02 41 16

Structural Demolition

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

### 1.02 SCOPE

A. Demolish in its entirety, the existing greenhouse, including but not limited to all features listed in Specification No. 010000, Division 1, General Requirements, Section A, Part 1.
B. Remove and legally dispose all debris from the site.
C. Disconnect and cap all utilities including water, electric and gas.

### 1.03 SUBMITTALS

A. Submit shop drawings and indicate demolition and removal sequence and location of salvageable items; location and construction of barricades, fences and temporary work.
B. Submit copy of permits required by regulatory agencies for demolition and sidewalk street closings.
C. Project Record Documents: Accurately record actual locations of capped utilities and subsurface obstructions.

### 1.04 QUALITY ASSURANCE

A. Conform to applicable codes for demolition of structures, safety of adjacent structures, dust control, runoff control and disposal.
B. Conform to applicable codes for hazardous or contaminated material removal and disposal.

### 1.05 QUALIFICATIONS

A. Demolition Firm: Company specializing in performing work of this section with minimum five years documented experience.
B. Design shoring, bracing, and underpinning under direct supervision of Professional Engineer experienced in design of this work and licensed in the state of New York.

## 1.06 SEQUENCING

A. Review sequence activities with Owner Representative.

## 1.07 SCHEDULING

A. Schedule work with Owner.

## 1.08 PROJECT CONDITIONS

A. Building indicated to be demolished will be vacated before start of Work.
B. Owner assumes no responsibility for actual condition of buildings to be demolished.
C. Do not sell demolished materials on-site.
D. Maintain existing pavement to remain to greatest extent possible.

# **PART 2 PRODUCTS** (Not Applicable)

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Examine existing buildings indicated to be demolished before demolition.
B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.
C. Determine where demolition may affect structural integrity or weather resistance of adjacent structures/buildings to remain.

    1. Identify measures required to protect buildings from damage.
    2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound and weather tight and watertight condition.

D. Verify hazardous material abatement is complete before beginning demolition.

## 3.02 PREPARATION

E. Notify Owner and the Underground Facilities Protection Organization (UFPO) not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

F. Notify affected utility companies before starting work and comply with utility's requirements.

G. Do not close or obstruct roadways, sidewalks, hydrants without permits.

H. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner and existing improvements indicated to remain.

I. Protect existing trees, and site appurtenances to remain.

J. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

## 3.04 DEMOLITION REQUIREMENTS

A. Use of explosives is not permitted.

B. Conduct demolition to minimize interference with adjacent structures.

C. Cease operations immediately when adjacent structures appear to be in danger. Notify Owner Representative. Do not resume operations until directed.

D. Conduct operations with minimum interference to public or private accesses to occupied adjacent structures.

E. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

F. Sprinkle Work with water to minimize dust. Provide hoses and water connections required for this purpose.

## 3.05 DEMOLITION

A. Utilities:

1. Indicated locations are approximate; determine exact locations before commencing work.
2. Disconnect remove, capping and plugging utility services.
3. Disconnect and remove utilities to a minimum of five feet from the building line or within existing tunnel system otherwise noted on drawings. Identify utilities at termination of demolition. Record termination or capped location on Record Documents.

B. Remove concrete slabs. Remove foundation to 1’-0” minimum below new concrete slab and footings.
C. Backfill areas excavated, open pits, and holes, resulting from demolition in accordance with Section 31 05 00.
D. Rough grade and compact areas affected by demolition 12" below new site grades and contours to accommodate subsequent construction operations.
E. Continuously clean-up and remove demolished materials from site. Do not allow materials to accumulate on site.
F. Do not burn or bury materials on site. Leave site in clean condition.

04/28/21:PDA ***END OF SECTION***

03 10 00

Concrete Work

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including University Agreement Conditions and requirements apply to work of this section.

### 1.02 SCOPE

A. Extent of concrete work shown on drawings,

### 1.03 SUBMITTALS

A. Shop Drawings: Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with CRSI - Manual of Standard Practice showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures. Reproduction of contract drawings is not permitted.

B. Samples: Submit samples of materials as requested by Architect, including names, sources and descriptions.

C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.

D. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

E. Product Data: Submit data on admixtures, anchors, forming accessories, vapor barriers, curing compounds, non shrink grout.

### 1.04 QUALITY ASSURANCE

A. Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings."
2. ACI 318 "Building Code Requirements for Reinforced Concrete."
3. Concrete Reinforcing Steel Institute, (CRSI) "Manual of Standard Practice."

B. Concrete Testing Service: Engage a testing laboratory acceptable to Architect to perform material evaluation tests and to design concrete mixes.
C. Materials and installed work may require testing, in addition to those defined in Section 01 45 33, and retesting at anytime during progress of work. Additional tests, including retesting of rejected materials for installed work, shall be at the Contractor's expense.
D. Special Inspections: See Section 01 45 33 – Special Inspections and Testing, for a description of the special inspection and testing to be paid for by the Owner, and for the extent of the Contractor's responsibilities with regard to the Special Inspections and Testing program.

### 1.05 PROJECT CONDITIONS

A. Protection Against Freezing: Cover completed work with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.
B. Protect adjacent finish materials against splatter during concrete placement.

## PART 2 PRODUCTS

### 2.01 FORM MATERIALS

A. Forms for Exposed Finished Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-typed materials, to provide continuous, straight, smooth exposed surfaces. Furnish in largest practicable sizes to minimize number of joints.
B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

### 2.02 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
C. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars in place. Use wire bar type supports complying with CRSI specifications.
D. Welded Wire Fabric: 6x6xW2.9xW2.9, ASTM A 185.

## 2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type 1. Use one brand of cement throughout project, unless otherwise acceptable to Architect.

B. Normal Weight Aggregates: ASTM C33, Class "S", and as herein specified. Provide aggregates from a single source for exposed concrete. Coarse aggregate to be crushed, no whole gravel.

C. Water: Drinkable.

D. Prohibited Admixtures: Calcium chloride thyocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

   a. "Air-Mix": Euclid Chemical Co.
   b. "Sika AER"; Sika Corp.
   c. "MB-VR or MB-AE"; Master Builders.
   d. "Darex AEA" or "Daravair"; W.R. Grace.

F. Water Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

   a. "Accelguard 90"; Euclid Chemical Co.
   b. "Pozzolith PolyHeed 997"; Master Builders.
   c. "Gilco Accelerator"; Gifford-Hill/American Admixtures.

## 2.04 RELATED MATERIALS

A. Granular Base: Evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade.

B. Vapor Retarder: Provide vapor retarder cover over prepared base material where indicated below slabs on grade. Use only materials which are resistant to decay when tested in accordance with ASTM E 154: polyethylene sheet not less than 8 mils thick.

C. Non-Shrink Grout: CRD-C 621, factory pre mixed grout.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. "Masterflow 713"; Master Builders.
b. “Euco-NS”, Euclid Chemical Co.
c. “Sonogrout 14K"; Sonneborn-ChemRex.
d. “Five Star Grout”, U.S. Grout Corp.
e. “Symons Multi-Purpose Construction Grout”, Symons Corp.

D. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicates per gal.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. "Surfhard”: Euclid Chemical Co.
b. “Labidolith"; Sonneborn-ChemRex.
c. “Saniseal”; Master Builders.

E. Bonding Agent: Water based three component epoxy resin / Portland cement bonding agent.

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. "Armatec 110”: Sika Corp.
b. “Sonoprep"; Sonneborn-ChemRex.
c. “Powerprep”; Sika Corp.

F. Bond Breaker

1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

a. “Super Bond Breaker” - The Burke Company
b. “Bond Breaker” - Crete-Lease

## 2.05 PROPORTIONING AND DESIGN OF MIXES

A. Prepare mix design for each type of strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. Mix designs submitted for approval shall be less than one year old and shall be representative of the concrete materials currently being used. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

B. Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.

C. Acceptance of mix design will require that average strength of test cylinders exceed the specified strength (f'c) established by ACI 318 Paragraph 4.3. If a suitable record of strength test performance is not available from the concrete supplier, proportions of the mix design shall be selected to provide and average strength at least 1200 psi greater than the specified strength (f'c).

D. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

| Use | Compressive Strength PSI | Minimum Cement Content Bags/CY | Maximum Aggregate Size |
|---|---|---|---|
| Slabs on Grade | 4500 | 6 | 3/4" |
| Footings & piers | 3000 | 5-1/2 | 1-1/2" |

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

F. Admixtures:

1. Use water-reducing admixture in concrete as required for placement and workability.
2. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 1.0 percent within following limits:
   a. 5.5 percent, 1-1/2" max. aggregate
   b. 6.0 percent, 3/4" & 1" max. aggregate.

G. Water-Cement Ratio: Provide concrete for following conditions with maximum water-cement (W/C) ratios of .50.
H. Establish slump based on mix preportioning.

1. Slabs on grade: not more than 4".
2. Piers: not more than 5".
3. Footings: not less than 1” or more than 4”.

### 2.06 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. All ready-mix concrete shall be obtained from NYSDOTSS approved automated batch plant.

## PART 3 EXECUTION

### 3.01 GENERAL

A. Coordinate the installation of joint materials with placement of forms and reinforcing steel.

### 3.02 SLAB BASE MATERIALS

A. Following leveling and compacting of existing subgrade and minimum 6” of compacted granular base.
B. Place vapor retarder sheeting with longest dimension parallel with direction of concrete placement. Lap joints 6 inches and seal with appropriate tape.
C. Extend vapor barrier a minimum of 4 inches up vertical surfaces, such as walls and columns, at edges of slabs, and pipe penetrations through slabs on grade. Tape top edge of vapor retarder to secure in place during concrete placement.

### 3.03 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
C. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange space and securely tie bars and bar supports to hold

reinforcement in position during concrete placement operations.

D. Install welded wire fabric in as long lengths as practical. Lap adjoining pieces at least one full mesh and lap spices with wire. Offset laps in adjacent widths to prevent continuous laps in either direction.

E. For floor slabs on ground, welded wire fabric shall be laid while the concrete is being placed and Awalked in≅ only after there is sufficient concrete to hold it at the desired location.

## 3.04 JOINTS

A. Construction Joints: Locate and install construction joints as indicated, or if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.

B. Provide keyways at least 1-1/2" deep in construction joints and between walls and footings; accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.

D. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, and elsewhere as indicated.

1. Joint filler and sealant materials are specified in Division 7 sections of these specifications.

E. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints to form panels of patterns as shown. If joint pattern is not shown, space joints in 10' x 10' grid. Conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).

1. Form contraction joints by inserting 1/4" wide x 1/4 of slab depth premolded plastic, hardboard or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed floor slabs may be formed by saw cuts 1/8" wide x 1/4 slab depth as soon as possible after slab finishing as may be safely done without dislodging aggregate, but within 24 hours after concrete placement.
3. In areas to be covered with finish floor materials, fill joints with 1:1 sand cement grout, trowel smooth. After grout has set, grind flush with adjoining surfaces.
4. In areas where slab is exposed, provide joint sealant. Joint sealant material is specified in Division 7 sections of these specifications

## 3.05 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

## 3.06 CONCRETE PLACEMENT

A. Preplacement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions, and guard against spattering during placement.

B. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as close as practicable to its final location to avoid segregation.

C. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. The contractor shall use special precautions in placement of concrete slabs on ground to prevent excessive shrinkage, cracking, and slab curl. Slump limitations, timing of concrete placement with regard to atmospheric conditions and curing are several but not necessarily all the requirements that should be met. If curling and/or shrinkage cracks should develop, the contractor shall correct the condition, including grinding, at his own expense.
2. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
4. Maintain reinforcing in proper position during concrete placement operations.

D. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306.1 and as herein specified.

1. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50EF (10°C), and not more than 80°F (27°C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

E. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel and subgrade just before concrete is placed.

## 3.07 MONOLITHIC SLAB FINISHES

A. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
2. Begin floating when surface water has disappeared or when

concrete has stiffened sufficiently to permit operation of power-driven floats, or both.

3. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
4. Check and level surface plane to tolerances of $F_F$ 18 - $F_L$ 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

B. Trowel and Fine Broom Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view. Immediately follow with fine brooming, to scarify surface slightly.

C. Chemical-Hardener Finish: Apply chemical-hardener finish to interior concrete floors. Apply liquid chemical-hardener after complete curing and drying of the concrete surface. Dilute liquid hardener with water (parts of hardener/water as follows), and apply in 3 coats; first coat, 1/3-strength; second coat, 1/2-strength; third coat, 2/3-strength. Evenly apply each coat, and allow 24 hours for drying between coats.

1. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.
2. After final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

NEED TO REVIEW WITH THE FLOOR COATING SYSTEM

## 3.08 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.

C. Begin final curing procedures immediately following initial curing and before concrete has dried. Weather permitting; keep continuously moist for not less than 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

D. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified.

E. Provide moist curing by following methods.

1. Keep concrete surface continuously wet by covering with water.
2. Continuous water-fog spray.
3. Covering concrete surface with absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and

edges, with 4" lap over adjacent absorptive covers.

## 3.09 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Owner may employ a testing laboratory to take samples and perform tests and to submit test reports.
B. The Contractor shall cooperate with the testing laboratory by providing the space and assistance required for the taking of test cylinders.
C. The Contractor shall notify the testing laboratory of concrete placements in a timely manner to allow tests to be taken if required.
D. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

04/24/21:PDA

*** END OF SECTION ***

SECTION 04 21 13

Unit Masonry

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

### 1.02 SCOPE

A. Furnish and install masonry veneer, masonry ties, anchors, and reinforcements necessary to complete all masonry work including but not limited to the preparation and setting of all items associated with masonry.

### 1.03 SAMPLES

A. Submit samples of face brick to illustrate color, texture, and color range to owner for selection.

### 1.04 ENVIRONMENTAL REQUIREMENTS AND PROTECTION

A. Protect stored material from contact with earth and keep covered until used to prevent inclusion of moisture.
B. Protect work in progress from weather, dehydration, and damage. Cover incomplete work until progress is resumed.
C. Exposed tops of masonry walls shall be covered and protected from the weather at night and during other interruptions of the work.
D. Cold weather masonry work shall be in accordance with standards established by the Structural Clay Products Institute.
E. No masonry may be built when the temperature is below 32°F on a rising temperature or below 40°F on a falling temperature at the place where the work is in progress.
F. No frozen material may be built upon.
G. Mortar which shows signs of frost when installed will cause replacement of such work.
H. Maintain materials and surrounding air temperature to minimum 50°F prior to, during, and 48 hours after completion of masonry work.

## PART 2 PRODUCTS

### 2.01 ACCEPTABLE CONCRETE MASONRY UNIT MANUFACTURERS

A. Auburn Cement Company.
B. Barnes and Cone.
C. Scranton Building Block Company.
D. Nichol Block Corp.

### 2.02 BRICK UNITS

A. Face Brick: ASTM C216, Grade SW Type FBS, manufactured 3-5/8" x 2-1/4" x 7-1/2" to 7-5/8" for 3/8" joints.
B. Brick: “As selected by Owner.
C. Warped, clinkered, extremely out of color, or soft burned brick shall be culled out and rejected. Deliver to and stack brick at site on pallets. The rejected brick and brick discarded because of damage caused by careless handling will not be paid for by the Owner.

### 2.03 REINFORCEMENT AND ANCHORAGES

A. Single Wythe Joint Reinforcement: Hot dipped galvanized steel construction, 9 gauge side rods with 9 gauge cross ties.
B Veneer Anchors for Metal Studs: Hohman & Banard, Inc., Thermal 2-Seal Wing Nut Tie anchoring system with 2X Hook, stainless steel, 16" on center spacing.

### 2.04 MORTAR

A. Type "N"
   1. Medium strength mortar, 750 psi.
   2. For general use for exterior walls above grade.
   3. 1 part Portland cement, 1 part lime, 5 parts sand; or 1 part masonry cement, 2-1/2 parts sand.

