Perform maintenance work using competent and qualified personnel under the supervision and in the direct employ of the equipment manufacturer or original installer.
- C. Provide service and maintenance of treatment systems for one year from Date of Substantial Completion.
- D. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit two copies of field service report after each visit.
- E. Provide laboratory and technical assistance services during this maintenance period.
- F. Provide on site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.

**END OF SECTION**

**SECTION 23 31 00**  
**HVAC DUCTS AND CASINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal ductwork.
- B. Casing and plenums.
- C. Kitchen hood ductwork.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 09 90 00 - Painting and Coating: Weld priming, weather resistant, paint or coating.
- C. Section 11 40 00 - Foodservice Equipment: Supply of kitchen range hoods for placement by this Section.
- D. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- E. Section 23 33 00 - Air Duct Accessories.
- F. Section 23 36 00 - Air Terminal Units.
- G. Section 23 37 00 - Air Outlets and Inlets.
- H. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

**1.03 REFERENCE STANDARDS**

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
- 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 A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
- E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy With Improved Formability, and Ultra-High Strength
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].
- H. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
- I. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe [Metric].
- J. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- K. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
- L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.

- M. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.
- N. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.
- O. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association.
- P. SMACNA (DCS) - HVAC Duct Construction Standards.
- Q. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association.
- R. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication & Installation Guidelines.
- S. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc..
- T. IECC 2012 - International Energy Conservation Code - Duct construction standards, leakage testing

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

#### **1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for duct materials and duct connections.
- C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.
- D. MANDATORY Test Reports: Pressure test all ductwork. Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.
  1. Utilize standard equation  $CL=FP^{0.65}$  where F= Measured leakage rate in CFM per 100 square feet of duct surface, and P = Static Pressure of the test.
- E. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.
- F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

#### **1.07 REGULATORY REQUIREMENTS**

- A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards.

#### **1.08 FIELD CONDITIONS**

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

## **PART 2 PRODUCTS**

### **2.01 DUCT ASSEMBLIES**

#### **2.02 MATERIALS**

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.
- C. Stainless Steel for Ducts: ASTM A 240/A 240M, Type 304.
- D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
- E. Flexible Ducts:
  - 1. Two ply vinyl film supported by helically wound spring steel wire.
    - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
    - b. Maximum Velocity: 4000 fpm.
    - c. Temperature Range: -10 degrees F to 160 degrees F.
- F. Insulated Flexible Ducts:
  - 1. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
    - a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
    - b. Maximum Velocity: 4000 fpm.
    - c. Temperature Range: -10 degrees F to 160 degrees F.
- G. Stainless Steel Ducts: ASTM A 666, Type 304.
- H. All Ducts: Galvanized steel, unless otherwise indicated.
- I. Low Pressure Supply (Heating Systems): 1 inch w.g. pressure class, galvanized steel.
- J. Low Pressure Supply (System with Cooling Coils): 1 inch w.g. pressure class, galvanized steel.
- K. Medium and High Pressure Supply (All VAV Primary Supply Duct between AHU and VAV Terminal Unit): 2 inch w.g. pressure class, galvanized steel.
- L. Return and Relief: 1 inch w.g. pressure class, galvanized steel.
- M. General Exhaust: 1 inch w.g. pressure class, galvanized steel.
- N. Kitchen Cooking Hood Exhaust: 1/2 inch w.g. pressure class, galvanized steel.
  - 1. Asphalt base.
  - 2. Construct of 18 gage stainless steel using continuous external welded joints in rectangular sections.
- O. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
  - 1. 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.
  - 2. VOC Content: Not more than 250 g/L, excluding water.

#### **2.03 DUCTWORK FABRICATION**

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T'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 turning vanes. .

- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.
- F. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- H. 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.

#### **2.04 MANUFACTURED DUCTWORK AND FITTINGS**

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Double Wall Insulated Round Ducts: Round spiral lockseam duct with paintable galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall. Provide paint in color selected by architect.
  - 1. Manufacture in accordance with SMACNA HVAC Duct Construction Standards.
  - 2. Insulation:
    - a. Thickness: 1 inch.
    - b. Material: Fiberglass, with mylar coating between insulation and perforated liner.
- C. Transverse Duct Connection System: SMACNA "J" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.
  - 1. Manufacturers:

#### **2.05 CASINGS**

- A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards and construct for operating pressures indicated.
- B. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- C. Mount floor mounted casings on 4 inch high concrete curbs. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- D. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.
  - 1. Provide clear wire glass observation ports, minimum 6 X 6 inch size.

#### **2.06 KITCHEN HOOD EXHAUST DUCTWORK**

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, SMACNA Kitchen Ventilation Systems and Food Service Equipment Fabrication & Installation Guidelines and NFPA 96.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.
- B. Install in accordance with manufacturer's instructions.
- C. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- D. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
- H. Use double nuts and lock washers on threaded rod supports.
- I. Tape joints of PVC coated metal ductwork with PVC tape.
- J. Connect terminal units to supply ducts with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
- K. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.
- L. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.
- M. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.
- N. Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed.
- O. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- P. At exterior wall louvers, seal duct to louver frame and install blank-out panels as required.

### **3.02 RANGE HOOD EXHAUST DUCT INSTALLATIONS**

- A. Install ducts to allow for thermal expansion of ductwork through 2000 deg F temperature range.
- B. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.
- C. Install ducts without dips or traps that may collect residues, unless traps have continuous or automatic residue removal.
- D. Install access openings at each change in direction and at 50-foot intervals; locate on sides of duct a minimum of 1-1 1/2 inches from bottom; and fit with grease-tight covers of same material as duct.
- E. Do not penetrate fire-rated assemblies.

### **3.03 CLEANING AND TESTING**

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

- B. Conduct required duct-leakage testing as defined within this specification and otherwise noted in the contract documents.

### **3.04 SCHEDULES**

- A. Ductwork Material:
  - 1. Low Pressure Supply (Heating Systems): Steel, Aluminum.
  - 2. Low Pressure Supply (System with Cooling Coils): Steel, Aluminum.
  - 3. Medium and High Pressure Supply: Steel.
  - 4. Return and Relief: Steel, Aluminum.
  - 5. General Exhaust: Steel, Aluminum.
  - 6. Kitchen Hood Exhaust: Carbon Steel, Stainless Steel.
  - 7. Outside Air Intake: Steel.
  - 8. Exposed round ductwork: Double-walled spiral.
- B. Ductwork Pressure Class:
  - 1. Supply (Heating Systems): 1 inch
  - 2. Supply (System with Cooling Coils): 2 inch.
  - 3. Return and Relief: 1 inch.
  - 4. General Exhaust: 1 inch.
  - 5. Outside Air Intake: 1 inch.

**END OF SECTION**

**SECTION 23 33 00**  
**AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Backdraft dampers.
- D. Combination fire and smoke dampers.
- E. Duct access doors.
- F. Duct test holes.
- G. Fire dampers.
- H. Flexible duct connections.
- I. Smoke dampers.
- J. Volume control dampers.

**1.02 RELATED REQUIREMENTS**

- A. Section 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Section 23 31 00 - HVAC Ducts and Casings.
- C. Section 23 36 00 - Air Terminal Units: Pressure regulating damper assemblies.
- D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- B. NFPA 92 - Standard for Smoke-Control Systems.
- C. NFPA 92A - Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences.
- D. SMACNA 1966 - HVAC Duct Construction Standards.
- E. UL 33 - Heat Responsive Links for Fire-Protection Service; Underwriters Laboratories Inc..
- F. UL 555 - Standard for Fire Dampers; Underwriters Laboratories Inc..
- G. UL 555S - Standard for Leakage Rated Dampers for Use in Smoke Control Systems; Underwriters Laboratories Inc..

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes, and hardware used. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors, and duct test holes.
- D. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

**1.05 PROJECT RECORD DOCUMENTS**

- A. Record actual locations of access doors and test holes.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Protect dampers from damage to operating linkages and blades.

**1.08 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Provide two of each size and type of fusible link.

**PART 2 PRODUCTS****2.01 AIR TURNING DEVICES/EXTRACTORS**

- A. Manufacturers:
  1. Krueger: [www.krueger-hvac.com](http://www.krueger-hvac.com).
  2. Ruskin Company: [www.ruskin.com](http://www.ruskin.com).
  3. Titus: [www.titus-hvac.com](http://www.titus-hvac.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

**2.02 BACKDRAFT DAMPERS - METAL****2.03 BACKDRAFT DAMPERS**

- A. Manufacturers:
  1. Louvers & Dampers, Inc: [www.louvers-dampers.com](http://www.louvers-dampers.com).
  2. Nailor Industries Inc: [www.nailor.com](http://www.nailor.com).
  3. Ruskin Company: [www.ruskin.com](http://www.ruskin.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

**2.04 BACKDRAFT DAMPERS - FABRIC**

- A. Fabric Backdraft Dampers: Factory-fabricated.
  1. Blades: Neoprene coated fabric material.
  2. Birdscreen: 1/2 inch nominal mesh of galvanized steel or aluminum.
  3. Maximum Velocity: 1000 fpm (5 m/sec) face velocity.
- B. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: galvanized steel or extruded aluminum, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

**2.05 COMBINATION FIRE AND SMOKE DAMPERS**

- A. Manufacturers:
  1. Louvers & Dampers, Inc: [www.louvers-dampers.com](http://www.louvers-dampers.com).
  2. Nailor Industries Inc: [www.nailor.com](http://www.nailor.com).
  3. Ruskin Company: [www.ruskin.com](http://www.ruskin.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A, UL 555, UL 555S, and as indicated.

- C. Provide factory sleeve and collar for each damper.
- D. Multiple Blade Dampers: Fabricate with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 inch actuator shaft.
- E. Operators: UL listed and labelled spring return electric type suitable for 120 volts, single phase, 60 Hz. Provide end switches to indicate damper position. Locate damper operator on interior of duct and link to damper operating shaft.
- F. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure.
- G. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of electro thermal link, flexible stainless steel blade edge seals to provide constant sealing pressure, stainless steel springs with locking devices to ensure positive closure for units mounted horizontally.
- H. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

## **2.06 DUCT ACCESS DOORS**

- A. Manufacturers:
  1. Nailor Industries Inc: [www.nailor.com](http://www.nailor.com).
  2. Ruskin Company: [www.ruskin.com](http://www.ruskin.com).
  3. SEMCO Incorporated: [www.semcoinc.com](http://www.semcoinc.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA 1966 and as indicated.
- C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
  1. Less Than 12 inches Square: Secure with sash locks.
  2. Up to 18 inches Square: Provide two hinges and two sash locks.
  3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
  4. Larger Sizes: Provide an additional hinge.
- D. Access doors with sheet metal screw fasteners are not acceptable.

## **2.07 DUCT TEST HOLES**

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## **2.08 FIRE DAMPERS**

- A. Manufacturers:
  1. Louvers & Dampers, Inc: [www.louvers-dampers.com](http://www.louvers-dampers.com).
  2. Nailor Industries Inc: [www.nailor.com](http://www.nailor.com).
  3. Ruskin Company: [www.ruskin.com](http://www.ruskin.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

- C. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.
- D. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.
- E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations or closure under air flow conditions. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.
- F. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- G. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

## 2.09 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA 1966 and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
  - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
    - a. Net Fabric Width: Approximately 6 inches wide.
  - 2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.
- C. Leaded Vinyl Sheet: Minimum 0.55 inch thick, 0.87 lbs per sq ft, 10 dB attenuation in 10 to 10,000 Hz range.

## 2.10 SMOKE DAMPERS

- A. Manufacturers:
  - 1. Louvers & Dampers, Inc: [www.louvers-dampers.com](http://www.louvers-dampers.com).
  - 2. Nailor Industries Inc: [www.nailor.com](http://www.nailor.com).
  - 3. Ruskin Company: [www.ruskin.com](http://www.ruskin.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with NFPA 90A and UL 555S, and as indicated.
- C. Dampers: UL Class 1 multiple blade type fire damper, normally closed automatically operated by electric actuator.
- D. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

## 2.11 VOLUME CONTROL DAMPERS

- A. Manufacturers:
  - 1. Louvers & Dampers, Inc: [www.louvers-dampers.com](http://www.louvers-dampers.com).
  - 2. Nailor Industries Inc: [www.nailor.com](http://www.nailor.com).
  - 3. Ruskin Company: [www.ruskin.com](http://www.ruskin.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fabricate in accordance with SMACNA 1966 and as indicated.
- C. Splitter Dampers:
  - 1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
  - 2. Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.

3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .
- D. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- F. 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.
- G. 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.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Verify that electric power is available and of the correct characteristics.

#### **3.02 INSTALLATION**

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA 1966. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust ducts in accordance with NFPA 96. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92.
  1. Smoke dampers shall be integrated into the "smoke purge control system". Dampers in the return ductwork shall be overridden to the open position when the smoke purge is activated.
- G. Demonstrate re-setting of fire dampers to Owner's representative.
- H. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- I. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment; see Section 22 05 48.
- J. For fans developing static pressures of 5.0 inches and over, cover flexible connections with leaded vinyl sheet, held in place with metal straps.
- K. 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.
- L. Use splitter dampers only where indicated.