### 2.06 MASONRY FLASHINGS

A. Copper Fabric: 7 oz. sheet with asphalt impregnated glass fibric bonded to both sides.

### 2.07 ACCESSORIES

A. Caulk Stop: Close cell polyvinylchloride rope oversize 50% for width of opening, self-expanding by maximum lengths.

B. Air Vents: Flexible ultra violet resistant polypropylene co-polymer DA1006 Cell Vent by Dur-O-Wal Inc., 7777 Washington Village Dr., Ste. 130, Dayton, OH 45459, (888) 977.9600, www.dur-o-wal.com., or equal.
   1. Size: Height 2-1/2 inch maximum except as indicated otherwise, by full width of brick.
   2. Color: To match mortar color.

C. Weep Vents: Flexible ultra violet stable recycled polyester mesh, rectangular shape by Mortar Net USA Ltd, 541 S. Lake St., Gary, IN 46403, (800) 664-6638, www.mortarnet.com, CavClear Weep Vents by Archovations, Inc., PO Box 241, Hudson, WI 54016, (888) 436-2620, www.cavclear.com, or equal.
   1. Size: Height 2-1/2 inch maximum except as indicated otherwise, by full width of Brick.
   2. Color: To match mortar color.

D. Cavity Wall Mortar Net: Lightweight polyethylene, 90 percent open woven mesh by Mortar Net USA Ltd, 541 South Lake Street, Gary, IN 46403, (800) -664-6638, www.mortarnet.com. or CavClear Masonry Mat by Archovations, Inc., PO Box 241, Hudson, WI 54016, (888) 436-2620, www.cavclear.com., or equal.
   1. Size: Height 10 inches, thickness as required to fill cavity.

E. Expansion Joint Filler: Will-Seal 150 sized for width of joint.
F. Compressible Filler: Multi-purpose fiber joint filler for construction joints. W. R. Meadows or equivalent.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Verify items provided by other sections of work are properly sized and located.
B. Establish lines, levels, and coursing. Protect from disturbance.
C. Provide temporary bracing during erection of masonry work. Maintain in place until building structure provides permanent bracing.

### 3.02 COURSING

A. Place masonry to lines and levels indicated.
B. Maintain masonry courses to uniform width. Make vertical and horizontal joints equal and of uniform thickness.
C. Lay brick in running, header, or soldier bond where indicated. Course three brick units and three mortar joints to equal 8". Form concave mortar joints.

## 3.03 PLACING AND BONDING

A. Lay masonry in full bed of mortar, properly jointed with other work. Buttering corners of joints.
B. Fully bond intersections, and external and internal corners.
C. Do not shift or tap masonry units after mortar has taken initial set. Where adjustment must be made, remove mortar and replace.
D. Remove excess mortar.
E. Perform job-site cutting with proper tools to provide straight unchipped edges. Take care to prevent breaking masonry unit corners or edges.
F. Cut mortar joints of masonry units flush where insulation adhesive or ceramic tile is applied.

## 3.04 CAVITY WALL

A. Do not let mortar fall into cavity air space or plug weep holes. Use wood lift board to keep cavity clean. Clean out promptly by lifting board to clean cavity of mortar.
B. Install cavity weep holes in veneer at 24" on center horizontally above wall flashing and at bottom of walls. Fill above flashings with mortar net. Do not compress.
C. Install light-gauge metal framed back-up wall ahead of brick veneer.
D. Verify that anchorages are properly placed. Attach anchorages to light-gauge metal framing at 16" on center horizontally and vertically.

## 3.05 TOLERANCES

A. Variation from Unit to Adjacent Unit: 1/32" maximum.
B. Variation from Plane of Wall: 1/4" in 10 feet and ½" in 20'-0" or more.
C. Variation from Plumb: 1/4" per story non-cumulative, ½" in two stories or more.
D. Variation from Level Coursing: 1/8" in 3'-0", 1/4" in 10'-0", ½" maximum.
E. Variation of Joint Thickness: 1/8" in 3'-0".
F. Maximum Variation from Cross Sectional Thickness of Walls: Plus or minus 1/4".

## 3.06 REINFORCEMENT AND ANCHORAGES

A. Install horizontal joint reinforcement 16" on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend 16" minimum each side of opening.
C. Place joint reinforcement continuous in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6". Extend 16" minimum each side of opening.
E. Reinforce joint corners and intersections with stainless steel strap anchors 16" on center.

## 3.07 MASONRY FLASHINGS

A. Extend flashings through veneer, turn up minimum 8" and bed to sheathing joints, attach to light gauge metal framing back up and seal to sheathing material.
B. Lap end joints minimum 6" and seal watertight.
C. Use flashing manufacturer's recommended adhesive.

## 3.08 LINTELS

A. Install loose steel lintels.

## 3.09 GROUTED COMPONENTS

A. Place and consolidate grout fill without disturbing reinforcing.

## 3.10 CONTROL JOINTS AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcing across control joints.
B. Install resilient compressible control joint filler and backer rod with continuous lengths.
D. Install expandable filler in expansion joints per manufacturer's instructions.

## 3.12 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, grounds, and other miscellaneous work of all trades. Cooperate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting any area not indicated or where appearance or strength of masonry work may be impaired.

## 3.13 CLEANING

A. Remove excess mortar and smears.
B. Replace defective mortar. Match adjacent work.
C. Clean soiled surfaces with a non-acidic solution which will not harm masonry or adjacent materials. Consult masonry manufacturer for acceptable cleaners.
D. Use non-metallic tools in cleaning operations.
E. While cleaning, inspect masonry. Where exposed, replace any defective chipped units, cut out any defective joints, rake clean, and repoint to match adjacent work.

## 3.14 PROTECTION

A. Protect finished installation.
B. Maintain protective boards at exposed external corners which may be damaged by construction activities.
C. Provide protection without damaging completed work.
D. At day's end, cover unfinished walls to prevent moisture infiltration.

04/26/21:PDA ***END OF SECTION***

**SECTION 05 40 00**

**COLD-FORMED METAL FRAMING**

## PART 1 GENERAL

### 1.01 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Insulation in voids inaccessible after fabrication or erection: Insulation noted on drawings.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Non-load Bearing, Light Gage Steel Framing: Section 092213.

### 1.03 REFERENCES

A. Except as shown or specified otherwise, the Work of this Section shall meet the requirements of the following:
   1. General Standard: "Specification for the Design of Cold-Formed Steel Structural Members" by the American Iron and Steel Institute (AISI Specification).
   2. Welding: "Structural Welding Code - Sheet Steel, AWS D1.3" by the American Welding Society (AWS Code).

B. Organizations:
   1. AISI: American Iron and Steel Institute, 1140 Connecticut Ave., NW, Suite 705, Washington, D.C. 20036, (202) 452-7100, www.steel.org.
   2. AWS: American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126, (800) 443-9353, www.aws.org.
   3. ASTM: ASTM International, 100 Barr Harbor Dr., PO Box C700, West Conshohocken, PA, 19428-2959, (610) 832-9500, www.astm.org.
   4. SSPC: The Society for Protective Coatings, 40 24th Street, 6th Floor, Pittsburgh PA 15222-4656, (877) 281-7772, www.sspc.org.

### 1.04 SYSTEM DESCRIPTION

A. Type of Metal Framing: Load carrying, formed steel framing.
   1. Framing with studs and accessories.
   2. Framing with joists and accessories.

### 1.05 SUBMITTALS

A. Shop Drawings: Erection and fabrication drawings for all load carrying metal framing and accessories.
   1. Include the following in an early submission:
      a. Erection drawings indicating sizes and locations of all metal framing members.
      b. Anchor bolt plan showing anchor bolts, if any, to be placed in cast-in-place concrete Work.
      c. Show plans and elevations.

2. Submit fabrication drawings for anchor bolts.
3. When shop drawings are marked “Approved as Noted”, promptly resubmit copies of corrected shop drawings for formal approval and record.

B. Product Data: Manufacturer’s printed specifications and installation instructions for each type of metal framing and accessory, including data required to show compliance with the Drawings and Specifications.

C. Design Loads:
1. Second Floor
   a. Dead loads: 15 psf
   b. Live loads: 40 psf
2. Roof
   a. Dead loads: 10 psf
   b. Ground snow loads: 50 psf
   c. Flat roof snow loads: 35psf

D. Calculation – Engineering calculations or data verifying the framing assembly’s ability to meet or exceed design requirements as required by codes and the Architect. These calculations shall include, but not be limited to the following:
1. Steel wall framing; deflection of L/600
2. Steel rafters framing; deflection of L/240
3. Member to Member and to structure Connections
4. Wall bracing Floor

**1.06 QUALITY ASSURANCE**

A. Fire Rated Construction: Wherever a fire resistance classification is indicated for metal framing components, provide framing and accessories which have been tested and classified or listed for the construction and rating shown.

**1.07 DELIVERY, STORAGE, AND HANDLING**

A. Deliver metal framing to the Site in manufacturer’s unopened containers or bundles, identified with brand, type, and gage.
B. Protect metal framing from damage and rusting. Store off the ground in dry, ventilated space.
C. Store and handle metal framing in a manner that will not cause distortion.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

A. Framing including Studs, Tracks, Joists, and Perimeter Channel:
1. Members of 12, 14, and 16 Gage Steel: Galvanized, structural quality sheet steel; ASTM A653, Grade D (minimum yield 50 ksi).

2. Members of 18 and 20 Gage Steel: Galvanized, structural quality sheet steel; ASTM A653, Grade A (minimum yield 33 ksi).

B. Accessories and Fasteners:
   1. Bracing, Bridging, Strapping, Reinforcement, Stiffeners, Plates, Gussets, Clip Angles, and Hangers: Unless otherwise indicated, metal framing manufacturer's standard products formed from ASTM A653 galvanized, structural quality sheet steel. Thickness and grade shall be determined by application requirements, with a minimum thickness of 20 gage and a minimum yield of 33 ksi.
   2. Power-Actuated Fasteners: Low velocity, powder activated, threaded studs complying with ASTM E 1190 and zinc coated in accordance with ASTM B633, Type III, Classification 5.
      a. Minimum Stud Size: 1/4-20 thread, 0.145 inch dia shank, with 1/4-20 nut and 5/8 inch outside diameter washer.
      b. Stud Material: ASTM A510 1060 or 1065 steel.
      c. Minimum Core Hardness: 51-56 Rockwell C.
      d. Minimum Tensile Strength: 285,000 psi.
      e. Minimum Shear Strength: 182,000 psi.
   3. Self-Drilling Fasteners: Cadmium plated, No. 12-14 x 3/4 inch, hex washer head, self-drilling, self-tapping fastener with pilot point.

C. Galvanizing: Hot-dip process complying with ASTM A653, Coating Designation G 60.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

## 2.02 FABRICATION

A. Fabricate metal framing in accordance with "Approved" or "Approved as Noted" fabrication drawings only.
   1. When fabrication drawings are "Approved as Noted", progress fabrication in strict accordance with the marks and notes thereon.

B. Pre-fabricated panels shall be not more than 1/8 inch out of square within the length of the panel, and shall be in compliance with the tolerances specified in Part 3.

C. Repairing Galvanizing: Clean shop welded and abraded surfaces and repair them with a 2 mil (dry) minimum thick coating of galvanizing repair paint. Comply with paint manufacturer's application instructions.

D. For metal framing indicated to receive insulation, install full width insulation in voids which will be inaccessible after fabrication.

# PART 3 EXECUTION

## 3.01 EXAMINATION

A. Verification of Conditions: Examine surfaces to receive metal framing for defects that will adversely affect the execution and quality of the Work. Do not proceed until unsatisfactory conditions are corrected.

## 3.02 SURFACE PREPARATION

A. Clean surfaces that support the Work of this Section.

## 3.03 INSTALLATION

A. Install metal framing and accessories in accordance with approved shop drawings, and with the metal framing manufacturer's printed installation instructions.

B. Provide temporary bracing to ensure stability of the structure during construction.

C. Repairing Galvanizing: Clean field welded and abraded surfaces and repair them with a 2 mil (dry) minimum thick coating of galvanizing repair paint. Comply with paint manufacturer's application instructions.

D. Tolerances:
   1. Vertical Alignment (Plumbness) of Studs: Within 1/960th (1/8 inch in 10 feet) of the height.
   2. Horizontal Alignment (Levelness) of Walls: Within 1/960th (1/8 inch in 10 feet) of their respective lengths.
   3. Spacing of Studs: Not more than + 1/8 inch from the designed spacing, providing that the cumulative error does not exceed the requirements of the finishing materials.

E. For metal framing indicated to receive insulation, install full width insulation in voids which will be inaccessible after erection.

F. Installation of Runner Tracks:
   1. Install continuous bottom and top tracks of size and gage shown. Align track accurately and, unless otherwise shown, attach to supporting structure with power-driven fasteners at 16 inches oc. Install fasteners at corners and ends of tracks.
   2. At track butt joints, securely attach abutting pieces of track to a common structural element, or splice them with a welded butt joint.

G. Installation of Studs:
   1. Install studs of size and gage shown. Space studs 16 inches maximum on center, unless otherwise shown.
   2. Install additional studs at wall corners and intersections, adjacent to wall openings, at wall ends, and at both sides of control joints.
      a. For gypsum board applications, keep studs not less than 2 inches nor more than 6 inches from inside corners.
   3. Install full length studs, without splices, between runner tracks.
   4. Install axially loaded studs with full bearing against the webs of the bottom and top runner tracks.
   5. Plumb and align studs and, unless otherwise shown, provide positive attachment to runner tracks using self-drilling fasteners or welds on both flanges of studs.
   6. Install lintels at wall openings wider than the stud spacing as shown or scheduled, or if not shown or scheduled, as recommended by the metal framing manufacturer for the opening spans and loads involved.
   7. Unless otherwise shown, install rough framing at openings using full length studs at the ends of lintels and jack studs from the bottom track to

the underside of the lintels. Install horizontal header tracks and, where required, horizontal sill tracks. Cut horizontal tracks to length, with split flanges and bent webs for flange overlap and attachment to jack studs with self-drilling fasteners. Install cut to length intermediate studs between jack studs at head and sill sections at the same spacing as full length studs.

8. At door openings, install rough framing as specified in 7. above. Coordinate jack studs with the types of door frames to be furnished.
   a. Where solid core wood doors, double doors, or doors weighing more than 50 pounds are shown or scheduled, install 2 full length studs at the ends of lintels instead of one.
9. Install horizontal bridging in equally spaced rows, not exceeding 3'-4" oc. For each row, install solid bridging between studs at corners, ends of walls, openings, and not exceeding 5'-4" on center plus continuous 2 inch by 16 gage strapping on both sides of the wall. Attach solid bridging to each flange of the studs with one self-drilling fastener, or make an equivalent welded connection. Attach the continuous strapping to flanges of all solid bridging with four self-drilling fasteners and to flanges of all studs with one self-drilling fastener, or make equivalent welded connections.
10. Install diagonal bracing as required.

H. Installation of Joists:
1. Install joists of size and gage shown. Space joists 16 inches maximum on center unless otherwise shown.
   a. Install additional joists under parallel partitions where the partition length exceeds 1/2 of the joist span.
2. Locate joists directly over bearing studs, or provide a load distribution member at the top track.
3. Unless otherwise shown, install joists with a minimum bearing of 1-1/2 inches at end supports and 3-1/2 inches at intermediate supports.
4. Install the following as shown, or if not shown, provide the metal framing manufacturer's recommended details:
   a. Framing connectors.
   b. Web stiffeners at bearing and concentrated load points.
   c. Reinforcement at intermediate supports.
5. Install bridging at joist ends and at intermediate supports, unless joists are otherwise restrained from rotation.
6. Install additional framing around floor openings wider than the joist spacing.
7. Unless otherwise shown, install transverse bridging at midspan for joist spans up to 15 feet, and in equally spaced rows not exceeding 8 feet oc for joist spans exceeding 15 feet. For each row, install solid bridging in the first two and last two joist spaces, and at single intermediate spaces not exceeding 10 feet oc, plus continuous 2 inch by 16 gage strapping on the bottom of the joists. The solid bridging shall be of the same depth as the joists and 16 gage minimum thickness. Fasten the solid bridging sections to the joists with 16 gage clip angles with a length one inch less than the joist depth, and with one row of self-drilling fasteners spaced 3 inches on center in each clip angle leg. Fasten the continuous strapping to the solid bridging with 4 self-drilling fasteners, and to the joist bottom

flanges with one self-drilling fastener. Do not fasten the strapping by welding.