- M. Provide balancing dampers on high velocity systems where indicated. Refer to Section 23 36 00 - Air Terminal Units.
- N. 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. Kitchen Ventilation Systems / Roof exhausters.
- B. Ceiling exhaust fans.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping Equipment.
- C. Section 23 33 00 - Air Duct Accessories: Backdraft dampers.
- D. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc..
- B. AMCA 204 - Balance Quality and Vibration Levels for Fans.
- C. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc. (ANSI/AMCA 210, same as ANSI/ASHRAE 51).
- D. AMCA (DIR) - [Directory of] Products Licensed Under AMCA International Certified Ratings Program; Air Movement and Control Association International, Inc..
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc..
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc..
- G. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association.
- H. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.
- I. UL 705 - Power Ventilators; Underwriters Laboratories Inc..

**1.04 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 clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Manufacturer's Instructions: Indicate installation instructions.
- D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 5 years of documented experience.
- B. Kitchen Range Hood Exhaust Fans: Comply with requirements of NFPA 96.
- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.06 FIELD CONDITIONS**

- A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

**1.07 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Supply two sets of belts for each fan.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Greenheck: [www.greenheck.com](http://www.greenheck.com).
- B. Loren Cook Company: [www.lorencook.com](http://www.lorencook.com).
- C. PennBarry: [www.pennbarry.com](http://www.pennbarry.com).
- D. American Coolair/ILG: [www.coolair.com](http://www.coolair.com)
- E. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 POWER VENTILATORS - GENERAL**

- A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.
- B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- C. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing AMCA Certified Sound Rating Seal.
- D. Fabrication: Conform to AMCA 99.
- E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**2.03 ROOF VENTILATORS, KITCHEN VENTILATION SYSTEMS**

- A. Product Requirements:
  1. Performance Ratings: Determined in accordance with AMCA 210 .
  2. Sound Ratings: AMCA 301, tested to AMCA 300.
  3. Fabrication: Conform to AMCA 99.
  4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- B. Performance and Model: As indicated on drawings.
  1. Motor: Refer to Section 23 05 13.
- C. 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.
- D. 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.
- E. Roof Curb: 20 inch high of galvanized steel with continuously welded seams, factory installed nailer strip.
- F. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor .
- G. Shunt Trip Breakers: Provide for each fan of 2,000 CFM or greater for interlock with Fire Alarm system.

- H. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
- I. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
- J. Make-up Air unit:
  - 1. Variable-volume direct-fired natural gas make-up air unit with spark ignition, discharge temperature control, and factory disconnect.

#### **2.04 CABINET AND CEILING EXHAUST FANS**

- A. Performance: As Indicated on drawings.
  - 1. Motor: Refer to Section 23 05 13.
- B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- C. Disconnect Switch: Cord and plug in housing for thermal overload protected motor .
- D. Grille: Molded white plastic or Aluminum with baked white enamel finish.
- E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof or wall exhausters with aluminum lag screws to roof curb or structure.
- C. Extend ducts to roof or wall exhausters into roof curb or structure. Counterflash duct to roof or wall opening.
- D. Hung Cabinet Fans:
  - 1. Install fans with resilient mountings and flexible electrical leads. Refer to Section 23 05 48.
  - 2. Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof and wall exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.

#### **END OF SECTION**



**SECTION 23 37 00**  
**AIR OUTLETS AND INLETS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Diffusers.
- B. Registers/grilles.
- C. Door grilles.
- D. Louvers.
- E. Goosenecks.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 90 00 - Painting and Coating: Painting of ducts visible behind outlets and inlets.

**1.03 REFERENCE STANDARDS**

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc..
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute.
- C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc..
- D. SMACNA 1966 - HVAC Duct Construction Standards.

**1.04 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.
- C. Samples: Submit one of each required air outlet and inlet type.
- D. Project Record Documents: Record actual locations of air outlets and inlets.

**1.05 QUALITY ASSURANCE**

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

**1.06 QUALITY ASSURANCE**

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

**1.07 MOCK-UP**

- A. Provide mock-up of typical exterior or exterior ceiling module with supply and return air outlets.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Carnes Company HVAC: [www.carnes.com](http://www.carnes.com).
- B. Krueger: [www.krueger-hvac.com](http://www.krueger-hvac.com).
- C. Price Industries: [www.price-hvac.com](http://www.price-hvac.com).

- D. Titus: [www.titus-hvac.com](http://www.titus-hvac.com).
- E. Tuttle and Bailey: [www.tuttleandbailey.com](http://www.tuttleandbailey.com).
- F. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.02 RECTANGULAR CEILING DIFFUSERS**

- A. Type: Square, stamped, multi-core diffuser to discharge air in 360 degree, one way, two way, three way or four way pattern as shown on drawings and with sectorizing baffles where indicated.
- B. Frame: Surface mount or inverted T-bar as indicated on drawings. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Aluminum with baked enamel off-white finish.
- D. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

## **2.03 PERFORATED FACE CEILING DIFFUSERS**

- A. Type: Perforated face with fully adjustable pattern and removable face.
- B. Frame: Surface mount or Inverted T-bar as indicated on drawings. In plaster ceilings, provide plaster frame and ceiling frame.
- C. Fabrication: Steel with steel or aluminum frame and baked enamel off-white finish.
- D. Accessories: Radial opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

## **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. Frame: 1 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum extrusions with factory off-white enamel or prime coat finish as indicated on drawings or selected by architect.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

## **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 45 degrees, horizontal face.
- B. Frame: 1 inch margin with countersunk screw mounting.
- C. Fabrication: Aluminum extrusions, with factory off-white enamel, baked enamel, or prime coated finish as indicated on drawings or selected by architect.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans.
- E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

## **2.06 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvers.
- B. Fabrication: Acrylic plastic with off-white finish.
- C. Frame: Channel lay-in frame for suspended grid ceilings.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

**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, horizontal face, double deflection.
- B. Frame: 1 inch margin with countersunk screw mounting and gasket.
- C. Fabrication: Aluminum extrusions, with factory off-white enamel, baked enamel, prime coat or clear lacquer finish as indicated on drawings or selected by architect.
- D. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face.
- E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

**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, horizontal face.
- B. Frame: 1 inch margin with countersunk screw mounting.
- C. Fabrication: Aluminum extrusions, with factory off-white enamel, baked enamel, prime coated or clear lacquer finish as indicated on drawings or selected by architect.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.
- E. Gymnasiums: Provide front pivoted or welded in place blades, securely fastened to be immobile.

**2.09 WALL GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvers.
- B. Fabrication: Aluminum with factory clear lacquer, off-white enamel or baked enamel finish as indicated on drawings or selected by architect.
- C. Frame: 1 inch margin with countersunk screw mounting.
- D. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

**2.10 DOOR GRILLES**

- A. Type: V-shaped louvers of 20 gage, 0.0359 inch thick steel, 1 inch deep on 1/2 inch centers.
- B. Frame: 20 gage, 0.0359 inch steel with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

**2.11 LOUVERS**

- A. Type: 4 inch or 6 inch deep as indicated on drawings with blades on 45 degree slope, heavy channel frame, 1/2 inch square mesh screen over exhaust and 1/2 inch square mesh screen over intake.
- B. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory prime coat, baked enamel, anodized or fluoropolymer spray finish as indicated on drawings or selected by architect.
- C. Mounting: Furnish with exterior angle flange, screw holes in jambs or masonry strap anchors for installation.

**2.12 GOOSENECKS**

- A. Fabricate in accordance with SMACNA 1966 of minimum 18 gage, 0.0598 inch galvanized steel.

- B. Mount on minimum 12 inch high curb base where size exceeds 9 x 9 inch.

### **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 conform 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. Refer to Section 09 90 00.

#### **3.02 AIR OUTLET AND INLET SCHEDULE**

- A. See Drawings

**END OF SECTION**

**SECTION 23 73 13****MODULAR CENTRAL-STATION AIR-HANDLING UNITS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Factory fabricated assembly of modular sections consisting of housed centrifugal or plenum fans with belt or direct drives, coils, filters, and other necessary modules to perform one or more of the functions of circulating, cleaning, heating, cooling, humidification, dehumidification, and mixing of air with construction suitable for indoor or outdoor applications.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- C. Section 23 07 19 - HVAC Piping Insulation.
- D. Section 23 33 00 - Air Duct Accessories: Flexible duct connections.
- E. Section 23 40 00 - HVAC Air Cleaning Devices.
- F. Section 23 82 00 - Convection Heating and Cooling Units: Air Coils.
- G. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.
- H. Section 26 29 23 - Variable Frequency Motor Controllers:

**1.03 REFERENCE STANDARDS**

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc..
- B. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; Air-Conditioning, Heating, and Refrigeration Institute.
- C. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc..
- D. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc. (ANSI/AMCA 210, same as ANSI/ASHRAE 51).
- E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc..
- F. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating.
- G. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- H. ASHRAE Std 62.1 - Ventilation For Acceptable Indoor Air Quality.
- I. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings (ANSI/ASHRAE/IES Std 90.1).
- J. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate the installation of all units with size, location and installation of service utilities.
- B. Coordinate the work with other trades for installation of roof mounted air handling units on roof curbs.
- C. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- D. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

**1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data:
  - 1. Published Literature: Indicate dimensions, weights, capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
  - 2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
  - 3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
  - 4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
  - 5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- D. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- E. Manufacturer's Instructions: Include installation instructions.
- F. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.
- G. 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 Fan Belts: One set for each unit.
  - 3. Extra Filters: One set for each unit.

**1.06 QUALITY ASSURANCE**

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

**1.07 REGULATORY REQUIREMENTS**

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

**PART 2 PRODUCTS****2.01 SEE SECTION 01 60 00 FOR ADDITIONAL REQUIREMENTS.****2.02 MANUFACTURERS**

- A. Daikin Applied; \_\_\_\_\_: [www.daikinapplied.com](http://www.daikinapplied.com).
- B. Trane Inc; \_\_\_\_\_: [www.trane.com](http://www.trane.com).
- C. York by Johnson Controls Inc; \_\_\_\_\_: [www.johnsoncontrols.com](http://www.johnsoncontrols.com).

**2.03 GENERAL DESCRIPTION**

- A. Components:

1. Casing construction.
2. Fan section.
3. Coil section.
4. Filter and air cleaner section.
5. Damper section.
6. Access section.
7. Controls.

B. Fabrication: Conform to AMCA 99 and AHRI 430.

## **2.04 CASING CONSTRUCTION**

A. Full Perimeter Base Rail:

1. Construct of galvanized steel.
2. Provide base rail of sufficient height to raise unit for external trapping of condensate drain pans.

B. Casing:

1. Construct of one piece, insulated, double wall panels.
2. Provide mid-span, no through metal, internal thermal break.
3. Construct outer panels of galvanized steel and inner panels of galvanized steel.
4. Casing Air Pressure Performance Requirements:

C. Access Doors:

1. Construction, thermal and air pressure performance same as casing.
2. Provide surface mounted handles on hinged, swing doors.

D. Unit Flooring: Construct with sufficient strength to support expected people and equipment loads associated with maintenance activities.

E. Casing Leakage: Seal all joints and provide airtight access doors so that air leakage does not exceed one percent of design flow at the specified casing pressure.

F. Insulation:

1. Provide minimum thermal thickness of 12 R throughout.
2. Completely fill all panel cavities in all directions preventing voids and settling.
3. Comply with NFPA 90A.

G. Drain Pan Construction:

1. Provide cooling coil sections with an insulated, double wall, galvanized steel drain pan complying with ASHRAE 62.1 for indoor air quality and sufficiently sized to collect all condensate.
2. Slope in two planes to promote positive drainage and eliminate stagnate water conditions.
3. Locate outlet of sufficient diameter at lowest point of pan to prevent overflow at normal operating conditions.
4. Provide threaded drain connections constructed of drain pan material, extended sufficient distance beyond the base to accommodate field installed, condensate drain trapping.

H. Finish:

## **2.05 FAN SECTION**

A. Type: Forward curved, single width, single inlet, centrifugal type fan.

B. Performance Ratings: Determined in accordance with AMCA 210 and labeled with AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301; tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.

D. Bearings: Self-aligning, grease lubricated, with lubrication fittings extended to exterior of casing with plastic tube and grease fitting rigidly attached to casing.

- E. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through removable casing panels or hinged access doors. Provide built-in inertia base of welded steel with bottom sheet and reinforcing grid for concrete ballast. Mount base on vibration isolators; refer to Section 23 05 48.
- F. Flexible Duct Connections: For separating fan and coil, and adjacent sections; refer to Section 23 33 00.
- G. Drives:
  1. Bearings: Heavy duty pillow block type, ball bearings, with ABMA 9 L-10 life at 50,000 hours.
  2. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
  3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

## 2.06 COIL SECTION

- A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.
- B. Drain Pans: 24 inch downstream of coil and down spouts for cooling coil banks more than one coil high.
- C. Eliminators: Three break of galvanized steel, mounted over drain pan.
- D. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410. Refer to Section 23 82 00.
- E. Fabrication:
  1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
  2. Fins: Aluminum.
  3. Casing: Die formed channel frame of galvanized steel.
- F. Water Heating Coils:
  1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
  2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.
- G. Refrigerant Coils:
  1. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
  2. Headers: Seamless copper tubes with silver brazed joints.
  3. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
  4. Configuration: Down feed with bottom suction.