8. Provide temporary lateral support for the joist top flanges between the solid bridging locations until the deck material has been installed.
9. Install diagonal bracing as shown.

I. Installation of Rafters:
   1. Comply with the applicable requirements for installation of joists, unless otherwise shown.

**END OF SECTION**

07 53 23

Adhered EPDM Roofing System

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

### 1.02 SCOPE

A. Provide and install vapor retarder insulation and elastic sheet roofing system to achieve a UL Class A external fire rating for the roof system. Work shall include, but not be limited to the following:

1. Polyisocyanurate insulation boards, non-tapered and tapered.
2. Fully adhered roofing membrane system.
3. EPDM flashing.
4. Flashing of mechanical curbs, support pipes, vents, and roof drains into roof membrane system.
5. Metal roof edge and wood blocking.
6. Walk-way pads.
7. 1/2" coverboard.
8. Air and Vapor Barrier

### 1.03 QUALITY ASSURANCE

A. Elastic Sheet Roofing Applicator Requirements

1. Single applicator specializing in the types of roofing required, providing undivided responsibility for the performance of all component parts of the roofing system.
2. Approved by the roofing system manufacturer for the installation of the primary roofing materials indicated, including membrane and flashings.
3. At least five years experience in installing commercial scale elastic sheet roofing system with minimum five successfully completed elastic sheet roofing system installations.

B. Elastic Sheet Roofing Manufacturer Requirements

1. The single-ply membrane systems manufacturer shall specialize in the manufacture and supply of waterproof membrane and roofing materials and have a minimum of ten completed elastic sheet roofing systems installed in field which has not failed in at least ten years.

C. All elastic sheet roofing work including all terminations and other work covered under the roofing manufacturer's warranty shall be performed by a single applicator.

D. Material Requirements: Obtain EPDM membrane and flashings, bonding adhesives, splicing cement, splice wash, and lap sealants from a single manufacturer. All other materials of this section, not provided by the membrane manufacturer, shall be approved in writing by the membrane manufacturer for use in its system.

E. UL Rating: Provide EPDM membrane and insulation which has been classified by Underwriters Laboratories as a component of Class A roofing system.

F. Provide roofing systems which meet the FM requirements for a I-90 rating.

## 1.04 SUBMITTALS

A. Manufacturer's Data

1. Roofing System: Submit of specifications and installation instructions from roofing system manufacturer.
2. Certifications: Submit certification that roofing systems installed as part of this project comply with the specifications and installation instructions of the roofing system manufacturer.

## 1.05 GUARANTEE AND WARRANTY

A. The Contractor shall guarantee the roof system for 2 years and provide a Manufacturer's 5-year System Warranty and a 5-year Membrane Materials-only Warranty, starting on or after the date of Substantial Completion of construction work.

B. Contractor's Guarantee

1. The Contractor guarantees that the total roofing installation, together with all related composition flashings, plastic flashings, metal flashings, roof insulation, vapor seal, cants, blocking, adhesives, and seals installed in connection with same, shall be watertight and free from defects as to materials, installation, and/or workmanship for a period of two (2) years from the date of acceptance of the completed project.

2. During the 2-year guarantee period, the Contractor agrees that within 24 hours of receipt of notice from the Owner, he shall inspect and make immediate emergency repairs to defects or to leaks in roof system, and that within a reasonable time, he shall restore the affected items to the standard of the original specifications.
3. Emergency and permanent work during the life of the Contractor's guarantee shall be done without cost to the Owner, except in the event it is determined that such leaks were caused by abuse, lightning, hurricane, tornado, hail storm, other unusual climatic phenomena of the elements, or failure of adjacent or related work previously installed by others not as part of this contract.

C. Manufacturer's Warranty
1. In addition to the Contractor's guarantee, the Contractor shall provide the roofing manufacturer's unconditional warranty that the roofing installation shall be watertight and free from defects as to materials, installation, and/or workmanship. This warranty shall include roof insulation, tapered insulation, crickets, and edge strips provided under this Contract.
The membrane and insulation shall withstand an extended peak gust wind speed coverage up to 72 MPH. This warranty shall be for 10 years for all roofing work. Such warranty shall commence with the Substantial Completion of all work covered under the Contract. The warranty shall not be limited to any dollar value.
2. A membrane materials-only warranty shall also be included that warrants the roof membrane shall not prematurely deteriorate to the point of failure because of weathering for a period of not less than 5 years.
3. Two (2) copies of Manufacturer's warranty shall be provided to the Owner at the time it accepts Substantial Completion of the project.

## 1.06 JOB CONDITIONS

A. Proceed with roofing work only after substrate preparation has been completed.
B. Examine the substrate and the conditions under which roofing work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
C. Environmental Requirements: Proceed with roofing work only when weather conditions are in compliance with manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with requirements and the manufacturer's recommendations.
D. Install roofing materials only when temperature is above 40°F and rising.

## 1.07 PRODUCT HANDLING, STORAGE, AND DELIVERY

A. Deliver materials in manufacturer's original, unopened containers and rolls with labels intact and legible. All materials shall be delivered to site and/or on hand prior to beginning roofing work.
B. Deliver materials requiring fire resistance classification to the job with labels attached and packaged as required by labeling service.
C. Store materials in accordance with manufacturer's requirements in weather protected environment, clear of ground and moisture. Materials damaged by weather or damaged in any way are not to be used and will be ordered removed from site.
D. Comply with fire and safety regulations.
E. Store emulsions in temperature above 60°F.
F. Store adhesives, flashing material, splice wash, and sealants in a secure, well ventilated, watertight place. Do not leave unused materials on the roof over night or when roofing work is not in progress.
G. Storage of materials on roof shall not be permitted, except materials required for a day's work may be stored on roof on protective plywood sheet and skids.

# PART 2 PRODUCTS

## 2.01 MANUFACTURERS

A. Carlisle Syntec Systems, Sure Seal Adhered Roofing System.
B. GenFlex EPDM fully adhered system.
C. Firestone Adhered RubberGard Roofing System.

## 2.02 MATERIALS

A. Roof Membrane

1. Provide homogeneous one layer 60 mil., FR non-reinforced EPDM membrane, color black.
2. Membrane Flashing

B. Insulation Board

1. Non-tapered and tapered polyisocyanurate HP, rigid closed-cell foam with a heavy glass facer tapered to 1/4" and 1/8" per foot.
   a. Size: Maximum 4'-0" x 4'-0".
   b. Thickness:
      .1 Non-tapered, 4 1/2" applied in 2 layers
      .2 Tapered to meet 7 1/2” total thickness at roof edge..

C. Cover Board, 1/2“ thick
D. Air and Vapor Barrier: 40 mil thick self adhering rubberized asphalt with poly film composite membrane, similar to Carlisle VapAir Seal 725TR
E. Membrane Sealants: Provide sealants compatible with the roofing membrane and flashing system and recommended by membrane manufacturer.
E. Bonding Adhesive: Provide adhesive compatible with membrane and materials to which membrane is to be adhered and recommended by membrane manufacturer.
F. Termination Bar: 1 Provide termination bar compatible with the roofing membrane system.
G. Field flash around all vent pipes, sleeves, equipment curbs and supports, hatch covers, skylights, and other roof penetrations.

### 2.03 ROOFING ACCESSORIES

A. Wood Nailers and Blocking
B. Elastoform Flashing 45 mil thick uncured EPDM
C. Fasteners: Manufacturer's standard type HP epoxy coated fastener and plate with minimum 3/4" penetration through deck. Size as required by manufacturer to suit application. Fasteners to be compatible with all materials and their design and spacing shall comply with Factory Mutual's requirements for I-90 rating of the completed roof systems.
D. Metal Roof Edge:

1. Material: .050" Aluminum.
2. Factory Mutual Rating: Certified FM I-90.
3. Color: dark bronze.
4. Concealed joint connections. Match color and finish of roof edge.
5. Provide factory manufactured corners.
6. 6 3/4" Face.

E. Walkway pad, provide roofing manufacture’s walkway adhered or taped applied pads
F. Edge strip: Install wood blocking as detailed on the drawings.

## PART 3 EXECUTION

### 3.01 INSPECTION

A. Verify deck is clean and smooth, free of depressions, waves, or projections.
B. Verify roof openings, curbs, pipes, and sleeves are solidly set, nailing strips in place.
C. Verify deck surfaces are dry and free of ice or snow.

## 3.02 INSTALLATION

A. General

1. Comply with the instructions and recommendations of the roofing materials manufacturer for the roofing system selected.
2. Confinement of Materials: Do not allow fluid and plastic materials to spill or migrate beyond surfaces of intended application or to flow into drains or conductors.
3. Performance: Watertight construction for normal weather exposures and no deterioration in excess of manufacturer's published limitations.

B. Install self adhering air and vapor barrier

C. Wood Blocking and Nailers: Install treated wood blocking and nailers as shown on drawings, as required by membrane manufacturer, or as required to complete the installation for the roofing system.

## 3.03 INSULATION BOARD

A. After installation of treated wood nailers per Section 06100, Rough Carpentry, thoroughly clean deck of all debris prior to installation of insulation board.
B. Adhere first layer of insulation board in accordance with membrane manufacturer's recommendations and instructions.
C. Adhere second layer of insulation board to the first layer of insulation board, with all joints staggered a minimum of 12" and in accordance with membrane manufacturer's recommendation and instructions.
D. Install taper insulation and crickets where indicated on drawings and/or where required by membrane manufacturer to achieve positive drainage. Adhere tapered insulation and crickets in accordance with membrane manufacturer's recommendations and instructions.
F. The boards shall be installed within 1/4" minimum and 1/2" maximum of walls or penetrations and shall be installed close to drains with the board being cut out with just enough room for drain body.
G. Tapered edge strips at transitions of ½" or more.

## 3.04 MEMBRANE APPLICATION

A. Fully adhere EPDM roofing system to horizontal and vertical substrate in accordance with manufacturer's recommendations and instructions. Extend membrane vertically to and completely under metal roof edge as required by membrane manufacturer. Thoroughly clean insulation board of all debris prior to installation of roofing system.
B. Install flashing and metal roofing edge in accordance with manufacturer's

recommendations.

## 3.05 ROOF DRAINS

A. Provide a smooth transition from the roof surface to the drain clamping ring.
B. Prepare the substrate around each roof drain to avoid membrane bridging at the sump area and possible distortion at the drain clamping ring.
C. The seal between the membrane and the drain base must be provided by water cut-off mastic under compression.
D. All bolts and/or clamps must be in place to provide compression on the water cut-off mastic.
E. The mating surfaces between the clamping ring and drain base must be clean and have a smooth finish with no seams within 3'-0" of roof drains.

## 3.06 CLEANING AND PROTECTION

A. In areas where finished surfaces are soiled by any source caused by work of this section, consult manufacturer for cleaning advice and conform to their instructions.
B. Protect building surfaces against damage from roofing work.
C. Keep roof surfaces clean at all stages of installation. All loose metal, nails, or objects which could cause damage should be removed immediately. An inspection clean up shall be conducted at the conclusion of each day's work.

04/28/21: PDA

*** END OF SECTION ***

## SECTION 078400

## FIRESTOPPING

### PART 1 GENERAL

### 1.01 REFERENCES

A. UL 263 Fire Tests of Building Construction and Materials.

B. UL 1479 Fire Tests of Through-Penetration Firestops.

C. UL 2079 Standard for Safety Tests for Fire Resistance of Building Joint Systems.

D. ASTM E 119 Methods of Fire Tests of Building Construction and Materials.

E. ASTM E 814 Method of Fire Tests of Through-Penetration Fire Stops.

### 1.02 DEFINITIONS

A. UL Fire Resistance Directory: Product directory published yearly, with supplements, by Underwriters Laboratories Inc., containing listings and classifications in effect as of the published date for product categories covered by UL.

B. Inchcape Directory of Listed Products: Product directory published yearly by Inchcape Testing Services containing listings which reflect certifications granted for materials, products, systems and equipment which have been tested by Inchcape Testing Services to recognized governing standards.

C. Omega Point Laboratories Listings Directory: Product Directory published yearly by Omega Point Laboratories, Inc. containing listed building products, materials, and assemblies which have been tested by Omega Point Laboratories to recognized governing standards.

D. Factory Mutual Approval Guide: Product directory published yearly, with supplements, by Factory Mutual Research Corp., containing listed building products, materials, and assemblies which have been tested by Factory Mutual Research Corp., to recognized governing standards.

E. F Rating: Prohibits flame passage through the system and requires acceptable hose stream test performance.

F. T Rating: Prohibits flame passage through the system and requires the maximum temperature rise on the unexposed surface of the wall or floor assembly, on the penetrating item and on the fill material not to exceed 325 degrees F above ambient, and requires acceptable hose stream test performance.

G. Company Field Advisor: An employee of the Company which lists and markets the primary components of the system under their name who is certified in writing by the Company to be technically qualified in design, installation, and servicing of the required products or an employee of an organization certified by the foregoing Company to be technically qualified in design, installation and servicing of the required products. Personnel involved solely in sales do not qualify.

## 1.03 DESIGN REQUIREMENTS

A. Devices and materials shall meet the hourly fire resistance ratings required by the Project as determined by UL 263, UL 1479, UL 2079, ASTM E 119 or ASTM E 814 and be listed and detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
   1. Exception: Where no listed designs exist that meet the requirements of a specific project condition, submit details and manufacturer's written recommendations for a design meeting the requirements. Include evidence of engineering judgment and extrapolation from listed designs.

## 1.04 SUBMITTALS

A. Submittals Package: Submit the following items specified below the same time as a package:
   1. Product Data.
   2. Samples.
   3. Quality Control Submittals.
   4. Firestop Schedule.

B. Product Data: Catalog sheets, specifications and installation instructions for each firestop device and material.
   1. Indicate design number for each firestop proposed to be used which is detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
   2. State the specific locations where each firestop system is proposed to be installed.

C. Samples: One of each product if requested.

D. Quality Control Submittals:
   1. Design Data: Show details and include engineering information and manufacturer's written recommendations required under Design Requirements Article for each proposed firestop if other than a design detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
      a. State the specific locations where each firestop is proposed to be installed.
   2. Installer's Qualifications Data:

a. Name of each person who will be performing the Work and their employer's name, business address and telephone number.
b. Names and addresses of 3 similar projects that each person has worked on during the past 5 years.

3. Company Field Advisor Data:
a. Name, business address and telephone number of Company Field Advisor secured for the required services.
b. Certified statement from the Company listing the qualifications of the Company Field Advisor, and listing of services and each product specifically listed for this Project for which Company Field Advisor is given authorization by the Company to render advice.

E. Firestop Schedule: Submit schedule itemizing the following:
1. Manufacturer's product reference numbers and/or drawing numbers.
2. UL, Inchcape Testing Services, Factory Mutual Research Corp., or Omega Point Lab design number.
3. Location of firestop material.
4. Penetrating Item Description/Limits: Material, size, insulated or uninsulated, and combustibility.
5. Maximum allowable annular space or maximum size opening.
6. Wall type construction.
7. Floor type construction.
8. Hourly Fire resistance rating of wall or floor.
9. F rating.
10. T rating, if available.

**NOTE:** Firestop Schedule is for information only, and will not be acted on for approval. Refer to Sample Firestop Schedule bound in Appendix.

## 1.05 QUALITY ASSURANCE

A. Installer Qualifications: The persons installing the firestopping and their supervisor shall be personally experienced in firestop work and shall have been regularly employed by a company installing firestopping for a minimum of 3 years.

B. Pre-Installation Conference: Before the firestop work is scheduled to commence, a conference will be called by the Director's Representative at the Site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by related trade Contractors (if any), their qualified firestopping installers, and associated firestopping manufacturer's Company Field Advisors.

C. Container/Package Labels: Include manufacturer's name and identifying product number, date of manufacturer, lot number, shelf life (if applicable), qualified testing and inspecting agency classification marking, curing time, and mixing instructions for multi-component materials.

D. Company Field Advisor: Secure the services of a Company Field Advisor for the following:
   1. Render advice regarding suitability of firestopping materials and methods.
   2. Assist in completing firestop schedule.
   3. Attend pre-installation conference.

E. Field-Constructed Sample Installations: Prior to installing firestopping, erect sample installations for each type through-penetration firestop system indicated in the Firestop Schedule to verify selections made and to establish standard of quality and performance by which the firestopping work will be judged.
   1. Build sample installations to comply with the following requirements, using materials indicated for final installations.
      a. Locate sample installations on site at locations where directed.
      b. Obtain Director's Representative's acceptance of sample installations before start of firestopping installation.
      c. Retain and maintain sample installations during construction in an undisturbed condition.
      d. Accepted sample installations in an undisturbed condition at time of substantial completion of Project may become part of completed firestopping work.

## 1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping materials to the Site in original, new unopened containers or packages bearing manufacturer's printed labels.

B. Store and handle firestopping materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, etc.

## 1.07 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Temperature: Do not install firestopping materials when ambient or substrate temperatures are outside limits permitted by manufacturer of firestopping materials.
   2. Humidity and Moisture: Do not install the Work of this Section under conditions that are detrimental to the application, curing, and performance of the materials.
   3. Ventilation: Provide sufficient ventilation wherever firestopping materials are installed in enclosed spaces. Follow manufacturer's recommendations.

## 1.08 SEQUENCING AND SCHEDULING

A. Leave exposed those firestopping installations that are to be concealed behind other construction until the Director's Representative has examined each installation.

## PART 2 PRODUCTS

### 2.01 FIRESTOPPING-GENERAL

A. Through-Penetration Firestop Devices, Forming Materials, And Fill, Void or Cavity Materials: As listed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
   1. For firestopping exposed to moisture, furnish products that do not deteriorate when exposed to this condition.
   2. For firestopping systems exposed to view, furnish products with flame-spread values of less than 25 and smoke developed values less than 50, as determined per ASTM E 84.
   3. For penetrations for piping services below ambient temperature, furnish moisture-resistant through-penetration firestop systems.
   4. For penetrations involving insulated piping, furnish through-penetration firestop systems not requiring removal of insulation.

B. Accessories: Components required to install fill materials as recommended by the firestopping manufacturer for particular approved fire rated system.

C. Identification Labels:
   1. Furnished by fire stopping manufacturer of suitable material for permanent field identification of through-penetration firestops.
   2. Identify the following:
      a. "WARNING - FIRESTOP MATERIAL".
      b. Company Name.
      c. Product Catalog number.
      d. F rating.
      e. T rating, if available.
   3. Field fabricated labels are not acceptable.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Examine existing through-penetrations of floors, walls, partitions, ceilings and roofs in the Work areas.

B. Examine existing junctures, control joints, and expansion joints in the Work areas.

C. Where firestopping is missing or not intact, submit a written report to the Director's Representative describing the existing conditions.

### 3.02 PREPARATION

A. Clean out openings immediately before installation of through-penetration firestopping. Comply with recommendations of firestopping manufacturer and the following requirements:
   1. Remove foreign materials from surfaces of openings, and from penetrating items that could interfere with adhesion of firestopping.
   2. Clean opening and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form release agents from concrete.

B. Clean out openings, and juncture, control, and expansion joints immediately before installation of firestopping. Comply with recommendations of firestopping manufacturer and the following requirements:
   1. Remove foreign materials from surfaces of openings and joint substrates, and from penetrating items that could interfere with adhesion of firestopping.
   2. Clean opening joint substrates to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form release agents from concrete.

C. Protection:
   1. Protect surfaces adjacent to through-penetration firestops with non-staining removable masking tape or other suitable covering to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or that would be caused by cleaning methods used to remove smears from firestopping materials.

D. Substrate Priming:
   1. Prime substrates in accordance with the firestopping manufacturer's printed installation instructions using recommended products and methods.
   2. Do not allow primer to spill or migrate onto adjoining exposed surfaces.

## 3.03 INSTALLATION OF THROUGH PENETRATION FIRESTOPS

A. Use through-penetration firestop devices, forming materials, and fill, void or cavity materials to form through-penetration firestops to prevent the passage of flame, and limit temperature rise of the unexposed surface as detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide, or the Omega Point Laboratories Listings Directory.
   1. Where applicable design is not detailed in the Directories, use forming materials and fill, void or cavity material to form through-penetration firestop in accordance with approved printed details and installation instructions from the company producing the forming materials and fill, void or cavity material.
   2. If the construction type(s) of the building cannot be determined, provide firestopping with fire resistance ratings as specified in the Building Code of New York State, Tables 720.1(1), 720.1(2), 720.1(3), and 302.3.2.

B. Provide through-penetration firestop systems with F ratings that shall equal or exceed the fire resistance rating of the penetrated building construction.

C. Provide through-penetration firestop systems with T ratings, in addition to F ratings, at floors where the following conditions exist:
   1. Where firestop systems protect penetrations located outside the wall cavities.
   2. Where firestop systems protect penetrations located outside fire resistive shaft enclosures.
   3. Through-penetration firestop systems protecting floor penetrations require a T-rating of at least 1 hour, but not less than the required floor fire-resistance rating.

D. Firestop through-penetrations of floors, walls, partitions, ceilings, and roofs.

E. Firestop through-penetrations associated with the new Work.

F. Firestop through-penetration of partitions identified on the Construction Work Drawings as smoke partitions and fire rated assemblies.

G. Firestop through-penetrations of floors, walls, partitions, ceilings, and roofs in accordance with the fire resistance rating assigned to the walls, partitions, floors, ceilings, and roofs on the Construction Work Drawings.

H. In areas where through-penetration items have been installed before the construction work, firestop the through-penetration items after the construction work has been completed. Furnish drawings or written information to the Construction Work Contractor covering the provisions to be made in the construction work to enable firestopping of the through-penetration items.

I. Permanently affix label at each firestop. Use adhesive compatible with surface construction at firestop location.

## 3.04 INSTALLATION OF JUNCTION, CONTROL, AND EXPANSION JOINT FIRESTOPS

A. Use joint treatment materials to form firestop to prevent the passage of flame and limit temperature rise of the unexposed surface, as detailed in the UL Fire Resistance Directory, Inchcape Directory of Listed Products, Factory Mutual Approval Guide or the Omega Point Laboratories Listings Directory.
   1. Where applicable design is not detailed in the Directories, use forming materials and fill, void or cavity material to form firestop in accordance with approved printed details and installation instructions from the company producing the forming materials and fill, void or cavity material.
   2. If the construction type(s) of the building cannot be determined, provide firestopping with fire resistance ratings as specified in the Building Code of New York State, Tables 720.1(1), 720.1(2), 720.1(3), and 302.3.2.

B. Firestop junctures, control joints, and expansion joints.

C. Firestop junctures, control joints, and expansion joints associated with the new Work.

D. Permanently affix labels every 10 feet along each firestop. Use adhesive compatible with surface construction at firestop location.

## 3.05 CLEANING

A. Clean off excess fill materials and sealants adjacent to penetrations by methods and cleaning materials recommended by manufacturers of firestopping products and of products in which penetrations occur.

B. Remove masking tape as soon as practical so as not to disturb the firestopping's bond with substrate.

C. Protect firestopping during and after curing period from contact with contaminating substances, or damage resulting from adjacent Work.

D. Cut out and remove damaged or deteriorated firestopping immediately, and install new materials as specified in firestop schedule.

**END OF SECTION**

**SECTION 099103**

**MECHANICAL AND ELECTRICAL PAINTING**

## PART 1 GENERAL

### 1.01 DEFINITIONS

A. The word "paint" in this Section refers to substrate cleaners, fillers, sealers, primers, undercoats, enamels and other first, intermediate, last or finish coatings.

B. The word "primer" in this Section refers to substrate cleaners, fillers, sealers, undercoats, and other first or intermediate coats beneath the last or finish coating.

C. The words "finish paint" in this Section refers to the last or final coat and previous coats of the same material or product directly beneath the last or final coat.

D. Finish Paint Systems: Finish paint and primers applied over the same substrate shall be considered a paint system of products manufactured or recommended by the finish coat manufacturer.
   1. Finish paint products shall meet or exceed specified minimum physical properties.

### 1.02 SUBMITTALS

A. Painting Schedule: Cross-referenced Painting Schedule listing all exterior and interior substrates to be painted and specified finish paint type designation; product name and manufacturer, recommended primers and product numbers, and finish paint color designation for each substrate to be painted.
   1. Designate exterior substrates by building name and number, substrate to be painted and surface location.
   2. Designate interior substrates by building name and number, floor, room name and number, and surface to be painted.

B. Product Data Sheets: Manufacturer's published product data sheets describing the following for each finish paint product to be applied:
   1. Percent solids by weight and volume, solvent, vehicle, weight per gallon, ASTM D 523 gloss/reflectance angle, recommended wet and dry film thickness, volatile organic compound (VOC) content in lbs/gallon, product use limitations and environmental restrictions, substrate surface preparation methods, directions and precautions for mixing and thinning, recommended application methods, square foot area coverage per gallon, storage instructions, and shelf-life expiration date.
   2. Manufacturer's recommended primer for each finish paint product and substrate to be painted.
   3. Manufacturer's complete range of available colors for each finish paint product to be applied.

C. Finish Paint Type Samples: Two finish paint samples applied over recommended primers for each substrate to be painted.
   1. Samples shall be in the designated color and specified ASTM D 523 reflectance.
   2. Label each sample with the following information:
      a. Project number and Painting Schedule designation describing substrates and locations represented by the sample.
      b. Finish paint and primer manufacturer, product names and numbers, finish paint color and reflectance.
   3. Leave a 1 inch wide exposed strip of unpainted substrate and each coat of primer and finish paint.
   4. Sample Sizes:
      a. Sheet Metals: 4 inch by 8 inch flat sheets.
      b. Bar and Tubular Metals: 8 inch long bars or tubular stock.

D. Quality Control Submittals:
   1. Test Reports: Furnish certified test results from an independent testing laboratory, showing that products submitted comply with the specifications, when requested by the Director's Representative
   2. Certificates: Furnish certificates of compliance required under QUALITY ASSURANCE Article.

**1.03 QUALITY ASSURANCE**

A. Volatile Organic Compounds (VOCs) Regulatory Requirements: Chapter III of Title 6 of the official compilation of Codes, Rules and Regulations of the State of New York (Title 6 NYCRR), Part 205 Architectural Surface Coatings.
   1. Certificate of Compliance: List of each paint product to be delivered and installed. List shall include written certification stating that each paint product listed complies with the VOC regulatory requirements in effect at the time of job site delivery and installation.

B. Container Labels: Label each product container with paint manufacturer's name, product name and number, color name and number, thinning and application instructions, date of manufacture, shelf-life expiration date, required surface preparations, recommended coverage per gallon, wet and dry film thickness, drying time, and clean up procedures.

C. Field Examples:
   1. Prior to on-site painting, at locations designated by the Director's Representative, apply field examples of each paint type to be applied.
   2. Field examples to be applied on actual substrates to be painted and shall duplicate earlier approved paint samples.
      a. Field Example Minimum Wet and Dry Film Thickness: As indicated on approved product data sheet.
      b. Application: Apply each coat in a smooth uniform wet mil thickness without brush marks, laps, holidays, runs, stains, cloudiness, discolorations and other surface imperfections.

1) Leave a specified exposed width of each previous coat beneath each subsequent coat of finish paint and primer.

c. Use of Field Examples: Field examples shall serve as a quality control standard for acceptance or rejection of painting Work to be done under this Section.

3. Field Example Sizes:
   a. Mechanical Equipment: 20 square feet with 1 foot wide strips.
   b. Linear Substrate Examples: 20 lineal feet with 12 inch long strips.
4. Do not begin applying paints represented by field examples until examples have been reviewed and approved by the Director's Representative.
   a. Protect and maintain approved field examples until all painting work represented by the example has been completed and approved.

D. Compatibility of Paint Materials: Primers and intermediate paints shall be products manufactured or recommended by the finish paint manufacturer.

## 1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to the Site in original, unopened containers and cartons bearing manufacturer's printed labels. Do not deliver products which have exceeded their shelf life, are in open or damaged containers or cartons, or are not properly labeled as specified.

B. Storage and Handling: Store products in a dry, well ventilated area in accordance with manufacturer's published product data sheets. Storage location shall have an ambient air temperature between 45 degrees F and 90 degrees F.

## 1.05 PROJECT CONDITIONS

A. Environmental Requirements:
1. Ambient Air Temperature, Relative Humidity, Ventilation, and Surface Temperature: Comply with paint manufacturer's published product data sheet or other printed product instructions.
2. If paint manufacturer does not provide environmental requirements, use the following:
   a. Ambient Air Temperature: Between 45 degrees F and .75 degrees F.
   b. Relative Humidity: Below 75 percent.
   c. Ventilation: Maintain the painting environment free from fumes and odors throughout the Work of this Section.
   d. Surface Temperature: At least 5 degrees F above the surface dewpoint temperature.
3. Maintain environmental requirements throughout the drying period.

B. The following items are not to be field painted unless otherwise specified, noted or directed:
1. Stainless steel, chrome plated or monel surfaces.

2. Piping or ductwork to be insulated.
3. Insulation on concealed piping and concealed ductwork.
4. Insulated items covered with aluminum, stainless steel, or PVC jacketing.
5. Insulation on piping in walk-in and non walk-in tunnels.
6. Uninsulated mechanical equipment with factory applied baked on enamel finish.
7. Mechanical equipment with enameled steel insulated jacket.
8. Prefabricated multi-wall chimneys.

## 1.06 EXTRA MATERIALS

A. Provide extra finish paint materials, from the same production run as paints to be applied, in the following quantities for each color installed:
   1. Paint Types EAL and IAL: Two gallons.
   2. Color Coded Paints: One gallon, each type.
   3. Other Paint Types: One gallon, each type.

# PART 2 PRODUCTS

## 2.01 PAINT MANUFACTURERS

A. Where noted, the following finish paint manufacturers produce the paint types specified.
   1. Ameron Protective Coatings, 201 Berry St., Brea, CA 92621, (800) 926-3766.
   2. Armstrong World Industries, Inc., P.O. Box 3001, Lancaster, PA 17604, (800) 866-5639.
   3. Benjamin Moore and Co., 51 Chestnut Ridge Rd., Montvale, NJ 07645, (201) 573-9600.
   4. ICI Dulux Paints, 4000 DuPont Cr., Louisville, KY 40207, (800) 984-5444.
   5. Inorganic Coatings, Inc., 500 Lapp Rd., Malvern, PA 19355, (800) 345-0531.
   6. Insl-X, 50 Holt Drive, P.O. Box 694, Stony Point, NY 10980, (845) 786-5000.
   7. PPG Architectural Finishes, One PPG Plaza, Pittsburgh, PA 15272, (800) 441-9695.
   8. Rust-Oleum Corporation, 11 Hawthorn Pky., Vernon Hills, IL 60061, (800) 553-8444.
   9. Sherwin-Williams Co., Cleveland, OH 44101; 1-800-321-8194.
   10. Valspar Corp., 1401 Severn St., Baltimore, MD 21230, (800) 638-7756.
   11. Wm. Zinsser & Co., 39 Belmont Dr., Somerset, NJ 08875-1285, (908) 469-8100.

## 2.02 MISCELLANEOUS PRODUCTS

A. Cleaning Solvents: Low toxicity with flash point in excess of 100 degrees F.

B. Color Pigments: Pure, non-fading, finely ground pigments with at least 99 percent passing a 325 mesh sieve.
   1. Use lime-proof color pigments on masonry, concrete and plaster.
   2. Use exterior pigments in exterior paints.