## 2.07 FILTER AND AIR CLEANER SECTION

- A. General: Provide filter sections with filter racks, minimum of one access door for filter removal, and filter block-offs to prevent air bypass.
- B. Throwaway Filters:
  1. Media: 2 inch fiberglass with rigid supporting mesh across the leaving face, capable of operating up to a maximum of 500 fpm without loss of efficiency and holding capacity.
  2. Frame: Rigid.

3. Minimum Efficiency Reporting Value: 10 MERV when tested in accordance with ASHRAE 52.2.
  4. Refer to Section 23 40 00.
- C. Differential Pressure Gage:
1. Provide factory installed dial type differential pressure gage, flush mounted with casing outer wall, and fully piped to both sides of each filter to indicate status.
  2. Maintain plus/minus 5 percent accuracy within operating limits of 20 degrees F to 120 degrees F.

## 2.08 DAMPER SECTION

- A. Mixing Section: Provide a functional section to support the damper assembly for modulating the volume of outdoor, return, and exhaust air. See drawings for exact configuration.
- B. Damper Blades:
1. Double-skin airfoil design with metal, compressible jamb seals and extruded-vinyl blade-edge seals on all blades.
  2. Self-lubricating stainless steel or synthetic sleeve bearings.
  3. Comply with ASHRAE 90.1 for rated maximum leakage rate.
  4. Base all leakage testing and pressure ratings on AMCA 500-D.
  5. Arrange in parallel or opposed-blade configuration.
- C. Provide 24V damper actuators by Belimo or equal.

## 2.09 ACCESS SECTION

- A. Provide access at all critical components. to allow for inspection, cleaning, and maintenance of field installed components.
- B. Construct access doors same as previously specified within this Section.

## 2.10 CONTROLS

- A. Combination VFD - Disconnects:
1. Provide factory mounted, combination VFD - disconnect in accordance with Section 26 29 23 for each fan motor.
  2. Factory mount in full metal enclosure and wire to fan motor.
  3. Mount VFD-disconnect on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
    - a. Internal Enclosure Construction Characteristics:
      - 1) Integral part of unit casing to allow for thermal venting to casing interior.
      - 2) Accessible from unit exterior via access door.
      - 3) Construction of access doors same throughout unit.
  4. Include circuit breaker disconnect with through-the-door interlocking handle for externally mounted starters, spring loaded, and designed to rest only in the full and lockable ON or OFF state.
  5. Include control transformer with sufficient capacity to support the following items:
    - a. VFD and controls.
    - b. Binary output on-off wiring.
    - c. Analog output speed-signal wiring.
    - d. All interfacing wiring between the VFD and the direct digital controller.
  6. Mount starter on fan section externally in a NEMA 1 enclosure within a dedicated controls section or housed fan section.
- B. Provide 24V control transformer and terminal strip for all necessary control functions.
- C. Prepare unit for controller installed by BAS contractor.

**PART 3 EXECUTION****3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Bolt sections together with gaskets.
- C. Isolate fan section with flexible duct connections.
- D. Install flexible duct connections between fan inlet and discharge ductwork and air handling unit sections. Ensure that metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- E. Install assembled unit on vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as required. Refer to Section 23 05 48. Adjust snubbers to prevent tension in flexible connectors when fan is operating.
- F. Make connections to coils with unions or flanges.
- G. Hydronic Coils:
  - 1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
  - 2. Provide shut-off valve on supply line and lockshield balancing valve with memory stop on return line.
  - 3. Locate water supply at bottom of supply header and return water connection at top.
  - 4. Provide manual air vents at high points complete with stop valve.
  - 5. Ensure water coils are drainable and provide drain connection at low points.
- H. Refrigerant Coils: Provide sight glass in liquid line within 12 inches of coil.
- I. Insulate coil headers located outside air flow as specified for piping. Refer to Section 23 07 19.

**END OF SECTION**

**SECTION 23 74 13****PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Packaged VAV multizone roof top unit.
- B. Unit controls.
- C. Remote panel.
- D. Mounting curb and base.
- E. Maintenance service.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 62 00 - Sheet Metal Flashing and Trim.
- B. Section 23 05 13 - Common motor requirements for HVAC Equipment.
- C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- D. Section 23 40 00 - HVAC Air Cleaning Devices.
- E. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Control components, time clocks.
- F. Section 23 09 13 - Instrumentation and Control Devices for HVAC: Installation of thermostats and other controls components.
- G. Section 26 27 17 - Equipment Wiring: Installation and wiring of thermostats and other controls components; wiring from unit terminal strip to remote panel.
- H. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- B. AHRI 270 - Sound Rating of Outdoor Unitary Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association.

**1.04 SUBMITTALS**

- A. See Section 01 33 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. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- D. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

**1.07 WARRANTY**

- A. Provide a five year warranty to include coverage for refrigeration compressors and heat exchangers.

**1.08 MAINTENANCE SERVICE**

- A. Furnish service and maintenance of packaged roof top units for one year from Date of Substantial Completion.
- B. Provide maintenance service with a two month interval as maximum time period between calls. Provide 24-hour emergency service on breakdowns and malfunctions.
- C. 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.
- D. Submit copy of service call work order or report, and include description of work performed.

**1.09 EXTRA MATERIALS**

- A. Provide two sets of filters.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Trane
- B. York
- C. Seasons 4
- D. Valent Incorporated

**2.02 MANUFACTURED UNITS**

- A. General: Roof mounted packaged units having gas burner primary heating as scheduled, electric tempering reheat, and electric refrigeration.
- B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, return fan, heat exchanger and burner, , energy recovery wheel (where noted in the schedule), factory-mounted controls, air filters, variable-air volume zone terminals with electric tempering reheat, refrigerant cooling coil and variable-speed compressors and hot-gas reheat circuits, condenser coil and condenser fan as scheduled.
- C. Disconnect Switch: Factory mount disconnect switch on equipment under provisions of Section 26 27 17.

**2.03 FABRICATION**

- A. Cabinet: Zinc coated, heavy-gauge galvanize Steel with baked enamel finish, including access panels with screwdriver operated flush cam type fasteners. Structural members shall be minimum 18 gage, 0.0478 inch, with access doors or panels of minimum 20 gage, 0.0359 inch.
- B. Access shall be limited to one side of the unit for all maintenance requirements.

- C. Insulation: two inch thick minimum glass fiber or injected foam, double-walled unit construction.
- D. Supply and Return and Exhaust Fan as scheduled: Forward curved, resiliently mounted with V-belt drive and adjustable variable pitch motor pulley, and rubber isolated hinge mounted high efficiency motor or direct drive as indicated. Isolate complete fan assembly. Provide factory-mounted variable-frequency drives for all fan motors.
- E. Air Filters: Minimum efficiency reporting value (MERV) of at least 10.
- F. Roof Mounting Curb: Minimum 14 inches high galvanized steel adapter curb, channel frame with gaskets, nailer strips, cutsum fabricated to match existing roof penetrations and duct connections.

#### **2.04 BURNER**

- A. Gas Burner: Forced draft type modulating 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 shut-off pilot. Provide turndown ratio as indicated in the schedule. Provide condensing burners as indicated in schedule.
- 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 air flow proven and slight delay, allow gas valve to open.
- C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, with provisions for continuous fan operation.

#### **2.05 EVAPORATOR OR INDOOR COILS**

- A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection for cooling coils.
- B. Provide 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.

#### **2.06 COMPRESSOR**

- 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 gage ports, and filter drier.
- B. Five minute timed off circuit to delay compressor start.
- C. Outdoor thermostat to energize compressor above 35 degrees F ambient.
- D. Provide step capacity control by variable-speed scroll technology and/or adjusting variable-speed compressors.
- E. Refrigerant shall be R 410A

#### **2.07 CONDENSER OR OUTDOOR COIL**

- A. Provide copper tube aluminum or copper fin coil assembly with subcooling rows and coil 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.
- C. Provide refrigerant pressure switches to cycle condenser fans.

#### **2.08 MIXED AIR CASING**

- A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper to fall to closed position.

- B. Gaskets: Provide tight fitting dampers with edge gaskets.
- C. Damper Operator, Units 7.5 Ton Cooling Capacity and Larger: 24 volt with gear train sealed in oil with spring return on.
- D. Outdoor airflow monitoring station: Provided at intake of the unit.
- E. Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position on call for heating and above 70 degrees (F) ambient, or when ambient air enthalpy exceeds return air enthalpy.

## **2.09 OPERATING CONTROLS**

- A. Provide factory controller and all necessary sensors and components for operation of refrigerant system, fan VFDs based on static-pressure feedback, energy recovery wheel, humidity control function, and economizer function. The humidity control (dehumidification sequence) shall be capable of being enabled when the unit is in both heating and cooling modes. The humidistat setpoint shall govern control of this sequence.
- B. Provide BACnet interface on unit for connection of operating controls for BAS control. Control shall allow for modulating heating via the gas-fired burner and modulating stages cooling, fan, and damper control. See section 23 09 93 for required data to be relayed to the BAS for monitoring and control.
- C. Provide remote mounted fan control switch for smoke-purge for each unit (on-auto) to activate only the exhaust fan at each unit, keep the outdoor air damper closed, and de-energize the energy wheel.
- D. See Specification Section 230993 - Sequence Of Operations, paragraphs 3.08 and 3.11 for required operating capabilities of the units.

## **2.10 INTEGRAL ZONE DAMPERS / TEMPERING HEATERS**

- A. Extruded aluminum airfoil type with blade edge and jam seals. Control shaft shall be 1/2" diameter rod extending at least 6" beyond the frame. Leakage rate of 6 CFM/SF maximum at 1" WG.
- B. Actuators shall be Belimo LMB24 3-Wire 24VAC actuators with floating point, quarter turn linkage release button. Constant drive rate independent of load, rated torque as required for the application.
- C. Electric zoned tempering reheats shall be provided for each zone and be sized for a minimum 30 degree F temperature rise at 30% airflow. The control inputs for the heaters shall be wired to each independent zone's UCM board. Each heater is single stage on/off control. The heaters shall be fused and wired back to the the main unit power supply to create a single-point power supply for the entire system. Each heater shall be equipped with an airflow switch and high temperature limits for safeties.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that roof is ready to receive work and opening dimensions are as indicated on shop drawings or illustrated by the 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.

- D. Locate remote panels where identified in field coordination meeting.
- E. Tie unit into BAS as specified.

### **3.03 SYSTEM STARTUP**

- A. Prepare and start equipment. Adjust for proper operation.

### **3.04 CLOSEOUT ACTIVITIES**

- A. Demonstrate operation to Owner's maintenance personnel.

### **3.05 MAINTENANCE**

- A. Provide service and maintenance of packaged roof top units for one year year from Date of Substantial Completion.
- B. Provide routine maintenance service with a three month interval as maximum time period between calls.
- C. 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.
- D. 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 01**  
**TERMINAL HEAT TRANSFER UNITS**

**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Unit ventilators.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 21 13 - Hydronic Piping.
- C. Section 23 21 14 - Hydronic Specialties.
- D. Section 23 09 93 - Sequence of Operations for HVAC Controls.
- E. Section 26 27 17 - Equipment Wiring: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

**1.03 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
  - 1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
  - 2. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
  - 3. Indicate mechanical and electrical service locations and requirements.,
- D. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- E. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access or valving.
- F. Operation and Maintenance Data: Include manufacturers descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.05 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturers warranty for all motors.
- C. Provide one year parts and labor warranty for entire unit, from substitute and completion.

**1.06 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Provide three (3) sets of filters, with a final change immediately prior to occupancy.

**PART 2 PRODUCTS****2.01 VERTICAL PACKAGED UNIT VENTILATORS****A. MANUFACTURERS**

1. Basis of Design: Bard Manufacturing [I-Tec]: [www.bardhvac.com](http://www.bardhvac.com)
2. Provide equal by Marvair, Inc. or Modine / Airedale.
3. Substitutions: See Section 01 60 00 - Product Requirements.

**B. AIR CONDITIONING UNITS**

1. Description: AHRI Certified, Packaged, self-contained, factory assembled, prewired unit, consisting of cabinet, compressor, condensing coil, evaporator fan, evaporator coil, outside air connection, hydronic heating coil, air filters, and controls; fully charged with refrigerant and filled with oil.
2. Assembly: Up flow air delivery, in draw-through configuration as indicated.
3. Electrical Characteristics: As Scheduled.
  - a. Refer to Section 26 27 17.
  - b. Disconnect Switch: The unit shall be fitted with a factory mounted power disconnect switch located on the control panel, sized for the full load amperage of the unit to enable the unit to be disconnected from the power supply prior to any maintenance. In the off position the switch can be locked out.