C. Galvanizing Compound, Cold: Single component compound with 93 percent pure zinc in the dried film and meeting the requirements of DOD-P-21035A (NAVY).

D. Masking Tape: Removable paper or fiber tape, self-adhesive and non-staining.

E. Metal Filler: Polyester resin base autobody filler.

F. Mineral Spirits: Low odor type recommended by finish paint manufacturer.

G. Paint Stripper: As recommended by finish paint manufacturer.

H. Stain Blocker, Primer-Sealer: As recommended by finish paint manufacturer.

I. Turpentine: ASTM D 13.

## 2.03 FINISH PAINT TYPES

A. Physical Properties:
   1. Specified percent solids by weight and volume, pigment by weight, wet and dry film thickness per coat, and weight per gallon are minimum physical properties of acceptable materials.
      a. Opaque Pigmented Paints: Physical properties specified are for white titanium dioxide base before color pigments are added.
      b. Specified minimum wet and dry film thickness per coat are for determining acceptable finish paint products. Minimum wet and dry film thickness per coat to be applied shall comply with approved finish paint manufacturer's product data sheets.
   2. Gloss or Reflectance: The following ASTM D 523 specified light levels and angles of reflectance:
      a. Flat: Below 15 at 85 degrees.
      b. Eggshell: Between 5 and 20 at 60 degrees.
      c. Satin: Between 15 and 35 at 60 degrees.
      d. Semigloss: Between 30 and 65 at 60 degrees.
      e. Gloss: Over 65 at 60 degrees.

B. Exterior Finish Paint Types:
   1. Paint Type EAL-1: Exterior Acrylic Latex, Flat.
      a. Solids by Weight: 52.0 percent.
      b. Solids by Volume: 32.0 percent.
      c. Solvent: Water.
      d. Vehicle: 100 percent acrylic resin.
      e. Weight per Gallon: 10.5 lbs.
      f. Wet Film Thickness: 4.0 mils.
      g. Dry Film Thickness: 1.3 mils.

h. Manufacturers: ICI Dulux, PPG, Sherwin-Williams.

2. Paint Type EAL-2: Exterior Acrylic Latex, Semigloss Enamel.
   a. Solids by Weight: 47.0 percent.
   b. Solids by Volume: 33.2 percent.
   c. Solvent: Water.
   d. Vehicle: 100 percent acrylic resin.
   e. Weight per Gallon: 10.0 lbs.
   f. Wet Film Thickness: 4.0 mils.
   g. Dry Film Thickness: 1.3 mils.
   h. Manufacturers: ICI Dulux, PPG, Sherwin-Williams.
3. Paint Type EAL-3: Exterior Acrylic Latex, Gloss Enamel.
   a. Solids by Weight: 40.0 percent.
   b. Solids by Volume: 32.0 percent.
   c. Solvent: Water.
   d. Vehicle: 100 percent acrylic resin.
   e. Weight per Gallon: 10.0 lbs.
   f. Wet Film Thickness: 3.4 mils.
   g. Dry Film Thickness: 1.2 mils.
   h. Manufacturers: Benjamin Moore, PPG, Sherwin- Williams.
4. Paint Type ESP: Exterior Steel Zinc-Rich Primer, Flat.
   a. Solids by Weight: 79.0 percent.
   b. Solids by Volume: 68.0 percent.
   c. Pigment by Weight: 90.0 percent zinc.
   d. Solvent: Water.
   e. Weight per Gallon: 24.6 lbs.
   f. Dry Film Thickness: 3.0 mils if finish coated, 4.0 mils if not finish coated.
   g. Manufacturers: Ameron Protective Coatings, Inorganic Coatings, Valspar.

C. Interior Finish Paint Types:
1. Paint Type IAL-1: Interior Acrylic Latex, Flat.
   a. Solids by Weight: 50.0 percent.
   b. Solids by Volume: 32.0 percent.
   c. Solvent: Water.
   d. Vehicle: Vinyl acrylic resin.
   e. Weight per Gallon: 10.9 lbs.
   f. Wet Film Thickness: 3.8 mils.
   g. Dry Film Thickness: 1.3 mils.
   h. Manufacturers: Benjamin Moore, ICI Dulux, Sherwin-Williams.
2. Paint Type IAL-2: Interior Acrylic Latex, Eggshell.
   a. Solids by Weight: 51.0 percent.
   b. Solids by Volume: 35.0 percent.
   c. Solvent: Water.
   d. Vehicle: Vinyl acrylic resin.
   e. Weight per Gallon: 11.0 lbs.
   f. Wet Film Thickness: 3.8 mils.
   g. Dry Film Thickness: 1.3 mils.
   h. Manufacturers: Benjamin Moore, ICI Dulux, Sherwin-Williams.

3. Paint Type IAL-3: Interior Acrylic Latex, Semigloss Enamel.
    a. Solids by Weight: 49.0 percent.
    b. Solids by Volume: 35.0 percent.
    c. Solvent: Water.
    d. Vehicle: Vinyl acrylic resin.
    e. Weight per Gallon: 10.0 lbs.
    f. Wet Film Thickness: 3.8 mils.
    g. Dry Film Thickness: 1.2 mils.
    h. Manufacturers: Benjamin Moore, ICI Dulux, Sherwin-Williams.
4. Paint Type IAL-4: Interior Acrylic Latex, Gloss Enamel.
    a. Solids by Weight: 40.0 percent.
    b. Solids by Volume: 32.0 percent.
    c. Solvent: Water.
    d. Vehicle: Vinyl acrylic resin.
    e. Weight per Gallon: 10.0 lbs.
    f. Wet Film Thickness: 3.4 mils.
    g. Dry Film Thickness: 1.2 mils.
    h. Manufacturers: Benjamin Moore, PPG, Sherwin-Williams.
5. Paint Type ISP: Interior Steel Primer, Flat.
    a. Solids by Weight: 72.0 percent.
    b. Solids by Volume: 52.0 percent.
    c. Vehicle: Alkyd resin.
    d. Weight per Gallon: 11.4 lbs.
    e. Wet Film Thickness: 3.0 mils.
    f. Dry Film Thickness: 1.5 mils.
    g. Manufacturers: PPG, Sherwin-Williams, Valspar.

D. Heat Resistant Finish Paint Types:
1. Paint Type HR-1: Ambient to 350 degrees Fahrenheit.
    a. Solids by Volume: 40.0 percent.
    b. Vehicle: Modified Silicone.
    c. Weight per Gallon: 9.0lbs.
    d. Wet Film Thickness: 2.5 mils.
    e. Dry Film Thickness: 1.0 mils.
    f. Manufacturers: Benjamin Moore, Insul-X, Rust-Oleum.
2. Paint Type HR-2: 350 degrees Fahrenheit to 800 degrees Fahrenheit.
    a. Solids by Volume: 34.0 percent.
    b. Vehicle: Modified Silicone.
    c. Weight per Gallon: 11.4 lbs.
    d. Wet Film Thickness: 3.0 mils.
    e. Dry Film Thickness: 1.5 mils.
    f. Manufacturers: Benjamin Moore, Rust-Oleum, Sherwin-Williams.
3. Paint Type HR-3: 800 degrees Fahrenheit to 1200 degrees Fahrenheit.
    a. Solids by Volume: 30.0 percent.
    b. Vehicle: 100 percent silicone.
    c. Weight per Gallon: 9.0 lbs.
    d. Wet Film Thickness: 3.0 mils.
    e. Dry Film Thickness: 1.5 mils.

f. Manufacturers: Benjamin Moore, Rust-Oleum, Sherwin-Williams.

E. Other Finish Paint Types:
1. Paint Type EIC: Elastomeric Insulation Coating, Acrylic Latex.
a. As manufactured or recommended by insulation manufacturer.
1) Armstrong Armaflex Insulation: Use WB Armaflex Finish.
2. Paint Type CTE: Coal Tar Epoxy.
a. Solids by Volume: 77.0 percent.
b. Vehicle: Polyamide epoxy.
c. Weight per Gallon: 10.8 lbs.
d. Wet Film Thickness: 10.4 mils.
e. Dry Film Thickness: 8.0 mils.
f. Manufacturers: Benjamin Moore, Insl-X, Sherwin-Williams.

E. Colors: Provide paint colors shown on contract drawings or to be selected by the Director from finish paint manufacturers available color selections.
1. Approved finish paint manufacturers to match designated colors of other manufacturers where colors are shown on contract documents.
2. Safety Colors: Industry Standard ANSI Safety Colors.
3. Fire Protection Systems: Paint exposed piping, and handles of valves serving the system as specified below:
a. Sprinkler Systems: Red piping, and green valve handles.
b. Standpipe Systems: Red piping, and red valve handles.
c. Combination Sprinkler/Standpipe Systems: Red piping, and yellow valve handles.
4. Color Coding: Apply exposed insulated and uninsulated piping finish paints in the following colors when piping is located in the following applicable rooms or spaces:
a. Applicable Rooms and Spaces: Mechanical Equipment Rooms, Steam Service Rooms, Refrigeration Machine Rooms, Boiler Rooms, Penthouse Mechanical Equipment Rooms and Power Houses.
b. Existing Facility Buildings: Color code to match Facility's color code.
c. New Facility Buildings: Color code as follows:
1) Air, Compressed: Safety Green.
2) Air, Control: Safety Green.
3) Air, Medical: Safety yellow.
4) Ammonia, Gas and Liquid: Safety Yellow.
5) Brine: Safety Green.
6) Carbon Dioxide: Safety Red.
7) Dangerous Materials: Safety Yellow.
8) Engine Exhausts: Safety Yellow.
9) Fire Protection Systems; Fire Standpipe, Sprinkler, and Wet Chemical Systems: Safety Red.
10) Flue Gases: Safety Yellow.
11) Gas, Natural and Manufactured: Safety Yellow.
12) Gasoline: Safety Yellow.

13) Glycol and Glycol/Water Mixtures: Safety Yellow.
14) Nitrous Oxide: Safety Blue.
15) Oils, Fuel and Lubrications: Safety Yellow.
16) Oxygen: Safety Green.
17) Pneumatic Tube Systems: Safety Green.
18) Refrigerants: Safety Yellow.
19) Sewers, Storm and Sanitary: Safety Yellow.
20) Steam; Supply, Condensate Return and Exhaust: Safety Yellow.
21) Vacuum: Safety Green.
22) Vent, Atmospheric: Safety Green.
23) Water, Up to 140 Degrees Fahrenheit: Safety Green.
24) Water, 141 Degrees and Above: Safety Yellow.

d. Other Colors:
1) Exposed Ductwork: Gray.
2) Insulated and Uninsulated Equipment: Gray.
a) Do not paint equipment with factory finish paint.

## PART 3 EXECUTION

### 3.01 EXAMINATION

A. Examine surfaces to be prepared, primed, or painted for compliance with contract documents, required environmental conditions, manufacturer's product data sheets, product label instructions and other written requirements.
1. Do not begin any phase of the work without first checking and verifying that surfaces and environmental conditions are acceptable for such work and that any earlier phase deficiencies and discrepancies have been properly corrected.
a. The commencement of new work shall be interpreted to mean acceptance of surfaces to be affected.

### 3.02 PREPARATION

A. Protection: Cover and protect surfaces to be painted, adjacent surfaces not to be painted, and removed furnishings and equipment from existing paint removals, airborne sanding particles, cleaning fluids and paint spills using suitable drop cloths, barriers and other protective devices.
1. Adjacent exterior surface protections include roofs, walls, landscaping, driveways and walkways. Interior protections include floors, walls, furniture, furnishings and electronic equipment.
2. Remove and replace removable hardware, lighting fixtures, telephone equipment, other devices and cover plates over concealed openings in substrates to be painted.
a. Cover and neatly mask permanently installed hardware, lighting fixtures, cover plates and other devices which cannot be removed and are not scheduled for painting.

3. Schedule and coordinate surface preparations so as not to interfere with work of other trades or allow airborne sanding dust particle to fall on freshly painted surfaces.
4. Provide adequate natural or mechanical ventilation to allow surfaces to be prepared and painted in accordance with product manufacturer's instructions and applicable regulations.
5. Provide and maintain "Wet Paint" signs, temporary barriers and other protective devices necessary to protect prepared and freshly painted surfaces from damages until Work has been accepted.

B. Clean and prepare surfaces to be painted in accordance with specifications, paint manufacturer's approved product data sheets and printed label instructions. In the event of conflicting instructions or directions, the more stringent requirements shall apply.
1. Cleaners: Use only approved products manufactured or recommended by finish paint manufacturer. Unless otherwise recommended by cleaner manufacturer, thoroughly rinse with clean water to remove surface contaminants and cleaner residue.

C. Surfaces:
1. Existing Painted Substrates: Thoroughly clean to remove dirt, soot, grease, mildew, chalkiness and stains using finish paint manufacturer's recommended cleaners.
   a. Remove loose, peeling, cracked and blistered paint by chipping, scraping, and sanding smooth with medium and fine sandpaper
   b. Completely strip and remove existing paint films where shown on the drawings using approved methods. When approved, chemical strippers are to be applied and rinsed or removed in accordance with product manufacturer's printed instructions.
   c. Fill surface holes and depressions with finish paint manufacturer's recommended filler and sand smooth to adjacent undisturbed edges.
   d. Touch-up bare spots on previously painted surfaces with finish paint manufacturer's recommended primer.
   e. Sand existing semigloss and gloss paint surfaces to a uniform smooth dull finish before painting.
   f. Fill and sand smooth existing paint surface damages, depressions, ridges and other imperfections that will remain visible after new paints have been applied.
2. Steel Substrates:
   a. Prepare steel in accordance with Structural Steel Painting Council (SSPC) standards:
      1) SSPC-SP1: Remove oil, grease, dirt, soil, salts, and other surface contaminants using appropriate cleaning solvents and clean rags, vapor, alkali, emulsion, or steam and adequate ventilation.
      2) SSPC-SP2: Remove loose rust, mill scale, and paint to the degree specified by hand chipping, scraping, sanding, and wire-brushing.

3) SSPC-SP3: Remove loose rust, mill scale, and paint to the degree specified by power-tool chipping, descaling, sanding, wire-brushing, and grinding.
4) SSPC-SP5: Remove all visible rust, mill scale, paint, and foreign matter by white-metal blast cleaning with wheel or nozzle (dry or wet) using sand, grit, or shot.
5) SSPC-SP6: Remove all visible rust, mill scale, paint, and foreign matter by commercial blast cleaning until at least two-thirds of each element of the surface is free of all visible residues.
6) SSPC-SP10: Near white blast cleaning for heat resistant paints.

5. Galvanized Metal:
   a. Allow new galvanized surfaces to weather as long as possible before cleaning. Remove surface contaminants using clean rags and petroleum spirits.
   b. Remove "white rust" using appropriate solvent and, if necessary, wire brushing or sanding.
   c. Use appropriate Structural Steel Painting Council Standard SSPC-SP1 to SSPC-SP6 to prepare steel substrates where galvanized protection has been removed.
6. Aluminum:
   a. Non-corroded Surfaces: Rub with fine steel wool and wipe clean with mineral spirits.
   b. Corroded Surfaces: Sand smooth, rub with fine steel wool and wipe clean with mineral spirits.

D. Painting Material Preparations:
1. Prepare painting materials in accordance with manufacturer's approved product data sheets and printed label instructions.
   a. Stir materials before and during application for a consistent mixture of density. Remove container surface paint films before stirring and mixing.
   b. Slightly tint first opaque finish coat where primer and finish coats are the same color.
   c. Do not thin paints unless allowed and directed to do so in writing within limits stated on approved product data sheets.

## 3.03 PAINTING SCHEDULE

A. Exterior Exposed Items: Unless otherwise specified, apply the following paint types with manufacturer's recommended primers on the following exterior substrates:
1. Paint Type EAL-3:
   a. Uninsulated piping and ductwork.
   b. Equipment hangers, supports and accessories for pipe and ductwork.
2. Paint Type EIC:
   a. Flexible elastomeric foam insulation on piping, ductwork, and equipment.