**C. CABINET**

1. The cabinet shall be constructed from galvanized sheet steel. The cabinet shall be degreased and coated with a dry powder, epoxy resin paint, baked after application, standard color shall be hammertone beige. The paint finish shall be easily cleanable and hard wearing to give maximum protection. The cabinet shall be insulated with acoustic foam insulation containing no fibrous materials. The foam insulation shall have a fire rating of UL94HF-1.
2. The front of the unit shall contain a low-level return air grille integral to the front of the doors and a sound attenuating inlet plenum. The doors shall be hinged with a spring-loaded pin to allow for easy removal if required. Doors shall be secured with a key lock.
3. The rear of the unit shall allow for high sill outside air discharge (up to 38"). A condensate connection stub shall also be provided internally at the rear of the unit for connection to the field installed building condensate drain.
4. The supplied product shall be a self-contained air conditioning unit available as a DX cooling only or a heat pump unit ventilator with options for electric heating, hot water, or steam (plenum mount only) heating. The unit shall be floor-mounted and vertically sized to allow the supply air to be ducted or supplied through a high level plenum. All access and maintenance shall be through the front of the unit. The unit shall be engineered to provide one stage of free cooling and three stages of mechanical cooling. Heat pump units shall also offer two stages of mechanical heating with automatic defrost control. The unit shall meet the Department of Energy (DOE) 13 SEER minimum standard for central air conditioning and heat pump units. The unit shall be constructed in accordance with ETL & CSA standards, and a label shall be affixed to the unit listing the product code under which it is registered. The unit shall be a product of ISO: 9001 quality control program and be fully assembled and tested prior to shipment.
5. Unit color: Color shall be selected from the manufacturer's unit color chart by Architect/Engineer.

**D. COMPRESSOR**

1. The refrigeration system shall contain a one or two stage hermetic scroll compressor equipped with a crankcase heater to guard against liquid flood-back conditions and the elimination of oil foaming upon start up. The compressor shall contain an internal

unloading mechanism to provide capacity control and enable part load efficiencies to be increased. An internal overload protector shall protect the compressor against excessive motor temperatures and currents. The compressor shall also be mounted on 125# all neoprene vibration absorbers for quiet operation.

2. Hot gas reheat shall be provided and installed to control humidity within the space.

E. REFRIGERANT COILS

1. The unit shall contain an enhanced, high efficiency, cross-rifle tubed condenser coil. The unit shall also contain a quick draining evaporator coil. Both coils shall be ideally positioned for optimal airflow and heat transfer, and fitted to stainless steel drain trays.

F. FANS & FAN MOTOR

1. The indoor fan assembly shall consist of two blowers and one common-shafted electronically commutated motor (ECM). The ECM motor shall have a wide range of programmable speed and torque characteristics for ultra high efficiency and low audible noise. The ECM motor provides constant airflow by automatically adjusting the speed if the external static pressure changes. The DC motor features a brushless, permanently lubricated ball bearing construction for maintenance free operation. The ECM motor shall also be fully programmed to compensate for a wide variety of static pressures as well as lack of maintenance (dirty air filters). The outdoor fan assembly shall consist of two backward curved plug fans with centrifugal blower wheels fitted with electronic speed control to allow for airflow adjustment.

G. FILTER

1. Each unit shall be fitted with 2" thick pleated disposable synthetic filters designed to meet ASHRAE standard 52-76, 90% arrestance with a Minimum Efficiency Reporting Value (MERV) 8 rating. The filter shall be treated with a durable, low toxicity, broad-spectrum antimicrobial that inhibits the growth of bacteria and fungi on the filter surfaces.

H. ECONOMIZER

1. Each unit shall be fitted with a spring return modulating damper that acts to mix the outdoor air with the return air. The damper shall have the capability of permitting only the outside air into the space, or recycling the return air and allowing only a minimum of outside air to enter the space. Full modulation allowing any mixture of outside air and return air shall be possible. A minimum damper position setting shall also be possible to continuously maintain outside air ventilation requirements dependent on control via the unit's microprocessor controller.

I. CONTROL PANEL

1. A. Located at the top of the unit behind the front door, the control panel shall contain a 24-volt control circuit transformer and all necessary contactors, relays and circuit breakers to provide the necessary control. All components located in the panel shall be clearly marked for easy identification. All terminal blocks and wires shall be individually numbered. All electrical wires in the control panel shall be run in an enclosed trough. Wiring outside the control panel shall be run in a protective sleeve. Powered Exhaust Powered exhaust shall be integral to the unit to prevent over pressurization of the space with the exhaust fan capable of exhausting 100% equivalent of the fresh air.

J. POWERED EXHAUST

1. Powered exhaust shall be integral to the unit to prevent over pressurization of the space with the exhaust fan capable of exhausting 100% equivalent of the fresh air.

K. MICROPROCESSOR CONTROLS

1. The unit shall be fitted with a programmable microprocessor controller mounted outside the air stream and specifically designed to operate the unit in an energy efficient manner using pre-engineered control strategies. The microprocessor shall determine mode of operation based on the return air, supply air, and ambient air temperatures. The

microprocessor controller shall be capable of managing the unit in each of the following modes of operation:

2. Free Cooling
  3. Stage One Mechanical Cooling: 67% capacity compressor, low speed supply fan
  4. Stage Two Mechanical Cooling: 100% capacity compressor, low speed supply fan
  5. Stage Three Mechanical Cooling: 100% capacity compressor, high speed supply fan
- L. Hydronic Heating: High speed supply fan
1. Microprocessor Controls - BacNet Plug-In Card - Unit shall come equipped with a plug-in card allowing for complete compatibility with MS/TP BacNet control system.
  2. HOT WATER HEATING COIL, CONTROL VALVE, AND VALVE PACKAGES
    - a. A hot water heating coil shall be factory mounted integral to the unit. The coil shall be constructed of copper tubes with aluminum fins. Capacity control shall be achieved by three way modulating valve. The valve package shall include factory piped circuit setter, manual shut off valves, strainer and drain with hose bib.
  3. HOT WATER FREEZE PROTECTION
    - a. The unit shall be fitted with a coil-covering serpentine freeze-stat to prevent any freezing of the hot water coil assembly. When the sensor detects a freeze up condition it shall shut the damper and force the flow control valve open and prevent the unit fans from running.
  4. 2CONDENSER COIL FILTER
    - a. A wire framed synthetic filter shall be fitted across the inlet of the outdoor coils. This shall be reusable and may be vacuum cleaned. Available on DX cooling units only.

## 2.02 ACCESSORIES (FIELD INSTALLED)

- A. Wall Sleeve
  1. The wall sleeve shall be constructed from galvanized steel. An interior separator plate running the entire length of the sleeve shall separate the fresh air inlet from the exhaust air. The sleeve shall be provided by Manufacturer and insulated by the installing contractor with foil back insulation.
- B. Outdoor Louver
  1. Provided as part of the curtainwall system.

## 2.03 CONTROLS

- A. Factory wired controls shall include contactor, high and low pressure cutouts, internal winding thermostat for compressor, humidistat, control circuit transformer, non-cycling reset relay.
- B. Contacts for control from BAS provided DDC controller, 24v control transformer. 24vac fan relay, damper actuators.
- C. Provide low voltage adjustable thermostat to control compressor and supply fan to maintain temperature setting. Include system selector switch.
- D. Refer to Section 23 09 13, 23 09 23, and 23 09 93 for requirements of the unit to interface with the BAS.

## PART 3 EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Do not damage equipment or finishes.
- C. Protection: Provide finished cabinet units with protective covers during balance of construction.

- D. Finned Tube Radiation: Locate on outside walls and run cover wall-to-wall unless otherwise indicated. Center elements under windows. Install 6' AFF in group toilet rooms. Install wall angles where units butt against walls.
- E. Unit Ventilators: Locate as indicated, level and shim units, and anchor to structure. Coordinate exact location of wall louvers.
- F. Hydronic Units: Provide with shut-off valve on supply and lockshield balancing valve on return piping. If not easily accessible, extend vent to exterior surface of cabinet for easy servicing. For cabinet unit heaters, fan coil units, and unit heaters, provide float operated automatic air vents with stop valve.
- G. Units with Cooling Coils: Connect drain pan and auxilliary drain pan to condensate drain.

### **3.02 CLEANING**

- A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
- C. Install new filters.

**END OF SECTION**



**SECTION 23 81 29****VARIABLE REFRIGERANT VOLUME (VRV) HVAC SYSTEM****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Variable refrigerant volume HVAC system includes:
  - 1. Outdoor/Condensing unit(s).
  - 2. Indoor/Evaporator units.
  - 3. Branch selector units.
  - 4. Refrigerant piping.
  - 5. Control panels.
  - 6. Control wiring.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 23 00 - Alternates: List of alternates relevant to this section.
- B. Section 01 79 00 - Demonstration and Training.
- C. Section 01 91 13 - General Commissioning Requirements.
- D. Section 01 91 14 - Commissioning Authority Responsibilities.
- E. Section 22 10 05 - Plumbing Piping: Condensate drain piping.
- F. Section 22 30 00 - Plumbing Equipment: Cooling condensate removal pumps.
- G. Section 23 08 00 - Commissioning of HVAC.
- H. Section 23 23 00 - Refrigerant Piping and Specialties: Additional requirements for refrigerant piping system.
- I. Section 26 27 17 - Equipment Wiring: Power connections to equipment.
  - 1. Provide separate power connections for each unit of equipment.
- J. Section 23 09 23 and 23 09 93: Building automation system providing centralized control of this system.

**1.03 REFERENCE STANDARDS**

- A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; Air-Conditioning, Heating, and Refrigeration Institute.
- B. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals.
- C. ASHRAE Std 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings; American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc (ANSI/ASHRAE/
- D. NFPA 70 - National Electrical Code; National Fire Protection Association.
- E. UL 1995 - Heating and Cooling Equipment.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

**1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Pre-Bid Submittals: For proposed substitute systems/products, as defined in PART 2, and alternate systems/products, as defined above, proposer shall submit all data described in this article, under the terms given for substitutions stated in PART 2.
- C. Design Data:

1. Provide design calculations showing that system will achieve performance specified.
  2. Provide design data required by ASHRAE 90.1.
- D. Product Data: Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings shown in the contract documents:
1. Control Panels: Complete description of options, control points, zones/groups.
- E. Specimen Warranty: Copy of manufacturer's warranties.
- F. Shop Drawings: Installation drawings custom-made for this project; include as-designed HVAC layouts, locations of equipment items, refrigerant piping sizes and locations, condensate piping sizes and locations, remote sensing devices, control components, electrical connections, control wiring connections. Include:
1. Detailed piping diagrams, with branch balancing devices.
  2. Condensate piping routing, size, and pump connections.
  3. Detailed power wiring diagrams.
  4. Detailed control wiring diagrams.
  5. Locations of required access through fixed construction.
  6. Drawings required by manufacturer.
- G. Operating and Maintenance Data:
1. Manufacturer's complete standard instructions for each unit of equipment and control panel.
  2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
  3. Identification of replaceable parts and local source of supply.
- H. Project Record Documents: Record the following:
1. As-installed routing of refrigerant piping and condensate piping.
  2. Locations of access panels.
  3. Locations of control panels.
- I. Warranty: Executed warranty, made out in Owner's name.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.
  2. Company that provides system design software to installers.
- B. Installer Qualifications: Trained and approved by manufacturer of equipment.

#### **1.07 DELIVERY, STORAGE AND HANDLING**

- A. Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

#### **1.08 WARRANTY**

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Compressors: Provide manufacturer's warranty for six (6) years from date of installation. During the stated period, should any part fail due to defects in material and workmanship, it shall be repaired or replaced by the manufacturer. All warranty service work shall be preformed by a factory trained service professional.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Basis of Design: The system design shown in the contract documents is based on equipment and system designed by LG Industries.
- B. Acceptable manufacturers:
  - 1. Daikin AC: [www.daikinac.com](http://www.daikinac.com)
  - 2. LG Industries: [www.lg-vrf.com](http://www.lg-vrf.com)
  - 3. Mitsubishi Electric: [mitsubishipro.com](http://mitsubishipro.com)
  - 4. Samsung: [www.www.samsungaccentre.com](http://www.www.samsungaccentre.com)
  - 5. Trane Corporation: [www.trane.com](http://www.trane.com)
- C. For systems proposed by other manufacturers, all required modifications to the design and installation shall be the responsibility of the contractor and supplier for both costs and coordination with all other contractors and designers. These changes include, but are not limited to:
  - 1. Changes in refrigerant piping sizes, lengths, and locations.
  - 2. Changes in branch selector quantities, locations, and accessibility.
  - 3. Changes in electrical requirements, including all power wiring, terminations, breakers, disconnects, and control wiring.
  - 4. Changes in heat-pump unit locations and quantities.
  - 5. Changes in structural supports, vibration isolation, and hangers.
  - 6. Changes to the drawings to reflect the new system parameters.

### **2.02 HVAC SYSTEM DESIGN**

- A. System Operation: Heating and cooling, simultaneously.
  - 1. Zoning: Provide capability for temperature control for each individual indoor/evaporator unit independently of all other units.
  - 2. Zoning: Provide heating/cooling selection for each individual indoor/evaporator unit independently of all other units.
  - 3. Provide a complete functional system that achieves the specified performance based on the specified design conditions and that is designed and constructed according to the equipment manufacturer's requirements.
  - 4. Conditioned spaces are shown on the drawings.
  - 5. Branch selector unit locations are shown on the drawings for reference only. Final design locations shall be coordinated in the field to ensure optimized line lengths and maintenance access.
  - 6. Required equipment unit capacities are shown on the drawings.
  - 7. Refrigerant piping sizes shown on the drawings are for general reference only. Final line sizing shall be the responsibility of the successful contractor and manufacturer.
  - 8. Connect equipment to condensate piping; condensate piping is shown on the drawings.
- B. Cooling Mode Interior Design Performance:
  - 1. Daytime Setpoint: 74 degrees F, plus or minus 2 degrees F.
  - 2. Setpoint Range: 57 degrees F to 80 degrees F.
  - 3. Night Setback: 78 degrees F.
  - 4. Interior Relative Humidity: 50 percent, maximum.
- C. Heating Mode Interior Design Performance:
  - 1. Daytime Setpoint: 70 degrees F, plus or minus 2 degrees F.
  - 2. Setpoint Range: 59 degrees F to 76 degrees F.
  - 3. Night Setback: 60 degrees F.
  - 4. Interior Relative Humidity: 20 percent, minimum.

- D. Outside Air Design Conditions:
  1. Summer Outside Air Design Temperature: 0.4 percent cooling design condition listed in ASHRAE Fundamentals Handbook.
- E. Operating Temperature Ranges:
  1. Simultaneous Heating and Cooling Operating Range: minus 4 degrees F to 60 degrees F dry bulb.
  2. Cooling Mode Operating Range: minus 4 degrees F to 110 degrees F dry bulb.
  3. Heating Mode Operating Range: 0 degrees F to 77 degrees F dry bulb; minus 4 degrees F to 60 degrees F wet bulb; without low ambient controls or auxiliary heat source.
- F. Refrigerant Piping Lengths: Provide equipment capable of serving system with following piping lengths without any oil traps:
  1. Minimum Piping Length from Outdoor/Central Unit(s) to Furthest Terminal Unit: 540 feet, actual; 620 feet, equivalent.
  2. Total Combined Liquid Line Length: 3280 feet, minimum.
  3. Minimum Piping Length Between Indoor Units: 49 feet.
- G. Controls: Provide the following control interfaces:
  1. For Each Indoor/Evaporator Unit: One wall-mounted wired "local" controller, with temperature sensor; locate where directed, in each space.
  2. One central remote control panel for entire system; locate where indicated.
  3. BACNet gateways and interfaces sufficient to connect all units to building automation system by others; include wiring to gateways.
  4. Building automation system by HVAC system manufacturer ; provide one user stations located where indicated.
- H. Local Controllers: Wall-mounted, wired, containing temperature sensor, setpoint adjustment (with central control override, maximum temperature adjustment +1/-1 degree, adjustable), and temperature display.

## 2.03 EQUIPMENT

- A. All Units: Factory assembled, wired, and piped and factory tested for function and safety.
  1. Refrigerant: R-410A.
  2. Performance Certification: AHRI Certified; [www.ahrinet.org](http://www.ahrinet.org).
  3. Safety Certification: Tested to UL 1995 by UL or Intertek-ETL and bearing the certification label.
  4. Provide outdoor/condensing units capable of serving indoor unit capacity up to 200 percent of the capacity of the outdoor/condensing unit.
  5. Provide units capable of serving the zones indicated.
  6. Thermal Performance: Provide heating and cooling capacity as indicated, based on the following nominal operating conditions:
  7. Energy Efficiency: Report EER and COP based on tests conducted at "full load" in accordance with AHRI 210/240 or alternate test method approved by U.S. Department of Energy.
- B. Electrical Characteristics:
  1. See drawings.
- C. System Controls:
  1. Include self diagnostic, auto-check functions to detect malfunctions and display the type and location.
- D. Unit Controls: As required to perform input functions necessary to operate system; provided by manufacturer of units.
  1. Unit controllers shall be mounted above ceiling. Provide remote duct-mounted temperature sensor for control of spaces with ducted units.

2. Provide remote flat-plate temperature sensors for non-ducted (ceiling cassette / wall mounted) units.
- E. Wiring:
1. Control Wiring: 18 AWG, 2-conductor, non-shielded, non-polarized, stranded cable.
  2. Control Wiring Configuration: Daisy chain.
  3. All control wiring for the VRF system in its entirety is the responsibility of the installing contractor.
- F. Refrigerant Piping:
1. Insulate each refrigerant line individually between the condensing and indoor units.

## 2.04 OUTDOOR/CONDENSING UNITS

- A. Outdoor/Condensing Units: Air-cooled DX refrigeration units, designed specifically for use with indoor/evaporator units; factory assembled and wired with all necessary electronic and refrigerant controls; modular design for ganging multiple units.
1. Refrigeration Circuit: Scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
  2. Refrigerant: Factory charged.
  3. Variable Volume Control: Modulate compressor capacity automatically to maintain constant suction and condensing pressures while varying refrigerant volume to suit heating/cooling loads.
  4. Capable of being installed with wiring and piping to the left, right, rear or bottom.
  5. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle (cooling mode) oil return or defrost is not permitted, due to potential reduction in space temperature.
  6. Sound Pressure Level: As specified, measured at 3 feet from front of unit; provide night setback sound control as a standard feature; three selectable sound level steps of 55 dB, 50 dB, and 45 dB, maximum.
  7. Power Failure Mode: Automatically restart operation after power failure without loss of programmed settings.
  8. Safety Devices: High pressure sensor and switch, low pressure sensor/switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
  9. Provide refrigerant sub-cooling to ensure the liquid refrigerant does not flash when supplying to indoor units.
  10. Oil Recovery Cycle: Automatic, occurring 2 hours after start of operation and then every 8 hours of operation; maintain continuous heating during oil return operation.
  11. Controls: Provide contacts for electrical demand shedding.
- B. Unit Cabinet: Weatherproof and corrosion resistant; rust-proofed mild steel panels coated with baked enamel finish.
1. Designed to allow side-by-side installation with minimum spacing.
- C. Fans: One or more direct-drive propeller type, vertical discharge, with multiple speed operation via DC (digitally commutating) inverter.
1. Provide minimum of 2 fans for each condensing unit.
  2. External Static Pressure: Factory set at 0.12 in WG, minimum.
  3. Indoor Mounted Air-Cooled Units: External static pressure field set at 0.32 in WG, minimum; provide for mounting of field-installed ducts.
  4. Fan Airflow: As indicated for specific equipment.

5. Fan Motors: Factory installed; permanently lubricated bearings; inherent protection; fan guard; output as indicated for specific equipment.
- D. Condenser Coils: Copper tubes expanded into aluminum fins to form mechanical bond; waffle louver fin and rifled bore tube design to ensure high efficiency performance.
- E. Compressors: Scroll type, hermetically sealed, variable speed inverter-driven and fixed speed in combination to suit total capacity; minimum of one variable speed, inverter driven compressor per condenser unit; minimum of two compressors per condenser unit; capable of controlling capacity within range of 6 percent to 100 percent of total capacity.
  1. Multiple Condenser Modules: Balance total operation hours of compressors by means of duty cycling function, providing for sequential starting of each module at each start/stop cycle, completion of oil return, and completion of defrost, or every 8 hours.
  2. Failure Mode: In the event of compressor failure, operate remaining compressor(s) at proportionally reduced capacity; provide microprocessor and associated controls specifically designed to address this condition.
  3. Provide each compressor with crankcase heater, high pressure safety switch, and internal thermal overload protector.
  4. Provide oil separators and intelligent oil management system.
  5. Provide spring mounted vibration isolators.

## 2.05 BRANCH SELECTOR UNITS

- A. Branch Selector Units: Concealed boxes designed specifically for this type of system to control heating/cooling mode selection of downstream units; consisting of electronic expansion valves, subcooling heat exchanger, refrigerant control piping and electronics to facilitate communications between unit and main processor and between branch unit and indoor/evaporator units.
  1. Provide one electronic expansion valve for each downstream unit served, except multiple indoor/evaporator units may be connected, provided balancing joints are used in downstream piping and total capacity is within capacity range of the branch selector.
  2. When branch unit is simultaneously heating and cooling, energize subcooling heat exchanger.
  3. Casing: Galvanized steel sheet; with flame and heat resistant foamed polyethylene sound and thermal insulation.
  4. Refrigerant Connections: Braze type.
  5. Condensate Drainage: Provide condensate drain tap where required by manufacturer.

## 2.06 INDOOR/EVAPORATOR UNITS

- A. All Indoor/Evaporator Units: Factory assembled and tested DX fan-coil units, with electronic proportional expansion valve, control circuit board, factory wiring and piping, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
  1. Refrigerant: Refrigerant circuits factory-charged with dehydrated air, for field charging.
  2. Temperature Control Mechanism: Return air thermistor and computerized Proportional-Integral-Derivative (PID) control of superheat.
  3. Coils: Direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.
    - a. Provide thermistor on liquid and gas lines.
  4. Fans: Direct-drive, with statically and dynamically balanced impellers; high and low speeds unless otherwise indicated; motor thermally protected.
  5. Return Air Filter: Washable long-life net filter with mildew proof resin, unless otherwise indicated.
  6. Condensate Drainage: Built-in condensate drain pan with PVC drain connection.
  7. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.

- B. Recessed Ceiling Units: Four-way airflow cassette with central return air grille, for installation in a fixed ceiling.
  - 1. Cabinet Height: Maximum of 10 inches above face of ceiling.
  - 2. Exposed Housing: White, impact resistant, with washable decoration panel.
  - 3. Supply Airflow Adjustment:
    - a. Via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 degrees.
    - b. Field-modifiable to 3-way and 2-way airflow.
    - c. Three auto-swing positions, including standard, draft prevention and ceiling stain prevention.
  - 4. Return Air Filter: High efficiency, MERV 8.
  - 5. Minimum Capacity: As indicated on the drawings.
  - 6. Sound Pressure Range: Between 28 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.
  - 7. Fan: Direct-drive turbo type, with motor output range of 0.06 to 0.12 HP.
  - 8. Condensate Pump: Built-in, with lift of 21 inches, minimum.
  - 9. Provide side-mounted fresh air intake duct connection.
- C. Concealed-In-Ceiling Units: Ducted horizontal discharge and return; galvanized steel cabinet.
  - 1. Return Air Filter: MERV 11.
  - 2. Sound Pressure: Measured at low speed at 5 feet below unit.
  - 3. Provide external static pressure switch adjustable for high efficiency filter operation
  - 4. Condensate Pump: Built-in, with lift of 9 inches, minimum.
  - 5. Switch box accessible from side or bottom.
- D. Wall Surface-Mounted Units: Finished white casing, with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.
  - 1. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaulting to same angle as previous operation.
  - 2. Sound Pressure Range: Measured at low speed at 3.3 feet below and away from unit.
  - 3. Condensate Drain Connection: Side (end), not concealed in wall.
  - 4. Fan: Direct-drive cross-flow type.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that required electrical services have been installed and are in the proper locations prior to starting installation.
- B. Verify that condensate piping has been installed and is in the proper location prior to starting installation.
- C. Notify Architect if conditions for installation are unsatisfactory.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install refrigerant piping in accordance with equipment manufacturer's instructions.
- C. Perform wiring in accordance with NFPA 70, National Electric Code (NEC).
- D. Coordinate with installers of systems and equipment connecting to this system.

### **3.03 FIELD QUALITY CONTROL**

- A. Provide manufacturer's field representative to inspect installation prior to startup.

**3.04 SYSTEM STARTUP**

- A. Provide manufacturer's field representative to perform system startup.
- B. Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
- C. Adjust equipment for proper operation within manufacturer's published tolerances.

**3.05 CLEANING**

- A. Clean exposed components of dirt, finger marks, and other disfigurements.

**3.06 CLOSEOUT ACTIVITIES**

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
  - 1. Use operation and maintenance data as reference during demonstration.
  - 2. Briefly describe function, operation, and maintenance of each component.
- C. Training: Train Owner's personnel on operation and maintenance of system.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
  - 3. Instructor: Manufacturer's training personnel.
  - 4. Location: At project site.

**3.07 PROTECTION**

- A. Protect installed components from subsequent construction operations.
- B. Replace exposed components broken or otherwise damaged beyond repair.

**3.08 MAINTENANCE**

- A. See Section 01 70 00 - Execution Requirements, for additional requirements relating to maintenance service.

**END OF SECTION**

**SECTION 26 05 01**  
**MINOR ELECTRICAL DEMOLITION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical demolition.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 70 00 - Execution and Closeout Requirements: Additional requirements for alterations work.

**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 that abandoned wiring and equipment serve only abandoned facilities.
- B. Demolition drawings are based on casual field observation and existing record documents.
- C. Report discrepancies to Owner before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

**3.02 PREPARATION**

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. 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.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
  - 2. Make temporary connections to maintain service in areas adjacent to work area.
- E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Notify Owner before partially or completely disabling system.
  - 2. Notify local fire service.
  - 3. Make notifications at least 24 hours in advance.
  - 4. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Telephone System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
  - 1. Notify Owner at least 24 hours before partially or completely disabling system.
  - 2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
  - 3. Make temporary connections to maintain service in areas adjacent to work area.

**3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- A. Remove, relocate, and extend existing installations to accommodate new construction.

- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. 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.
- E. Repair adjacent construction and finishes damaged during demolition and extension work.
- F. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

#### **3.04 CLEANING AND REPAIR**

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. 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.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

**END OF SECTION**

**SECTION 26 05 34**  
**CONDUIT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Flexible metal conduit (FMC).
- B. Conduit fittings.
- C. Conduit, fittings and conduit bodies.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 05 53 - Identification for Electrical Systems.
- E. Section 26 05 37 - Boxes.

**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 Steel Electrical Metallic Tubing (EMT).
- C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC).
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); National Electrical Contractors Association.
- F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association (ANSI/NEMA FB 1).
- G. UL 1 - Flexible Metal Conduit.
- H. UL 514B - Conduit, Tubing, and Cable Fittings.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide for metallic conduit and flexible metal conduit.
- C. Samples of Materials Actually Delivered to Site:
  - 1. Two pieces each of conduit, 2 feet long.
- D. Project Record Documents: Accurately record actual routing of conduits larger than 2 inches.

**1.05 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

- D. Protect PVC conduit from sunlight.

## **PART 2 PRODUCTS**

### **2.01 CONDUIT REQUIREMENTS**

- A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

### **2.02 METAL CONDUIT**

- A. Manufacturers:
  - 1. Allied Tube & Conduit: [www.alliedtube.com](http://www.alliedtube.com).
  - 2. Beck Manufacturing, Inc: [www.beckmfg.com](http://www.beckmfg.com).
  - 3. Wheatland Tube Company: [www.wheatland.com](http://www.wheatland.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

### **2.03 FLEXIBLE METAL CONDUIT (FMC)**

- A. Manufacturers:
  - 1. AFC Cable Systems, Inc: [www.afcweb.com](http://www.afcweb.com).
  - 2. Electri-Flex Company: [www.electriflex.com](http://www.electriflex.com).
  - 3. International Metal Hose: [www.metalhose.com](http://www.metalhose.com).
  - 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- C. 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.
- D. Description: Interlocked steel construction.
- E. Fittings: NEMA FB 1.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify routing and termination locations of conduit prior to rough-in.
- E. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Conduit Support:
  - 1. Secure and support conduits 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. Do not provide support from piping, ductwork, or other systems.
- D. Connections and Terminations:
1. Use suitable adapters where required to transition from one type of conduit to another.
  2. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
  3. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- E. 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. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
  6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  7. 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. Include proposed locations of penetrations and methods for sealing with submittals.
  8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- F. 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.
- G. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
  2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- H. Provide grounding and bonding in accordance with Section 26 05 26.

### **3.03 INTERFACE WITH OTHER PRODUCTS**

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- B. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation specified in Section roofing section.

**END OF SECTION**



**SECTION 26 05 35**  
**SURFACE RACEWAYS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface raceway systems.
- B. Wireways.

**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.
  - 1. Includes metal channel (strut) used as raceway.
- C. Section 26 05 34 - Conduit.
- D. Section 26 05 37 - Boxes.
- 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 05 - Structured Cabling for Voice and Data - Inside-Plant: Voice and data jacks.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association.
- C. UL 5 - Surface Metal Raceways and Fittings.
- D. UL 111 - Outline of Investigation for Multioutlet Assemblies.

**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 37 and conduit provided under Section 26 05 34 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 the 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.

**1.06 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

**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-wiring.com](http://www.hubbell-wiring.com).
  - 2. Wiremold, a brand of Legrand North America, Inc: [www.legrand.us](http://www.legrand.us).
  - 3. 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.
- D. Metal Channel (Strut) Used as Raceway: Comply with Section 26 05 29.
- E. Type DS-4000 - Surface Raceway System:
  - 1. Raceway Type: Two channel, painted steel.
  - 2. Size: 4 3/4" by 1 3/4 " inches.
  - 3. Length: As indicated on the drawings.
  - 4. Color: To be selected by Architect.
  - 5. Accessory Device Boxes: Suitable for the devices to be installed; color to match raceway.
  - 6. Integrated Device Provisions:
    - a. Receptacles:
      - 1) Comply with Section 26 27 26, except for finishes.
      - 2) Configuration: As indicated on the drawings.
      - 3) Color: Match raceway.
      - 4) Spacing: As indicated on the drawings.
    - b. Communications Outlets:
      - 1) Voice and Data Jacks: As specified in Section 27 10 05.
      - 2) Configuration: As indicated on the drawings.
      - 3) Spacing: As indicated on the drawings.
  - 7. Products:
    - a. Pass & Seymour.
    - b. Wiremold.
    - c. Substitutions: See Section 01 60 00 - Product Requirements.
  - 8. Applications:
    - a. Class rooms, Hallways and Labs.

**2.03 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 shown on the drawings.
- 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. Install raceways in a neat and workmanlike manner in accordance with NECA 1.
- C. Install raceways plumb and level.
- D. Secure and support raceways in accordance with Section 26 05 29 at intervals complying with NFPA 70 and manufacturer's requirements.
- E. Close unused raceway openings.
- F. Provide grounding and bonding in accordance with Section 26 05 26.
- G. 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 37**  
**BOXES**

**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. Wall and ceiling outlet boxes.
- D. Floor boxes.
- E. Pull and junction boxes.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 84 00 - Firestopping.
- B. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- C. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- D. Section 26 27 26 - Wiring Devices:
  - 1. Wall plates.
- E. Section 26 27 16 - Electrical Cabinets and Enclosures.
- F. Section 26 27 26 - Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association (ANSI/NEMA FB 1).
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association (ANSI/NEMA OS 1).
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; National Electrical Manufacturers Association (ANSI/NEMA OS 2).
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations.
- J. UL 508A - Industrial Control Panels.
- K. 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 the contract documents. Obtain direction before proceeding with work.

### **1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.

## **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.
  12. 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 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  2. NEMA 250 Environment Type, Unless Otherwise Indicated:
  3. Junction and Pull Boxes Larger Than 100 cubic inches:
    - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

## 2.02 MANUFACTURERS

- A. Appleton Electric: [www.appletonelec.com](http://www.appletonelec.com).
- B. Steel City
- C. Substitutions: Reco, Inc. See Section 01 60 00 - Product Requirements.

## 2.03 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
  1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch male fixture studs where required.
  2. Concrete Ceiling Boxes: Concrete type.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- D. Wall Plates for Finished Areas: As specified in Section 26 27 26.

## 2.04 FLOOR BOXES

- A. Floor Boxes: NEMA OS 1, fully adjustable, \_4 inches deep.
- B. Material: Cast metal.
- C. Shape: Rectangular.
- D. Service Fittings: As specified in Section 26 27 26.

## 2.05 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 26 27 16.
- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
  1. Material: Galvanized cast iron; Cast Aluminum.
  2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
  1. Material: Galvanized cast iron; Cast Aluminum.
  2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
  3. Cover Legend: "ELECTRIC".

## PART 3 EXECUTION

### 3.01 EXAMINATION

#### 3.02

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive boxes.

- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Verify locations of floor boxes and outlets in offices and work areas prior to rough-in.

### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 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. 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.
- E. Install boxes plumb and level.
- F. 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.
- G. Install boxes as required to preserve insulation integrity.
- H. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- I. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- J. Close unused box openings.
- K. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- L. Provide grounding and bonding in accordance with Section 26 05 26.
- M. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
- N. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
- O. Coordinate installation of outlet boxes for equipment connected under Section 26 27 17.
- P. Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- Q. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
  1. Adjust box locations up to 10 feet if required to accommodate intended purpose.
- R. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- S. Maintain headroom and present neat mechanical appearance.
- T. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

- U. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- V. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- W. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- X. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- Y. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- Z. Use flush mounting outlet box in finished areas.
- AA. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- AB. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches separation. Provide minimum 24 inches separation in acoustic rated walls.
- AC. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- AD. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- AE. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- AF. Use adjustable steel channel fasteners for hung ceiling outlet box.
- AG. Do not fasten boxes to ceiling support wires.
- AH. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.
- AI. Use gang box where more than one device is mounted together. Do not use sectional box.
- AJ. Use gang box with plaster ring for single device outlets.
- AK. Use cast outlet box in exterior locations exposed to the weather and wet locations.
- AL. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.
- AM. Set floor boxes level.
- AN. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

### **3.04 ADJUSTING**

- A. Adjust floor boxes flush with finish flooring material.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused box openings.

### **3.05 CLEANING**

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

### **3.06 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 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.
- F. Field-painted identification of conduit.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 90 00 - Painting and Coating.

**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; National Fire Protection Association.
- D. UL 969 - Marking and Labeling Systems.

**1.04 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- 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.

**1.05 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.

**1.06 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements for additional requirements.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION REQUIREMENTS**

- A. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
- B. Identification for Conductors and Cables:
  - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
  - 2. 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.

**2.02 MANUFACTURERS**

- A. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com).
- B. Seton Identification Products: [www.seton.com/aec](http://www.seton.com/aec).

- C. HellermannTyton: [www.hellermanntyton.com](http://www.hellermanntyton.com).
- D. Substitutions: See Section 01 60 00 - Product Requirements.

### **2.03 IDENTIFICATION NAMEPLATES AND LABELS**

- A. Identification Nameplates:
  - 1. Materials:
  - 2. 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. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- D. Locations:
  - 1. Each electrical distribution and control equipment enclosure.
  - 2. Communication cabinets.
  - 3. Disconnect switches, and starters.
- E. Letter Size:
  - 1. Use 1/8 inch letters for identifying individual equipment and loads.
  - 2. Use 1/4 inch letters for identifying grouped equipment and loads.

### **2.04 WIRE AND CABLE MARKERS**

- A. Manufacturers:
  - 1. Panduit Corp.
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. 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.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.
- H. Description: split sleeve type wire markers.
- I. Locations: Each conductor at panelboard gutters, pull boxes, outlet boxes, and junction boxes each load connection.
- J. Legend:
  - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
  - 2. Control Circuits: Control wire number indicated on shop drawings.

### **2.05 VOLTAGE MARKERS**

- A. Manufacturers: Panduit Corp.
  - 1. Substitutions: See Section 01 60 00 - Product Requirements.
- B. 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.
- C. Legend:
1. Markers for Voltage Identification: Highest voltage present.
  2. Markers for System Identification:
    - a. Emergency Power System: Text "EMERGENCY".
    - b. Other Systems: Type of service.
- D. Color: Black text on orange background unless otherwise indicated.
- E. Location: Furnish markers for each conduit longer than 6 feet.
- F. Spacing: 20 feet on center.
- G. Color:
1. 480 Volt System: Brown.
  2. 208 Volt System: Yellow.
  3. Fire Alarm System: Red.
- H. Legend:
1. 480 Volt System: brown.
  2. 208 Volt System: yellow.
  3. Fire Alarm System: red.

## **2.06 WARNING SIGNS AND LABELS**

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
1. Materials:
  2. 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.
- B. Degrease and clean surfaces to receive nameplates and labels.

### **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. Interior Components: Legible from the point of access.
  6. Conductors and Cables: Legible from the point of access.
- 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.

**END OF SECTION**

**SECTION 26 05 73****OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Short circuit study.
- B. Coordination study and analysis.

**1.02 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Study Report: Submit protective device studies as specified, prior to submission of product data submittals or ordering or fabrication of protective devices.
  - 1. Include stamp or seal and signature of preparing engineer.

**1.03 PROTECTIVE DEVICE STUDY**

- A. Analyze the specific electrical and utilization equipment (according to NEC definition), the actual protective devices to be used, and the actual feeder lengths to be installed.
  - 1. Study Methodology: Comply with requirements and recommendations of NFPA 70, IEEE 399, and IEEE 242.
  - 2. Report: State the methodology and rationale employed in making each type of calculation; identify computer software package(s) used.
- B. One-Line Diagrams: Prepare schematic drawing of electrical distribution system, with all electrical equipment and wiring to be protected by the protective devices; identify nodes on the diagrams for reference on report that includes:
  - 1. Calculated fault impedance, X/R ratios, utility contribution, and short circuit values (asymmetric and symmetric) at the main switchboard bus and all downstream devices containing protective devices.
  - 2. Breaker and fuse ratings.
  - 3. Transformer kVA and voltage ratings, percent impedance, X/R ratios, and wiring connections.
  - 4. Identification of each bus, with voltage.
  - 5. Conduit materials, feeder sizes, actual lengths, and X/R ratios.
- C. Short Circuit Study: Calculate the fault impedance to determine available 3-phase short circuit and ground fault currents at each bus and piece of equipment during normal conditions, alternate operations, emergency power conditions, and other operations that could result in maximum fault conditions.
  - 1. Show fault currents available at key points in the system down to a fault current of 7,000 A at 480 V and 208 V.
  - 2. Include motor contributions in determining the momentary and interrupting ratings of the protective devices.
  - 3. Report: Include all pertinent data used in calculations and for each device include:
    - a. Device identification.
    - b. Protective device.
    - c. Device rating.
    - d. Calculated short circuit current, asymmetrical and symmetrical, and ground fault current.
- D. Coordination Study: Perform an organized time-current analysis of each protective device in series from the individual device back to the primary source, under normal conditions, alternate operations, and emergency power conditions.
  - 1. Graphically illustrate that adequate time separation exists between series devices, including upstream primary device.