B. Exterior and Interior Exposed Fuel System Items: Unless otherwise specified, apply the following paint types with manufacturer's recommended primers on the following exterior and interior substrates.

1. Paint Type EAL-3:
   a. Galvanized steel vent piping.
   b. Galvanized steel piping except vent piping.
      1) Colors: As specified on Drawing No. _____ which is bound in Section _____.
   c. Structural steel supports for fuel pump island dry chemical extinguishing system.
   d. Pipe bollards.
      1) Color: Safety Yellow.
   e. Fuel pump island fascia.
   f. Manhole frames and lids, and fill caps; unless factory finished with appropriate A.P.I. color and symbol.

      1) Colors and Symbols: As specified on Drawing No. _____ which is bound in Section _____.
2. Paint Type CTE:
   a. Non-stainless steel exposed surfaces of hold down straps, turnbuckles, adjustment rods, wire rope, wire rope clamps, eye bolts, and anchor rods.

C. Interior Exposed Items: Unless otherwise specified, apply the following paint types with manufacturer's recommended primers on the following interior substrates.

1. Paint Type IAL-3:
   a. Insulated and uninsulated piping and ductwork.
   b. Equipment hangars, supports and accessories for pipe and ductwork.
   c. Hot and cold service equipment insulation.
   d. Direct cast iron radiators.
   e. Electrical raceways, fittings, pull boxes, junction boxes, etc.
2. Paint Type IAL-4, on shop or factory primed substrates:
   a. Type A service sinks.
   b. Grease traps and interceptors.
   c. Uninsulated mechanical equipment.
   d. Cast iron fixture brackets.
   e. Metal fabrication in finished spaces.
3. Paint Type EIC:
   a. Flexible elastomeric foam insulation on piping, ductwork, and equipment.
4. Paint Type HR-1, HR-2 or HR-3 to match substrate continuous and intermittent operational surface temperatures.
   a. Uninsulated smoke flue pipe.
   b. Uninsulated breeching.
   c. Uninsulated exposed iron and steel boiler surfaces including steel casing, buck stays, boiler fronts, castings, smoke flue pipes,

breeching, and exposed iron or steel surfaces installed in conjunction with boiler and incinerator Work.

## 3.04 APPLICATION

A. Environmental Conditions:
   1. Water-based Paints: Apply when surface temperatures will be 50 degrees Fahrenheit to 90 degrees Fahrenheit throughout the drying period.
   2. Other Paints: Apply when surface temperatures will be 45 degrees Fahrenheit to 95 degrees Fahrenheit throughout the drying period.
   3. Apply exterior paints during daylight hours free from rain, snow, fog and mist when ambient air conditions are more than 5 degrees above the surface dewpoint temperature and relative humidity less than 85 percent.
      a. When exterior painting is allowed or required during nondaylight hours, provide portable outdoor weather recording station with constant printout showing hourly to diurnal air temperature, humidity, and dewpoint temperature.
   4. Exterior Cold Weather Protection: Provide heated enclosures necessary to maintain specified temperature and relative humidity conditions during paint application and drying periods.

B. Application: Apply approved paints where specified, or shown on the drawings, and to match approved field examples.
   1. Applicators: Brushes, rollers or spray equipment recommended by the paint manufacturer and appropriate for the location and surface area to be painted.
      a. Approved minimum wet and dry film thicknesses for each coat shall be as recommended on approved product data sheets and the same for each application method and substrate.

C. Paint Type Coats To Be Applied: Unless otherwise specified, or recommended by finish paint manufacturer's product data sheet and approved by submittal, the number of coats to be applied for each paint type are as follows:
   1. Acrylic Latex Paint Types EAL and IAL:
      a. New Unpainted Surfaces: Apply 1 coat of primer and 2 coats of finish paint.
      b. Existing Painted Surfaces:
         1) Apply 2 coats of finish paint when existing paint has a lower gloss.
         2) Apply one coat of primer and 2 finish coats when existing paint has a higher gloss.
      c. Paint Type IAL: Provide mildewcide additive for bathrooms, kitchens, janitor closets, laundry rooms, restrooms and other wet or damp areas.
   2. Paint Types ESP and ISP: Apply 1 coat.
      a. Allow paint to dry one week and test adhesion. Remove and replace defective primer where adhesion failures occur.

3. Other Paint Types: Apply in accordance with paint manufacturer's product data sheets.

## 3.05 FIELD QUALITY CONTROL

A. Paint Samples: Assist the Director's Representative in obtaining random one quart paint samples for testing at any time during the Work.
   1. Notify the Director's Representative upon delivery of paints to the Site.
   2. Furnish new one quart metal paint containers with tight fitting lids and suitable labels for marking.
      a. Furnish labor to thoroughly mix paint before sampling and provide assistance with sampling when required.

## 3.06 ADJUSTING AND CLEANING

A. Reinstall removed items after painting has been completed.
   1. Restore damaged items to a condition equal to or better than when removed. Replace damaged items that cannot be restored.

B. Touch up and restore damaged finish paints. Touch up and restoration paint coats are in addition to the number of specified finish paint coats.

C. Remove spilled, splashed, or spattered paint without marring, staining or damaging the surface. Restore damaged surfaces to the satisfaction of the Director's representative.

D. Remove temporary barriers, masking tape, and other protective coverings upon completion of painting, cleaning and restoration work.

**END OF SECTION**

## SECTION 220519

## COLD WATER METERS

### PART 1 GENERAL

### 1.01 SUBMITTALS

A. Product Data: Manufacturer's catalog sheets indicating type, size, materials of construction, end connections, sensitivity, and installation instructions.

B. Test Report: Certified factory test curve, indicating percentage of accuracy of meter and loss of head in psi from 0 to 100 percent delivery range.

### 1.02 REGULATORY REQUIREMENTS

A. Comply with the requirements of the applicable American Water Works Association (AWWA) Standard.

### PART 2 PRODUCTS

### 2.01 COLD WATER METERS

A. Types:
   1. Type A (Displacement Meters): Incorporates nutating disc, or oscillating piston, bronze main case; AWWA C700.
   2. Type B (Turbine Meters):
      a. Vertical shaft, or low velocity horizontal shaft; AWWA C701, Class I.
   3. Type C (Compound Meters): Combination main line turbine meter for measuring high flow rates, with automatic valve mechanism for diverting low rates of flow for measurement through integral bypass meter; AWWA C702.
   4. Type D (Fire Service Meters): Combination main line proportional type, having unobstructed passageway of essentially full pipe size for measuring high flow rates, with automatic valve mechanism for diverting low rates of flow for measurement through appropriately sized integral bypass meter; AWWA C703.
      a. Alternate turbine type meter may be used, as approved, if it meets the C703 criteria, and is furnished with a UL Listed strainer having the required cross-sectional area.
   5. Type E (Propeller Meters): For main line applications. Registers by recording revolutions of propeller set in motion by force of flowing water striking blades; AWWA C704.

B. Materials: Provide materials in accordance with the applicable AWWA Standard:

1. Exception: Materials prefixed in the standard with the terms “anti-corrosion”, “corrosion-resistant”, and/or “suitable”, and the suffix “treated to resist corrosion”, shall be separately submitted for approval with detailed description of materials and intended usage for specific meter part(s).

C. Strainers: Furnish meters, except for fire service turbine type, with integral strainers as described in the applicable AWWA Standard.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install meters in accordance with the manufacturer’s printed installation instructions.

1. Provide frost proof meters in pits or structures outside of buildings, and in unheated areas.

**END OF SECTION**

**SECTION 220523**

**VALVES**

## PART 1 GENERAL

### 1.01 ABBREVIATIONS

A. IBBM: Iron body, bronze mounted.

B. OS&Y: Outside screw and yoke.

C. WOG: Water, oil, gas.

D. WSP: Working steam pressure.

### 1.02 SUBMITTALS

A. Product Data: Manufacturer's catalog sheets and specifications for each valve type.

B. Valve Schedule: List type of valve, manufacturer's model number, and size for each service application.

## PART 2 PRODUCTS

### 2.01 VALVES - GENERAL

A. Valve Standardization: Valves from one or more manufacturers may be used, however valves supplied for each specific valve type shall be the product of one manufacturer.

B. Valves shall be first quality, free from all imperfections and defects, with body markings indicating manufacturer and rating.

C. Valve parts of same manufacturer, size and type shall be interchangeable.

D. Manually operated gate, globe and angle valves shall be of rising stem type, unless otherwise specified.

E. Valves which use packing, shall be capable of being packed when wide open and under full working pressure.

F. Size valves the same size as the piping in which they are installed, unless specified otherwise.

### 2.02 GATE VALVES

A. Type A: 125 psig WSP, 200 psig WOG, bronze body, union bonnet, solid wedge disc, and threaded ends. Acceptable Valves: Crane428UB, Hammond IB617, Jenkins 47CU, Milwaukee 1152, Nibco T13, and Stockham B105.

B. Type C: 125 psig WSP, 200 psig WOG up to 12 inch size, and 150 psig WOG for 14 inch and 16 inch sizes; IBBM OS&Y, bolted bonnet, solid wedge disc, and threaded or flanged ends depending on size. Acceptable Valves: Crane 464-1/2, 465-1/2, Hammond IR1140, Milwaukee F2885, Nibco T6170 & F6170, and Stockham G620 & G623

C. Type D: 125 psig WSP, 200 psig WOG, bronze body, threaded bonnet, solid wedge disc, and solder ends. Acceptable Valves: Crane 1330, Hammond IB635, Jenkins 991AJ, Milwaukee 149, Nibco S111, and Stockham B108.

## 2.03 GLOBE AND ANGLE VALVES

A. Type J: 125 WSP, 200 psig WOG, bronze body, threaded bonnet, and threaded ends. Acceptable Valves: Crane 1, Hammond IB440 & IB463, Jenkins 101J, Milwaukee 502, Nibco T211 & T311, and Stockham B16.

B. Type K: 125 psig WSP, 200 psig WOG, IBBM OS&Y, bolted bonnet, and threaded or flanged ends depending on size. Acceptable Valves: Crane 351 353, Hammond IR116, Jenkins 613C & 615C, Milwaukee F2981, Nibco F718B & F818B, and Stockham G512, & G515.

C. Type O: 125 psig, 200 psig WOG, bronze body, threaded bonnet, and solder ends. Acceptable Valves: Crane 1310, Hammond IB423, Jenkins 1200C, Milwaukee 1502, Nibco S21, and Stockham B17.

## 2.04 CHECK VALVES

A. Type S: 125 psig WSP, 200 psig WOG, bronze body, brass or bronze trim, horizontal swing, renewable and regrindable disc, and threaded ends. Face discs for cold water service with teflon. Acceptable Valves: Crane 37, Hammond IB940, Jenkins 4092, Milwaukee 509, Nibco T413Y, and Stockham B319Y.

B. Type U: 125 psig WSP, 200 psig WOG, bronze body, brass or bronze trim, horizontal swing, renewable and regrindable disc, and solder ends. Face discs for cold water service with teflon. Acceptable Valves: Crane 1340, Hammond IB912, Jenkins 4093, Milwaukee 1509, Nibco S413Y, and Stockham 309Y.

C. Type V: 125 psig WSP, 200 psig WOG, IBBM, horizontal swing, bolted bonnet, regrindable and renewable seat ring and disc, and threaded or flanged ends depending on size. Discs on valves 4 inch size and larger may be cast iron with bronze face. Acceptable Valves: Crane 372, & 373, Hammond IR1124, Jenkins 623CJ & 624CJ, Milwaukee F2974, Nibco F918, and Stockham G927 & G931.

## 2.05 BUTTERFLY VALVES

A. Type BF: Iron body, flangeless wafer or lugged type, (lug for each bolt hole, drilled and tapped for cap screws), with replaceable reinforced resilient EPT (EPDM) seats, bronze or nickel plated ductile iron discs, phosphate coated steel or stainless steel stems, and raised necks able to accommodate 2 inches of insulation. Acceptable Manufacturers: Crane, Demco, De Zurik, Hammond, Keystone, Milwaukee, Nibco, Stockham, and Watts.
   1. Pressure Ratings:
      a. 12 inch size and Less: 200 psig WOG at 275 degrees F.

B. Operators:
   1. 6 inch size and Less: Manual actuator handles with external indication of disc position, and suitable means of locking actuator in any fixed position.

## 2.06 WATER PRESSURE REDUCING VALVES

A. Main Water Service:
   1. Valve shall be an adjustable, direct acting, spring loaded, diaphragm operated, single seat, bottom guided type suitable for dead end service; guaranteed not to stick and shall maintain a constant discharge pressure which will not vary more than 1 psig for each 10 psig decrease in inlet pressure. Valves shall have cast iron, mild steel or bronze bodies, with either flanged ends or screwed ends with unions. Valve trim shall be of stainless steel with renewable composition disc. Parts subject to wear shall be renewable.
   2. Material of diaphragm and disc shall be suitable for an operating temperature to 150 degrees F. The control line, from diaphragm casing, shall be connected to the discharge piping at least 10 feet downstream from pressure reducing valve. Control line shall be of same material as adjoining piping. Valves shall be standard weight for inlet pressures up to 125 psig, and extra heavy weight for inlet pressures in excess of 125 psig.
   3. Acceptable Valves: Fisher Governor Type 655A, Kieley Mueller Type 4250.

## 2.07 SAFETY AND RELIEF VALVES

A. General Requirements: Valves shall be as specified by ASME Code governing manufacture of such valves within scope of their particular usage, i.e., Heating Boilers, Unfired Pressure Valves, etc., shall be tested, rated and listed, unless otherwise specified. Valves for applications specified shall conform to the ASME Code, Section IV, Heating Boilers and the following:
   1. Valves for combination domestic hot water heater and storage tanks shall conform to the requirements of ASME Code, Section IV and USA Standard Z21.22 and shall be NBB listed. Valves shall be of the temperature - pressure type. Thermostatic element shall, on rising temperature, cause the valve to open at 200 degrees F. and valve shall deliver its rated capacity at 210 degrees F. and close drip tight at 195 degrees F. Valves shall be sized in accordance with Unfired Vessel Code.

2. End Connections: Unless otherwise specified, safety valves, relief valves and safety relief valves, in sizes 3/4 inch to 3 inches IPS inclusive, may be furnished with male or female pipe thread inlet and female pipe thread outlet; valves over 3 inches IPS must be furnished with 125 lb. or 250 lb. flanged inlet and may be equipped with female threaded or 125 lb. flanged outlet.

## 2.08 NEEDLE STOP VALVES

A. For Temperatures to 300 degrees F.: All brass or forged carbon steel construction, union bonnet, threaded ends, built for 1000 psi at 300 degrees F. Acceptable Manufacturers: Marsh Instrument Co., H.O. Trerice Co., Weksler Instruments Co.

## 2.09 GAGE COCKS

A. Gage Cocks: All brass construction, "T" or lever handles, threaded ends, built for 300 psig hydraulic pressure. Acceptable Manufacturers: Marsh Instrument Company, Mueller Instruments Co., H.O. Trerice Co. and Weksler Instruments Corp.

## 2.10 BALL VALVES

A. Type BV: 150 psig WSP, 600 psig WOG, 2 piece bronze body, solid blow-out proof stem, teflon seats, chrome plated brass ball, teflon seals, corrosion resistant steel lever handles with vinyl grips, balancing stop, and threaded or solder ends. Acceptable Manufacturers: Conbraco, Hammond, Milwaukee, Nibco, and Watts.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. General: Install valves at locations noted on the drawings or specified.

## 3.02 VALVE APPLICATION SCHEDULE

A. Schedule of valve applications for the different services is as follows:
   1. Cold Water In Buildings and Tunnels (CW) 125 psig and Less:
      a. 3 inch and Less: A or D gates or BV balls, O globes or angles, and S or U checks; or C gates, K globes or angles, and V checks, with solder joint companion flanges.
      b. 4 inch and Up: C gates or BF butterflys, K globes or angles, and V checks.
   2. Domestic Hot Water and Circulating (DHW & DHWC) 125 psig and Less:
      a. 3 inch and Less: A or D gates or BV balls, J or O globes or angles, and S or U checks.

**END OF SECTION**

**SECTION 220529**

**PIPE HANGERS AND SUPPORTS**

## PART 1 GENERAL

### 1.01 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Companion high density filler pieces for installation over the top 180 degree surface of pipe or tubing, at points of support where a combination clevis hanger, insulation shield and high density insulating saddle are installed.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Piping Insulation: Section 220700.

### 1.03 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions for each item specified except fasteners.

### 1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with the applicable requirements of the ASME B31 Piping Codes.
   2. Unless otherwise shown or specified, comply with the requirements of the Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58, and SP-69.
   3. Materials for use in Sprinkler Systems and Standpipe and Hose Systems shall comply with the requirements of NFPA 13 and NFPA 14 as applicable.
   4. Hang and support cast iron soil pipe and fittings in accordance with the recommendations of the Cast Iron Soil Pipe's Institute's (CISPI) Cast Iron Soil Pipe and Fittings Handbook.

## PART 2 PRODUCTS

### 2.01 PIPE HANGERS AND SUPPORTS

A. Combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddle with companion high density filler piece.
   1. Insulating saddles and filler pieces shall be of the same thickness and materials as the adjoining pipe insulation. Saddles shall cover the lower 180 degrees of the pipe or tubing, and companion filler pieces shall cover the upper 180 degrees of the pipe or tubing. Physical sizes, gages, etc. of the components of insulated hangers shall be in accordance with the following schedule:

| PIPE OR | SHIELD | | SADDLE | VAPOR BARRIER |
|---|---|---|---|---|

| TUBING SIZE (Inches) | LENGTH (Inches) | SHIELD GAGE | LENGTH (Inches) | JACKET LENGTH (Inches) |
|---|---|---|---|---|
| Up to 2-1/2 | 4 | 16 | 6 | 10 |
| 3 to 6 | 4 | 14 | 6 | 10 |

B. Pipe Insulation Shields: Fabricated of steel, with a minimum arc of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

| PIPE OR TUBING SIZE (Inches) | SHIELD LENGTH (Inches) | SHIELD GAGE |
|---|---|---|
| Up to 2-1/2 | 8 | 18 |
| 3 to 8 | 10 | 16 |

C. Pipe Covering Protection Saddles: 3/16 inch thick steel, of sufficient depth for the insulation thickness specified, notched so that saddle contact with the pipe is approximately 50 percent of the total axial cross section. Saddles for pipe 12 inches in size and larger shall have a center support.

D. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.
1. Swivel ring type hangers will be allowed for sprinkler piping up to a maximum of 2 inches in size.

E. Adjustable Floor Rests and Base Flanges: Steel.

F. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with two nuts at each end for positioning rod and hanger, and locking each in place.

G. Riser Clamps: Malleable iron or steel.

H. Rollers: Cast Iron.

## 2.02 ANCHORS AND ATTACHMENTS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN, HN, or FS Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS Series.

C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips S Series.

D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.

E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS Series.

F. Beam Clamps: Forged steel beam clamp, with weldless eye nut (right hand thread), steel tie rod, nuts, and washers, Grinnell's Fig No. 292 (size for load, beam flange width, and rod size required).

## 2.03 FASTENERS

A. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

## 2.04 SHOP PAINTING AND PLATING

A. Hangers, supports, rods, inserts and accessories used for pipe supports, unless chromium plated, cadmium plated or galvanized shall be shop coated with metal primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper pipe or copper tubing.

B. Hanger supports for chromium plated pipe shall be chromium plated brass.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Do not hang or support one pipe from another or from ductwork.
1. Do not bend threaded rod.

B. Support all insulated horizontal piping conveying fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.

C. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.
1. For Steel, and Threaded Brass Pipe:

| PIPE SIZE (Inches) | MAXIMUM SPACING (Feet) |
|---|---|
| 1 and under | 8 |
| 1-1/4 and 1-1/2 | 9 |
| 2 | 10 |
| 2-1/2 and up | 12 |
| | |

2. For Grooved End Steel Pipe:

| PIPE SIZE (Inches) | MAXIMUM SPACING (Feet) |
|---|---|
| 1-1/2 and under | 7 |
| 2 through 4 | 10 |

| PIPE SIZE (Inches) | MAXIMUM SPACING (Feet) |
|---|---|
| | |

No pipe length shall be left unsupported between any two coupling joints.

3. For Copper Pipe and Copper Tubing:

| PIPE OR TUBING SIZE (Inches) | MAXIMUM SPACING (Feet) |
|---|---|
| 1-1/2 and under | 6 |
| 2 and over | 10 |
| | |

4. Cast Iron Soil Pipe:
   a. General:
      1) Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway bracing to prevent horizontal pipe movement.
      2) Additionally, brace piping 5 inches and larger to prevent horizontal movement and/or joint separation. Provide braces, blocks, rodding or other suitable method at each branch opening, or change of direction
   b. For Bell & Spigot Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of 5 feet. Place hangers or supports as close as possible to joints and when hangers or supports do not come within 1 foot of a branch line fitting, install an additional hanger or support at the fitting.
   c. For Hubless Cast Iron Soil Pipe: Space hangers or support pipe at each joint or on maximum centers of 5 feet. Place hanger or supports as close as possible to joints and when hangers or supports do not come within 1 foot of a branch line fitting, install an additional hanger or support at the fitting.
5. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.
6. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.
7. For Branch Piping Runs and Runouts Over 5 feet In Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.
8. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.

9. Support floor drain traps from the overhead construction, with hangers of type and design as required and approved. Overhead supports are not required for floor drain traps installed directly below earth supported concrete floors.

D. Size hanger rods in accordance with the following:

| PIPE OR TUBING SIZE (Inches) | SINGLE ROD HANGER SIZE (Inches) | | DOUBLE ROD HANGER SIZE (Inches) | |
|---|---|---|---|---|
| | PIPE | TUBING | PIPE | TUBING |
| 1/2 to 2 | 3/8 | 1/4 | 3/8 | 1/4 |
| 2-1/2 and 3 | 1/2 | 3/8 | 3/8 | 1/4 |
| 4 and 5 | 5/8 | 1/2 | 1/2 | 3/8 |

1. Secure hanger rods as follows: Install one nut under clevis, angle or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each rod, two at upper hanger attachment and two at hanger.

E. Vertical Piping:

1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.
2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.
3. Support cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and 1/4 inch thick malleable iron or steel riser clamps with extension arms at each floor level, with the distance between clamps not to exceed 25 feet. Support cast iron risers in vertical shafts equivalent to the aforementioned.
4. Support hubless cast iron risers, by means of heavy duty hangers installed close to the base of the pipe risers, and by malleable iron or steel riser clamps with the extension arms at each floor level, with the distance between clamps or intermediate supports not to exceed 12 feet. Support risers in vertical shafts equivalent to the aforementioned.

F. Floor Supports: Install adjustable yoke rests with base flanges, for the support of piping, unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.

G. Underground Cast Iron Pipe Supports: Firmly bed pipe laid underground, on solid ground along bottom of pipe. Install masonry piers for pipe laid in disturbed or excavated soil or where suitable bearing cannot be obtained. Support pipe, laid proximate to building walls in disturbed or excavated soil, or where suitable bearing cannot be obtained, by means of wall brackets or hold-fasts secured to walls in an approved manner.

## 3.03 UPPER HANGER ATTACHMENTS

A. General:
1. Secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
2. Do not attach hangers to steel decks that are not to receive concrete fill.
3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
4. Do not use flat bars or bent rods as upper hanger attachments.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.
1. Do not use drive-on beam clamps.
2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
3. Do not drill holes in main structural steel members.
4. Beam clamps, with tie rods as specified, may be used as upper hanger attachments for the support of piping, subject to clamp manufacturer's recommended limits.

C. Attachment to Wood Construction: Secure hangers to the sides (only) of wood members, by means of malleable iron side beam connectors, or malleable iron or steel side beam brackets. Do not secure hanger attachments to nailing strips resting on top of steel beams.
1. Secure side beam connectors to wood members with two No. 18 x 1-1/2 inch long wood screws, or two No. 16 x 1-1/2 inch long drive screws. Do not support piping over 1-1/2 inches in size from side beam connectors. Do not hammer in wood screws.
2. Secure side beam brackets to wood members with steel bolts or lag screws. Do not use lag screws in wooden members having a nominal thickness (beam face) under 2 inches in size. Install bolts or lag screws, in the sides of a timber or a joist, at the mid-point or above, not less than 2-1/2 inches from the lower edge when supporting branch lines and not less than 3 inches from the lower edge when supporting mains. Install heavy gage steel washers under all nuts.
3. Secure side beam brackets to wooden beams or joists, with lag screws or bolts of size as follows:

| PIPE SIZE (Inches) | LAG SCREW SIZE (Inches) | BOLT DIAMETER (Inches) |
|---|---|---|
| 2 and under | 3/8 diameter x 1-3/4 | 3/8 |
| 2-1/2 and 3 | 1/2 diameter x 2 | 1/2 |
| 4 and 5 | Use Bolt | 5/8 |

| PIPE SIZE (Inches) | LAG SCREW SIZE (Inches) | BOLT DIAMETER (Inches) |
|---|---|---|
| | | |

a. Do not support piping larger than 3 inches with lag screws. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.

b. The minimum width of the lower face of wood beams or joints in which lag screws of size as specified may be used is as follows:

| LAG SCREW DIAMETER (Inches) | NOMINAL WIDTH OF BEAM FACE (Inches) |
|---|---|
| 3/8 | 2 |
| 1/2 | 3 |
| | |

4. Do not secure hanger attachment to the diagonals or vertical members of the trusses.

## 3.04 ANCHORS, RESTRAINTS, RIGID SUPPORTS, STAYS AND SWAY BRACES

A. Cast Iron Soil Piping Systems:

1. Where piping is suspended on centers in excess of 18 inches by means of non-rigid hangers, provide sway braces, of design, number and location in accordance with the Cast Iron Soil Pipe Institute's Cast Iron Soil Pipe and Fittings Handbook to prevent horizontal pipe movement.

## 3.05 COMBINATION CLEVIS HANGER, PIPE INSULATION SHIELD AND VAPOR BARRIER JACKETED HIGH DENSITY INSULATING SADDLES

A. Install a combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddles, at all points of support for piping or tubing to be insulated for cold service. Furnish companion high density vapor barrier jacketed saddle pieces, of the same material, thickness and length, for installation over the top 180 degree surface of pipe or tubing, at each point of support where an insulated clevis hanger is utilized.

## 3.06 PIPE INSULATION SHIELDS

A. Unless otherwise specified, install a pipe insulation shield, at all points of support. Center shields on all hangers and supports outside of high density insulation insert, and install in such a manner so as not to cut, or puncture jacket.

## 3.07 PIPE COVERING PROTECTION SADDLES

A. Install pipe covering protection saddles at all points of support, for steel piping 6 inches in size and larger, insulated with hot service insulation. Weld saddles to piping to insure movement with pipe.

**END OF SECTION**

**SECTION 220553**

**PIPE AND VALVE IDENTIFICATION**

## PART 1 GENERAL

### 1.01 REFERENCES

A. ANSI A13.1 - Scheme for Identification of Piping Systems.

### 1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions for each item specified.

## PART 2 PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. W.H. Brady Co., Milwaukee, WI.

B. Emed Co., Buffalo, NY.

C. Panduit Corp., Tinley Park, IL.

D. Seton Nameplate Corp., New Haven, CT.

### 2.02 PIPE MARKERS AND ACCESSORIES

A. Snap-on Marker: One piece wrap around type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, 3/4 inch adhesive strip on inside edge, and 360 degree visibility.

B. Strap-On Marker: Strip type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, factory applied grommets, and pair of stainless steel spring fasteners.

C. Stick-On Marker: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.

D. Pipe Marker Legend and Color Field Sizes:

| OUTSIDE DIAMETER OF PIPE OR INSULATION (Inches) | LETTER SIZE (Inches) | LENGTH OF COLOR FIELD (Inches) |
|---|---|---|

| OUTSIDE DIAMETER OF PIPE OR INSULATION (Inches) | LETTER SIZE (Inches) | LENGTH OF COLOR FIELD (Inches) |
|---|---|---|
| 3/4 to 1-1/4 | 1/2 | 8 |
| 1-1/2 to 2 | 3/4 | 8 |
| 2-1/2 to 6 | 1-1/4 | 12 |

E. Banding Tapes: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating.
   1. Plain Tape: Unprinted type; color to match pipe marker background.
   2. Flow Arrow Tape: Printed type with integral flow arrows; color to match pipe marker background.

F. Pipe Size Labels: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, vertical reading pipe size in inches, and legend size matching adjacent pipe marker.

## 2.03 PIPE SERVICE IDENTIFICATION TAGS

A. Type: No. 19 B & S gage brass, with 1/4 inch high pipe service abbreviated legend on one line, over 1/2 inch high pipe size legend in inches, both deep stamped and black filled; and 3/16 inch top hole for fastener.

B. Size: 2 inch square tag.

C. Fasteners: Brass "S" hook or brass jack chain of size as required for pipe to which tag is attached.

## 2.04 VALVE SERVICE IDENTIFICATION TAGS

A. Type: No. 19 B & S gage brass, with 1/4 inch high valve service abbreviated lettering on one line over 1/2 inch high valve service chart number, both deep stamped and black filled; and with 3/16 inch top hole for fastener.

B. Sizes:
   1. Plumbing Use: 1-1/2 inch hexagon.

C. Fasteners: Brass "S" hook or brass jack chain of size as required for valve stem or handle to which tag is attached.

## 2.05 VALVE SERVICE IDENTIFICATION CHART FRAMES

A. Type: Satin finished extruded aluminum frame with rigid clear plastic glazing, size to fit 8-1/2 x 11 inches valve chart.

# PART 3 EXECUTION

## 3.01 PREPARATION

A. Complete testing, insulation and finish painting work prior to completing the Work of this Section.

B. Clean pipe surfaces with cleaning solvents prior to installing piping identification.

C. Remove dust from insulation surfaces with clean cloths prior to installing piping identification.

## 3.02 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. Stick-On Pipe Markers:
   1. Install minimum of 2 markers at each specified location, 90 degrees apart on visible side of pipe.
   2. Encircle ends of pipe markers around pipe or insulation with banding tape with one inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.

C. Pipe Size Labels: Install labels adjacent to each pipe marker and upstream from flow arrow. Install a minimum of 2 pipe size labels at each specified location, 90 degrees apart on visible side of pipe.

D. Pipe Service Identification Tags: Attach tags to piping being identified with "S" hooks or jack chains.

## 3.03 PIPING IDENTIFICATION SCHEDULE

A. Piping Identification Types:
   1. Piping or Insulation under 3/4 inch od: Pipe identification tags.
   2. Piping or Insulation 3/4 inch to 5-7/8 inch od: Snap-on marker or stick-on marker.
   3. Piping or Insulation 6 inch od and Larger: Strap-on marker or stick-on marker.

B. Identify exposed piping, bare or insulated, as to content, size of pipe and direction of flow, with the following exceptions:
   1. Piping in furred spaces or suspended ceilings, except at valve access panels where valves and piping shall be identified as specified for exposed piping systems.
   2. Piping in finished spaces such as offices, class rooms, wards, toilet rooms, shower rooms and spaces as specified.

C. Locate piping identification to be visible from exposed points of observation.

1. Locate piping identification at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs.
2. Where 2 or more pipes run in parallel, place printed legend and other markers in same relative location.

## 3.04 VALVE IDENTIFICATION SCHEDULE

A. Valve Service Identification Tags:
   1. Tag control valves, except valves at equipment, with a brass tag fastened to the valve handle or stem, marked to indicate service and numbered in sequence for the following applications:
      a. Domestic water valves controlling mains, risers and branch runouts.
      b. Valves in sprinkler and fire standpipe systems, except hose valves.