2. Plot the specific time-current characteristics of each protective device on log-log paper.
  3. Organize plots so that all upstream devices are clearly depicted on one sheet.
  4. Also show the following on curve plot sheets:
    - a. Device identification.
    - b. Voltage and current transformer ratios for curves.
    - c. 3-phase and 1-phase ANSI damage curves for each transformer.
    - d. No-damage, melting, and clearing curves for fuses.
    - e. Cable damage curves.
    - f. Transformer inrush points.
    - g. Maximum short circuit cutoff point.
    - h. Simple one-line diagram for the portion of the system that each curve plot illustrates.
    - i. Software report for each curve plot, labeled for identification.
- E. Analysis: Determine ratings and settings of protective devices to minimize damage caused by a fault and so that the protective device closest to the fault will open first.
1. Required Ratings and Settings: Derive required ratings and settings of protective devices in consideration of upstream protective device settings and optimize system to ensure selective coordination.
  2. Identify any equipment that is underrated as specified.
  3. Identify specified protective devices that will not achieve required protection or coordination and cannot be field adjusted to do so, and for which adequate devices would involve a change to the contract sum.
  4. In all cases where adequate protection or coordination cannot be achieved at no extra cost to Owner, provide a discussion of alternatives and logical compromises for best achievable coordination.
- F. Protective Device Rating and Setting Chart: Summarize in tabular format the required characteristics for each protective device based on the analysis; include:
1. Device identification.
  2. Relay CT ratios, tap, time dial, and instantaneous pickup.
  3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
  4. Fuse rating and type.
  5. Ground fault pickup and time delay.
  6. Input level and expected response time at two test points that are compatible with commonly available test equipment and the ratings of the protective device.
  7. Highlight all devices that as furnished by Contractor will not achieve required protection.

#### **1.04 QUALITY ASSURANCE**

- A. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
- B. Contractor Responsibility: Provide all project-related data needed by study preparer, including equipment, wire sizes, insulation types, conduit types, and actual circuit lengths.
- C. Owner's Responsibility: Provide data on relevant Owner power distribution equipment.

**END OF SECTION**

**SECTION 26 27 01**  
**ELECTRICAL SERVICE ENTRANCE**

**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Service racks.
- B. Metering transformer cabinets.
- C. Meter bases.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 24 13 - Switchboards: Metering transformer compartment.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association.

**1.04 SYSTEM DESCRIPTION**

- A. System Characteristics: 480Y/277 volts, three phase, four-wire, 60 Hertz.

**1.05 SUBMITTALS**

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide ratings and dimensions of transformer cabinets and meter bases.
- C. Submit utility company-prepared drawings.

**1.06 QUALITY ASSURANCE**

- A. Utility Company: City of Seaford dept of Electric
- B. Perform work in accordance with utility company written requirements and NFPA 70.
  - 1. Maintain one copy of each document on site.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.07 PRE-INSTALLATION MEETING**

- A. Convene one week prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. GE Industrial: [www.geindustrial.com](http://www.geindustrial.com).
- B. Milbank Manufacturing: [www.milbankmfg.com](http://www.milbankmfg.com).
- C. Square D: [www.squared.com](http://www.squared.com).
- D. Substitutions: See Section 01 60 00 - Product Requirements.

**2.02 COMPONENTS**

- A. Metering Transformer Cabinets: Sheet metal cabinet with hinged door, conforming to utility company requirements, with provisions for locking and sealing.
  - 1. Size: As required by utility.
- B. Meter Base: Furnished by utility company.
- C. Utility Transformer Pad: sized as indicated on drawings or size as required by Delmarva Power.
- D. Other Components: As required by utility company.

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Arrange with utility company to obtain permanent electric service to the Project.
- B. Verify that field measurements are as indicated on utility company drawings.

**3.02 INSTALLATION**

- A. Install service rack, transformer pad, metering transformer cabinets, and meter base as required by utility company.
- B. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

**END OF SECTION**

**SECTION 26 27 17**  
**EQUIPMENT WIRING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical connections to equipment.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 05 34 - Conduit.
- B. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (600 V and Less).
- C. Section 26 05 37 - Boxes.
- D. Section 26 27 26 - Wiring Devices.

**1.03 REFERENCE STANDARDS**

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association.
- B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association.

**1.04 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.

**1.05 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.

**1.06 COORDINATION**

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  - 1. Colors: Conform to NEMA WD 1.
  - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
  - 4. Product:
  - 5. Substitutions: See Section 01 60 00 - Product Requirements.

- B. Disconnect Switches: As specified in Section and in individual equipment sections.
- C. Wiring Devices: As specified in Section 26 27 26.
- D. Flexible Conduit: As specified in Section 26 05 34.
- E. Wire and Cable: As specified in Section 26 05 19.
- F. Boxes: As specified in Section 26 05 37.

## **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.
- J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

**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. Floor box service fittings.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 35 - Surface Raceways: Surface raceway systems, including multioutlet assemblies.
- C. Section 26 05 37 - Boxes.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- E. 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.
- F. Section 26 27 17 - Equipment Wiring: Cords and plugs for equipment.

**1.03 REFERENCE STANDARDS**

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association.
- E. NEMA WD 6 - Wiring Device -- Dimensional Specifications; National Electrical Manufacturers Association.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association.
- G. UL 20 - General-Use Snap Switches.
- H. UL 498 - Attachment Plugs and Receptacles.
- I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices.
- J. UL 943 - Ground-Fault Circuit-Interrupters.
- K. 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 installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.

4. Notify Architect of any conflicts or deviations from the 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 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.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### **1.07 DELIVERY, STORAGE, AND PROTECTION**

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

#### **1.08 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Furnish two of each style, size, and finish wall plate.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Hubbell Incorporated; : [www.hubbell-wiring.com](http://www.hubbell-wiring.com).
- B. Leviton Manufacturing Company, Inc; : [www.leviton.com](http://www.leviton.com).
- C. Lutron Electronics Company, Inc: [www.lutron.com](http://www.lutron.com).
- D. Pass & Seymour, a brand of Legrand North America, Inc; : [www.legrand.us](http://www.legrand.us)
- E. Cooper Wiring Devices: [www.cooperwiringdevices.com](http://www.cooperwiringdevices.com).
- F. Leviton Manufacturing, Inc: [www.leviton.com](http://www.leviton.com).
- G. Substitutions: See Section 01 60 00 - Product Requirements.
- H. Source Limitations: Where possible, for each type of wiring device furnish products produced by a single manufacturer and obtained from a single supplier.

#### **2.02 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 GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.
- D. Provide GFI protection for all receptacles installed within 6 feet of sinks.
- E. Unless noted otherwise, do not use combination switch/receptacle devices.
- F. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

**2.03 ALL WIRING DEVICES**

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**2.04 WALL SWITCHES**

- A. Manufacturers:
  1. Hubbell Incorporated; : [www.hubbell-wiring.com](http://www.hubbell-wiring.com).
  2. Leviton Manufacturing Company, Inc; : [www.leviton.com](http://www.leviton.com).
  3. Pass & Seymour, a brand of Legrand North America, Inc; : [www.legrand.us](http://www.legrand.us)
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Wall Switches: 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.
- C. Standard Wall Switches: Commercial 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.
- D. Wall Switches: Heavy Duty, AC only general-use snap switch, complying with NEMA WD 6 and WD 1.
  1. Body and Handle: White plastic with toggle handle.
  2. Ratings:
    - a. Voltage: 120 - 277 volts, AC.
    - b. Current: 20 amperes.
  3. Ratings: Match branch circuit and load characteristics.
- E. Switch Types: Single pole, double pole, 3-way, and 4-way.

**2.05 WALL DIMMERS**

- A. Manufacturers:
  1. Leviton Manufacturing Company, Inc; \_\_\_\_\_: [www.leviton.com](http://www.leviton.com).
  2. Lutron Electronics Company, Inc; Maestro Series: [www.lutron.com](http://www.lutron.com).
  3. Pass & Seymour, a brand of Legrand North America, Inc; \_\_\_\_\_: [www.legrand.us](http://www.legrand.us)
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Wall Dimmers: 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.
- C. Control: Slide control type with separate on/off switch.

**2.06 RECEPTACLES**

- A. Manufacturers:
  1. Hubbell Incorporated; : [www.hubbell-wiring.com](http://www.hubbell-wiring.com).
  2. Leviton Manufacturing Company, Inc; : [www.leviton.com](http://www.leviton.com).
  3. Pass & Seymour, a brand of Legrand North America, Inc; : [www.legrand.us](http://www.legrand.us)
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Receptacles: 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.
- C. GFI Receptacles:
  1. All GFI Receptacles: Provide with feed-through protection, light to indicate ground fault tripped condition and loss of protection, and list as complying with UL 943, class A.
- D. Receptacles: Heavy duty, complying with NEMA WD 6 and WD 1.
  1. Device Body: Black plastic.
  2. Configuration: NEMA WD 6, type as specified and indicated.
- E. Convenience Receptacles: Type 5 - 20.
- F. Single Convenience Receptacles.
- G. Duplex Convenience Receptacles.
- H. GFCI Receptacles: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

## 2.07 TELEPHONE JACKS

- A. Product: AMP manufacturing
- B. Substitutions: See Section 01 60 00 - Product Requirements.

## 2.08 WALL PLATES

- A. Manufacturers:
  1. Hubbell Incorporated; : [www.hubbell-wiring.com](http://www.hubbell-wiring.com).
  2. Leviton Manufacturing Company, Inc; : [www.leviton.com](http://www.leviton.com).
  3. Pass & Seymour, a brand of Legrand North America, Inc; : [www.legrand.us](http://www.legrand.us)
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All 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.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.
- D. Decorative Cover Plates: stainless steel.
- E. Jumbo Cover Plates: stainless steel.
- F. Weatherproof Cover Plates: Gasketed cast metal with hinged cover.

## 2.09 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
  1. Hubbell Incorporated; : [www.hubbell-wiring.com](http://www.hubbell-wiring.com).
  2. Thomas & Betts Corporation; : [www.tnb.com](http://www.tnb.com).
  3. Wiremold, a brand of Legrand North America, Inc; : [www.legrand.us](http://www.legrand.us)
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Service fittings compatible with floor boxes provided under Section 26 05 37 with all components, adapters, and trims required for complete installation.
- C. Flush Floor Service Fittings:
  1. Dual Service Flush Combination Outlets:
    - a. Cover: Rectangular.
    - b. Configuration:
      - 1) Power: One standard convenience duplex receptacle(s) with duplex flap opening(s).
      - 2) Communications: \_\_\_\_\_.

2. Accessories:
  - a. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- 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 floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that openings in access floor are in proper locations.
- H. 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 a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1, including mounting heights specified in that standard unless otherwise indicated.
- C. Coordinate locations of outlet boxes provided under Section 26 05 37 as required for installation of wiring devices provided under this section.
- D. Install wiring devices in accordance with manufacturer's instructions.
- E. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- F. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- G. 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.
- H. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- I. Install securely, in a neat and workmanlike manner, as specified in NECA 1.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- 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. Install receptacles with grounding pole on top.
- Q. Connect wiring device grounding terminal to outlet box with bonding jumper.
- R. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- S. Connect wiring devices by wrapping conductor around screw terminal.
- T. Use jumbo size plates for outlets installed in masonry walls.
- U. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

### **3.04 INTERFACE WITH OTHER PRODUCTS**

- A. Coordinate locations of outlet boxes provided under Section 26 05 37 to obtain mounting heights.
- B. Install wall switch 48 inches above finished floor.
- C. Install convenience receptacle 18 inches above finished floor.
- D. Install convenience receptacle 6 inches above backsplash of counter.
- E. Install telephone jack 18 inches above finished floor.
- F. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches above finished floor.
- G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.
- H. Coordinate installation of access floor boxes with access floor system provided under Section 09 69 00.
- I. Coordinate the installation of wiring devices with underfloor duct service fittings provided under Section 26 05 40.

### **3.05 FIELD QUALITY CONTROL**

- A. Perform field inspection, testing, adjusting, and balancing in accordance with Section 01 40 00.
- 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. Operate each wall switch with circuit energized and verify proper operation.
- E. Verify that each receptacle device is energized.
- F. Test each receptacle to verify operation and proper polarity.
- G. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- H. Correct wiring deficiencies and replace damaged or defective wiring devices.
- I. Verify that each telephone jack is properly connected and circuit is operational.

### **3.06 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.

**3.07 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 REFERENCE STANDARDS**

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements.

**1.03 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.

**1.04 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.05 MAINTENANCE MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Furnish two fuse pullers.
- C. Furnish three of each size and type fuse installed.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Cooper Bussmann, a division of Cooper Industries: [www.cooperindustries.com](http://www.cooperindustries.com).
- B. Mersen (formerly Ferraz Shawmut): [ferrazshawmut.mersen.com](http://ferrazshawmut.mersen.com).
- C. Littelfuse, Inc: [www.littelfuse.com](http://www.littelfuse.com).
- D. Substitutions: See Section 01 60 00 - Product Requirements.

**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. Power Load Feeder Switches: Class RK1 (time delay).
- H. Motor Load Feeder Switches: Class RK1 (time delay).

- I. Other Feeder Switches: Class RK1 (time delay).
- J. General Purpose Branch Circuits: Class RK1 (time delay).
- K. Motor Branch Circuits: Class L time delay.
- L. Lighting Branch Circuits: Class G.

### **2.03 CLASS RK1 (TIME DELAY) FUSES**

- A. Manufacturers:
  - 1. Bussman Corp.
  - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Construction: Current limiting, dual-element fuse, 10 seconds minimum at 500% rated amps, with copper fuse element.

### **2.04 CLASS G FUSES**

## **PART 3 EXECUTION**

### **3.01 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 29 23****VARIABLE-FREQUENCY MOTOR CONTROLLERS****PART 2 PRODUCTS****1.01 DESCRIPTION**

- A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
- B. Enclosures: NEMA 250, Type 1, suitable for equipment application in places regularly open to the public.

**1.02 OPERATING REQUIREMENTS****1.03 COMPONENTS****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. Ballasts and drivers.
- E. Lamps.
- F. Luminaire accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 05 37 - Boxes.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- C. Section 26 09 23 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, outdoor motion sensors, time switches, outdoor photo controls, and daylighting controls.
- D. Section 26 27 26 - Wiring Devices: Manual wall switches and wall dimmers.
- E. Section 26 56 00 - Exterior Lighting.

**1.03 REFERENCE STANDARDS**

- A. ANSI C78.379 - American National Standard for Electric Lamps -- Reflector Lamps -- Classification of Beam Patterns.
- B. ANSI C82.1 - American National Standard for Lamp Ballast - Line Frequency Fluorescent Lamp Ballast.
- C. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type).
- D. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements.
- E. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association.
- G. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association.
- H. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association.
- I. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association.
- J. NFPA 70 - National Electrical Code; National Fire Protection Association.
- K. NFPA 101 - Life Safety Code; National Fire Protection Association.
- L. UL 924 - Emergency Lighting and Power Equipment.
- M. UL 935 - Fluorescent-Lamp Ballasts.

- N. UL 1598 - Luminaires.
- O. 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 the 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. Shop Drawings:
  1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
  2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- D. 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.
- E. Field Quality Control Reports.
- F. 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.
- G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- H. 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 Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
  3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
  4. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.
- I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

#### **1.06 QUALITY ASSURANCE**

- A. Conform to requirements of NFPA 70.

- B. Conform to requirements of NFPA 70 and NFPA 101.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### **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 two year manufacturer warranty for all linear fluorescent ballasts.

#### **1.10 EXTRA MATERIALS**

- A. See Section 01 60 00 - Product Requirements, for additional provisions.
- B. Furnish two of each plastic lens type.
- C. Furnish one replacement lamps for each lamp type.
- D. Furnish two of each ballast type.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS - LUMINAIRES**

- A. Acuity Brands, Inc; : [www.acuitybrands.com](http://www.acuitybrands.com).
- B. Hubbell Lighting, Inc; : [www.hubbellighting.com](http://www.hubbellighting.com).
- C. Lightolier: [www.lightolier.com](http://www.lightolier.com).
- D. Lithonia Lighting: [www.lithonia.com](http://www.lithonia.com).
- E. Columbia Lighting.
- F. Substitutions: See Section 01 60 00 - Product Requirements, except where individual luminaire types are designated with substitutions not permitted.

#### **2.02 LUMINAIRES**

- A. Manufacturers:
  1. Acuity Brands, Inc; : [www.acuitybrands.com](http://www.acuitybrands.com).
  2. Cooper Lighting, a division of Cooper Industries; : [www.cooperindustries.com](http://www.cooperindustries.com).
  3. Hubbell Lighting, Inc; : [www.hubbellighting.com](http://www.hubbellighting.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that comply with requirements of NFPA 70.
- C. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. 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.

- F. 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.
- G. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- H. LED Luminaires: Listed and labeled as complying with UL 8750.
- 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. Manufacturers:
  1. Acuity Brands, Inc; : [www.acuitybrands.com](http://www.acuitybrands.com).
  2. Cooper Lighting, a division of Cooper Industries; : [www.cooperindustries.com](http://www.cooperindustries.com).
  3. Hubbell Lighting, Inc; : [www.hubbellighting.com](http://www.hubbellighting.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924. Emergency and Exit light combination unit with (2) unit mounted lamps and LED exit light with battery backup. This combination unit shall have spare capacity to power remote emergency lamp heads.
- C. 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.
- D. Battery:
  1. Sealed maintenance-free nickel cadmium unless otherwise indicated.
  - 2.
  3. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- E. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- F. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- G. 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.
- H. Accessories:
  1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
  2. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
  3. Provide compatible accessory wire guards where indicated.
  4. 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 LUMINAIRES

- A. Furnish products as indicated in Schedule attached to this section.
- B. Substitutions: See Section 01 60 00 - Product Requirements.
  1. Input Voltage: 120 or 277 volts.

## 2.05 EXIT SIGNS

- A. Manufacturers - Powered and Self-Luminous Signs:
  1. Acuity Brands, Inc; : [www.acuitybrands.com](http://www.acuitybrands.com).
  2. Cooper Lighting, a division of Cooper Industries; : [www.cooperindustries.com](http://www.cooperindustries.com).
  3. Hubbell Lighting, Inc; : [www.hubbellighting.com](http://www.hubbellighting.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
  1. Number of Faces: Single or double as indicated or as required for the installed location.
  2. Directional Arrows: As indicated or as required for the installed location.
- C. Self-Powered Exit Signs:
  1. 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.
  2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
  3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
  4. Provide low-voltage disconnect to prevent battery damage from deep discharge.
  5. 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.
- D. Accessories:
  1. Provide compatible accessory high impact polycarbonate vandal shields where indicated.
  2. Provide compatible accessory wire guards where indicated.
- E. Manufacturers: As indicated on lighting fixture schedule.
  1. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Exit Signs: Exit sign fixture .
  1. Housing: Plastic.
  2. Face: Translucent glass face with red letters on white background.
  3. Face: Aluminum stencil face with red letters.
  4. Directional Arrows: Universal type for field adjustment.
  5. Mounting: Universal, for field selection.
  6. Battery: 12 volt, nickel-cadmium type, with 1.5 hour capacity.
  7. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
  8. Lamps: Manufacturer's standard.
  9. Input Voltage: 120/277 volts.

## 2.06 BALLASTS AND DRIVERS

- A. Manufacturers:
  1. General Electric Company/GE Lighting; : [www.gelighting.com](http://www.gelighting.com).
  2. Osram Sylvania; : [www.sylvania.com](http://www.sylvania.com).
  3. Philips Lighting Electronics/Advance; : [www.advance.philips.com](http://www.advance.philips.com).
  4. Substitutions: See Section 01 60 00 - Product Requirements.
  5. Manufacturer Limitations: Where possible, for each type of luminaire provide ballasts produced by a single manufacturer.
- B. All Ballasts:
  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.
- C. Fluorescent Ballasts:
1. All Fluorescent Ballasts: Unless otherwise indicated, provide high frequency electronic ballasts complying with ANSI C82.11 and listed and labeled as complying with UL 935.
    - a. Input Voltage: Suitable for operation at voltage of connected source, with variation tolerance of plus or minus 10 percent.
    - b. Total Harmonic Distortion: Not greater than 10 percent.
    - c. Power Factor: Not less than 0.95.
    - d. Thermal Protection: Listed and labeled as UL Class P, with automatic reset for integral thermal protectors.
    - e. Sound Rating: Class A, suitable for average ambient noise level of 20 to 24 decibels.
    - f. Lamp Compatibility: Specifically designed for use with the specified lamp, with no visible flicker.
    - g. Lamp Operating Frequency: Greater than 20 kHz, except as specified below.
      - 1) Do not operate lamp(s) within the frequencies from 30 kHz through 40 kHz in order to avoid interference with infrared devices.
    - h. Lamp Current Crest Factor: Not greater than 1.7.
    - i. Provide automatic restart capability to restart replaced lamp(s) without requiring resetting of power.
    - j. Provide end of lamp life automatic shut down circuitry for T5 and smaller diameter lamp ballasts.
    - k. Surge Tolerance: Capable of withstanding characteristic surges according to IEEE C62.41.2, location category A.
    - l. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of CFR, Title 47, Part 18, for Class A, non-consumer application.
    - m. Provide high efficiency T8 lamp ballasts certified as NEMA premium where indicated.
    - n. Ballast Marking: Include wiring diagrams with lamp connections.
  2. Non-Dimming Fluorescent Ballasts:
    - a. Lamp Starting Method:
      - 1) T8 Lamp Ballasts: Programmed start unless otherwise indicated.
      - 2) T5 Lamp Ballasts: Programmed start unless otherwise indicated.
      - 3) Compact Fluorescent Lamp Ballasts: Programmed start unless otherwise indicated.
    - b. Lamp Starting Temperature: Capable of starting standard lamp(s) at a minimum of 0 degrees F, and energy saving lamp(s) at a minimum of 60 degrees F unless otherwise indicated.

## 2.07 LAMPS

- A. Manufacturers:
1. General Electric Company/GE Lighting; : [www.gelighting.com](http://www.gelighting.com).
  2. Osram Sylvania; : [www.sylvania.com](http://www.sylvania.com).
  3. Philips Lighting Company; : [www.lighting.philips.com](http://www.lighting.philips.com).
  4. Philips Lighting Co of NA: [www.lighting.philips.com](http://www.lighting.philips.com).
  5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Lamps - General Requirements:
1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
  2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.

3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
  4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect to be inconsistent in perceived color temperature.
- C. Compact Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
  2. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
  3. Color Rendering Index (CRI): Not less than 80.
  4. Average Rated Life: Not less than 10,000 hours for an operating cycle of three hours per start.
- D. Linear Fluorescent Lamps: Wattage and bulb type as indicated, with base type as required for luminaire.
1. Low Mercury Content: Provide lamps that pass the EPA Toxicity Characteristic Leaching Procedure (TCLP) test for characteristic hazardous waste.
  2. T8 Linear Fluorescent Lamps:
    - a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
    - b. Color Rendering Index (CRI): Not less than 80.
    - c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
  3. T5 Linear Fluorescent Lamps:
    - a. Correlated Color Temperature (CCT): 3,500 K unless otherwise indicated.
    - b. Color Rendering Index (CRI): Not less than 80.
    - c. Average Rated Life: Not less than 20,000 hours for an operating cycle of three hours per start.
- E. Lamp Types: As specified for each luminaire.
- F. Fluorescent Lamps:
1. Product: Phillips Lighting - Type T5 or T8.
  2. Substitutions: See Section 01 60 00 - Product Requirements.
- G. High Intensity Discharge (HID) Lamps:
1. Product: Match Lighting Fixture Type
  2. Substitutions: See Section 01 60 00 - Product Requirements.

## **2.08 ACCESSORIES**

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.
- D. Tube Guards for Linear Fluorescent Lamps: Provide clear virgin polycarbonate sleeves with endcaps where indicated.
- E. Product: As indicated in lighting fixture schedule.
  1. Substitutions: See Section 01 60 00 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.

- 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 37 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. 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 pendant-mounted luminaires to building structure.
  4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
  5. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
  6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- F. 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.
- G. Suspended Luminaires:
  1. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
  2. Install canopies tight to mounting surface.
- H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- I. Install fixtures securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting).
- J. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- K. Support luminaires independent of ceiling framing.
- L. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.

- M. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- N. Exposed Grid Ceilings: Support surface mounted luminaires in grid ceiling directly from building structure.
- O. Exposed Grid Ceilings: Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires.
- P. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- Q. Install recessed luminaires to permit removal from below.
- R. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- S. Install clips to secure recessed grid-supported luminaires in place.
- T. Install wall mounted luminaires, emergency lighting units, and exit signs at height as scheduled.
- U. Install accessories furnished with each luminaire.
- V. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- W. Bond products and metal accessories to branch circuit equipment grounding conductor.
- X. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.
- Y. Air Handling Luminaires: Interface with air handling accessories furnished and installed under Section 23 36 00.
- Z. 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.
- AA. 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.
- AB. Install lamps in each luminaire.
- AC. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

### **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. Perform field inspection, testing, and adjusting in accordance with Section 01 40 00.
- D. Operate each luminaire after installation and connection to verify proper operation.
- E. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- F. 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.
- D. Aim and adjust luminaires as indicated.
- E. Position exit sign directional arrows as indicated.

### **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.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

### **3.07 CLOSEOUT ACTIVITIES**

- A. Just prior to Substantial Completion, replace all lamps that have failed.

### **3.08 PROTECTION**

- A. Protect installed luminaires from subsequent construction operations.

### **3.09 PROTECTION**

- A. Relamp luminaires that have failed lamps at Substantial Completion.

### **3.10 SCHEDULE - ATTACHED**

**END OF SECTION**

SECTION 30 0300 – SUBMITTAL REQUIREMENTS FOR SITE WORKPART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes submittal requirements for various site paving and utility work. Site work is shown and specified on the civil Drawings CC-01 and CC-02.
- B. General Requirements: Comply with Division 01 Section “Submittal Procedures”

## 1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Water pipe.
  - 2. Pipe fittings.
- B. Shop Drawings: For the following:
  - 1. Meter pit.
  - 2. Concrete paving materials and mixes.
  - 3. Hot mix asphalt paving materials and mixes.

PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Refer to civil Drawings.

PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Refer to civil Drawings.

END OF SECTION 30 0300