B. Valve Service Identification Charts:
   1. Provide 2 framed valve charts for each piping system specified to be provided with valve identification tags. Type charts on 8-1/2 x 11 inches heavy white bond paper, indicating valve number, service and location.
   2. Hang framed charts at locations as directed.

**END OF SECTION**

## SECTION 220576

## DRAINAGE ACCESSORIES

### PART 1 GENERAL

### 1.01 REFERENCES

A. Comply with the applicable requirements of ASME A112.36.2M - Cleanouts, and ASME A112.1.2 - Drainage Funnels and Air Gaps.

### 1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications, and installation instructions for each item specified except fasteners.

### PART 2 PRODUCTS

### 2.01 CLEANOUT PLUG

A. Cast brass or bronze, with threaded end, and raised or countersunk head.
   1. Tapped head for attachment of cleanout wall or deck plate covers where required.

B. Anti-Seize Lubricant: Never-Seez by Bostik Chemical Group, Broadview, IL; Molycote 1000 by Dow Corning Corp, Midland, MI; Anti-Seize Lubricant by Loctite Corp, Newington, CT.

### 2.02 CLEANOUT

A. Threaded pipe fitting or cast iron ferrule with gas tight cleanout plug.

### 2.03 CLEANOUT WALL PLATE

A. Round, stainless steel or polished chrome plated bronze cover plate with stainless steel vandal resistant fastener to secure to cleanout plug.

### 2.04 CLEANOUT DECK PLATE

A. Standard duty floor cleanout fitting with coated cast iron body; round, polished nickel bronze scoriated top secured to cleanout plug with stainless steel vandal resistant fastener; threaded height adjustment, cast iron head, gas tight cleanout plug, and connection to match piping option selected.

B. Membrane flange and clamping collar, secured with corrosion resistant fasteners.

### 2.09 AIR GAP FITTING

A. Coated cast iron body with air gaps, set screw or threaded inlet, and outlet connection to match piping option selected.

## 2.10 INDIRECT WASTE FUNNEL

A. Combination Funnel Drain and P Trap: Polished chrome plated cast brass construction.
   1. Funnel: 4 inch top dia., 4 inches deep, with threaded outlet.
   2. P Trap: Bottom cleanout, threaded inlet, and outlet connection to match piping option selected.

## 2.11 FASTENERS

A. Corrosion Resistant Fasteners: Brass, bronze, or Type 302 or 304 stainless steel bolts.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. Cleanout Plug: Lubricate threads with anti-seize lubricant before final installation.

**END OF SECTION**

## SECTION 220577

## FLOOR AND AREA DRAINS

### PART 1 GENERAL

### 1.01 REFERENCES

A. Unless otherwise specified, the Work of this section shall meet the applicable requirements of FS WW-P-541 - Plumbing Fixtures, and ASME A112.21.1M - Floor Drains.

### 1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions for each type drain specified.

### 1.03 MAINTENANCE

A. Special Tools: Deliver to the Director's Representative.
   1. Tools for Vandal Resistant Fasteners: One for each type and size.

### PART 2 PRODUCTS

### 2.01 TYPE A FLOOR DRAIN

A. Drain Body: Coated cast iron, two-piece body with reversible flashing clamp, minimum 9 inch dia drainage flange, corrosion resistant bolts, weep holes, bottom outlet, and connection to match piping option selected.

B. Strainer Head: Round, minimum 7 inch dia, nickel bronze with threaded shank for height adjustment.

C. Strainer Grate: Polished nickel bronze, heel proof; secured with stainless steel vandal resistant fasteners.

D. Acceptable Drain Series: Josam 30000A, Smith 2010A, Wade W1100, and Zurn Z415.

### 2.02 FASTENERS

A. Corrosion Resistant Fasteners: Brass, bronze, or Type 302 or 304 or stainless steel bolts.

B. Vandal Resistant Fasteners: Torx head with center pin.

### 2.03 FREE AREA OF GRATE

A. Minimum strainer grate free area listed below for each connecting pipe size:

| CONNECTING PIPE SIZE (Inches Nominal) | INTERIOR DRAINS FREE AREA (Square Inches) | EXTERIOR DRAINS FREE AREA (Square Inches) |
|---|---|---|
| 1-1/2 | 3.06 | 4.08 |
| 2 | 4.71 | 6.28 |
| 3 | 10.59 | 14.12 |

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. Protect weep holes from plugging during installation. Rod out weep holes after installation to remove obstructions.

C. Set drainage flange flush with top of structural floor slab, or at elevation otherwise indicated.

D. After membrane waterproofing installed and cured, secure clamping ring.

E. Adjust strainer head to height indicated. If height not indicated, set at 1/2 inch below finished floor elevation.

F. Secure external components in place with vandal resistant fasteners or devices which cannot be removed without special tools.

**END OF SECTION**

**SECTION 220700**

**PIPING INSULATION**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Through Penetration Firestops: Section 078400.

B. Painting: Section 099103.

C. Pipe Hangers and Supports: Section 220529.

### 1.02 ABBREVIATIONS

A. FS: Federal Specification.

B. K: Thermal Conductivity, i.e., maximum Btu per inch thickness per hour per square foot.

C. pcf: Pounds per cubic foot.

D. PVC: Polyvinylchloride.

### 1.03 SUBMITTALS

A. Product Data: Manufacturer's catalog sheets, specifications and installation instructions for the following:
   1. Insulation Materials.
   2. Jacket Materials.

B. Quality Control Submittals:
   1. Installers Qualification Data:
      a. Name of each person who will be performing the Work, and their employer's name, business address and telephone number.
      b. Furnish names and addresses of the required number of similar projects that each person has worked on which meet the qualifications.

### 1.04 QUALITY ASSURANCE

A. Qualifications: The persons installing the Work of this Section and their Supervisor shall be personally experienced in mechanical insulation work and shall have been regularly employed by a company installing mechanical insulation for a minimum of 5 years.

B. Regulatory Requirements:

1. Insulation installed inside buildings, including laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.

## PART 2 PRODUCTS

### 2.01 PIPING INSULATION

A. Fibrous Glass (Mineral Fiber) Insulation: Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.
   1. Preformed Pipe Insulation: Minimum density 3 pcf; ASTM C 547:
      a. Class 1 (Suitable for Temperatures Up to 450 degrees F): K of 0.26 at 75 degrees F.
   2. Premolded Fitting Insulation: Minimum density 4.0 pcf, K of 0.26 at 75 degrees F; ASTM C 547, Class 1.
   3. Insulation Inserts for PVC Fitting Jackets: Minimum density 1.5 pcf, K of 0.28 at 75 degrees F; ASTM C 553, Type III.
      a. Suitable for temperatures up to 450 degrees F.

B. Flexible Elastomeric Foam Insulation:
   1. FM tested and approved, meeting the following:
      a. Maximum Water Vapor Transmission: 0.10 perm - inch based on ASTM E 96, Procedure A.
      b. K of 0.27 at 75 degrees F based on ASTM C 518 or C 177.
      c. Fire Spread/Smoke Developed Rating: 25/50 or less based on ASTM E 84.
   2. Pipe Insulation: ASTM C 534, Type I.
   3. Polyethylene and polyolefin insulation is not acceptable.

C. High Density Jacketed Insulation Inserts for Hangers and Supports:
   1. For Use with Fibrous Glass Insulation:
      a. Cold Service Piping:
         1) Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75 degrees F, minimum compressive strength of 125 psi.
   2. For Use with Flexible Elastomeric Foam Insulation: Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as specified or required.

D. Cements:
   1. Fibrous Glass Thermal Insulating Cement: Asbestos free; ASTM C 195.
   2. Fibrous Glass Hydraulic Setting Thermal Insulating and Finishing Cement: ASTM C 449/C 449M.

### 2.02 INSULATION JACKETS

A. Laminated Vapor Barrier Jackets for Piping: Factory applied by insulation manufacturer, conforming to ASTM C 1136, Type I.

1. Type I: Reinforced white kraft and aluminum foil laminate with kraft facing out.
    a. Pipe Jackets: Furnished with integral 1-1/2 inch self sealing longitudinal lap, and separate 3 inch wide adhesive backed butt strips.
2. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.

B. Canvas Jackets: Cotton duck, fire retardant, complying with NFPA 701, 4 oz or 6 oz per sq yd as specified.

C. Premolded PVC Fitting Jackets:
1. Constructed of high impact, UV resistant PVC.
    a. ASTM D 1784, Class 14253-C.
    b. Working Temperature: 0-150 degrees F.

## 2.03 ADHESIVES, MASTICS, AND SEALERS

A. Lagging Adhesive (Canvas Jackets): Childers' CP-50AMV1, Epolux's Cadalag 336, Foster's 30-36.

B. Vapor Lap Seal Adhesive (Fibrous Glass Insulation): Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-60 or 85-20.

C. Vapor Barrier Mastic(Fibrous Glass Insulation): Permeance shall be .03 perms or less at 45 mils dry per ASTM E 96. Childers' CP-34, Epolux's Cadalar 670, Foster's 30-65.

D. Adhesive (Flexible Elastomeric Foam): Armstrong's 520, Childers' CP-82, Epolux's Cadoprene 488, Foster's 85-75. 5 gallon cans only

E. Adhesive (Fiberglass Duct Liner): Childers' Chil Quick CP-127, Foster Vapor Fas 85-60. Must comply with ASTM C 916, Type II

F. Weather Barrier Breather Mastic (Reinforcing Membrane): Childers' VI-CRYL CP-10/11, Foster's Weatherite 46-50.

G. Sealant (Metal Pipe Jacket): Non hardening elastomeric sealants. Foster Elastolar 95-44, Childers Chil Byl CP-76, Pittsburgh Corning 727

H. Reinforcing Membrane: Childers' Chil Glas #10, Foster Mast a Fab, Pittsburgh Corning PC 79

## 2.04 MISCELLANEOUS MATERIALS

A. Pressure Sensitive Tape for Sealing Laminated Jackets:
1. Acceptable Manufacturers: Alpha Associates, Ideal Tape, Morgan Adhesive.
2. Type: Same construction as jacket.

B. Wire, Bands, and Wire Mesh:
   1. Binding and Lacing Wire: Nickel copper alloy or copper clad steel, gage as specified.
   2. Bands: Galvanized steel, 1/2 inch wide x 0.015 inch thick, with 0.032 inch thick galvanized wing seals.
   3. Wire Mesh: Woven 20 gage steel wire with 1 inch hexagonal openings, galvanized after weaving.

C. Reinforcing Membrane: Glass or Polyester, 10 x 10 mesh. Alpha Associates Style 59, Childer's Chil-Glas, Foster's MAST-A-FAB.

## PART 3 EXECUTION

### 3.01 PREPARATION

A. Perform the following before starting insulation Work:
   1. Install hangers, supports and appurtenances in their permanent locations.
   2. Complete testing of piping.
   3. Clean and dry surfaces to be insulated.

### 3.02 INSTALLATION, GENERAL

A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions unless otherwise specified.

B. Provide continuous piping insulation and jacketing when passing thru interior wall, floor, and ceiling construction.
   1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed. See Section 078400.
      a. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.

C. Do not intermix different insulation materials on individual runs of piping.

### 3.03 INSTALLATION AT HANGERS AND SUPPORTS

A. Reset and realign hangers and supports if they are displaced while installing insulation.

B. Install high density jacketed insulation inserts at hangers and supports for insulated piping.

C. Insulation Inserts For Use with Fibrous Glass Insulation:
   1. Where clevis hangers are used, install insulation shields and high density jacketed insulation inserts between shield and pipe.

a. Where insulation is subject to compression at points over 180 degrees apart, e.g. riser clamps, U-bolts, trapezes, etc.; fully encircle pipe with 2 protection shields and 2 high density jacketed fibrous glass insulation inserts within supporting members.
   1) Exception: Locations where pipe covering protection saddles are specified for hot service piping, 6 inch and larger.

D. Insulation Inserts For Use with Flexible Elastomeric Foam Insulation:
1. Where clevis hangers are used, install insulation shields with hardwood filler pieces, same thickness as adjoining insulation, inserted in undersized die cut or slotted holes in insulation at support points.
2. Contour hardwood blocks to match the curvature of pipe, and shield.
3. Coat dowels and blocks with insulation adhesive, and insert while still wet.
4. Vapor seal outer surfaces of dowels and blocks with adhesive after insertion.
5. Install filler pieces as follows:

| PIPE/TUBING SIZE | FILLER PIECES | POSITION |
|---|---|---|
| Thru 1-1/2” | 2 dowel plugs | 6 o’clock; in tandem |
| 2” thru 4” | 1 block, 2 dowel plugs | 6 o’clock, and 4 & 8 o’clock respectively |
| | | |

## 3.04 INSTALLATION OF FIBROUS GLASS COLD SERVICE INSULATION

A. Install insulation materials with a field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket, unless otherwise specified.

B. Piping:
1. Butt insulation joints together, continuously seal minimum 1-1/2 inch wide self-sealing longitudinal jacket laps and 3-inch wide butt adhesive backed strips.
   a. Substitution: 3 inch wide pressure sensitive sealing tape, of same material as jacket, may be used in lieu of butt strips.
2. Bed insulation in a 2-inch wide band of vapor barrier mastic, and vapor seal exposed ends of insulation with vapor barrier mastic at each butt joint between pipe insulation and equipment, fittings or flanges at the following intervals:
   a. Horizontal Pipe Runs: 21 ft.
   b. Vertical Pipe Runs: 9 ft.

C. Fittings, Valves, Flanges and Irregular Surfaces:
1. Insulate with mitre cut or premolded fitting insulation of same material and thickness as pipe insulation.
2. Secure insulation in place with 16-gage wire, with ends twisted and turned down into insulation.

3. Butt insulation against pipe insulation and bond with joint sealer.
4. Insulate valves up to and including bonnets, without interfering with packing nuts.
5. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.
6. When insulating cement has dried, seal fitting, valve and flange insulation, by imbedding a layer of reinforcing membrane or 4 oz. canvas jacket between 2 flood coats of vapor barrier mastic, each 1/8 inch thick wet.
7. Lap reinforcing membrane or canvas on itself and adjoining pipe insulation at least 2 inches.
8. Trowel, brush or rubber glove outside coat over entire insulated surface.
9. Exceptions:
    a. Type C and D Piping Systems: Valves, fittings and flanges may be insulated with premolded PVC fitting jackets, with fibrous glass insulation inserts.
        1) Additional insulation inserts are required for services with operating temperatures under 45 degrees F or where insulation thickness exceeds 1-1/2 inches. The surface temperature of PVC fitting jacket must not go below 45 degrees F.

## 3.05 INSTALLATION OF FIBROUS GLASS HOT SERVICE INSULATION

A. Install insulation materials with field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket unless otherwise specified.

B. Canvas Jackets on Piping, Fittings, Valves, Flanges, Unions, and Irregular Surfaces:
1. For Piping 2 inch Size and Smaller: 4 oz per sq yd unless otherwise specified.
2. For Piping Over 2 inch Size: 6 oz per sq yd unless otherwise specified.

C. Piping:
1. Butt insulation joints together, continuously seal minimum 1-1/2 inch wide self-sealing longitudinal jacket laps and 3-inch wide adhesive backed butt strips.
    a. Substitution: 3 inch wide pressure sensitive sealing tape, of same material as the jacket, may be used in lieu of butt strips.
2. Fill voids in insulation at hanger with insulating cement.
3. Exceptions:
    a. Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Spaces and Concealed Piping: Butt insulation joints together and secure minimum 1-1/2 inch wide longitudinal jacket laps and 3 inch wide butt strips of same material as jacket, with outward clinching staples on maximum 4 inch centers. Fill voids in insulation at hangers with insulating cement.

D. Fittings, Valves, Flanges and Irregular Surfaces:

1. Insulate with mitre cut or premolded fitting insulation of same material and thickness as insulation.
2. Secure in place with 16-gage wire, with ends twisted and turned down into insulation.
3. Butt fitting, valve and flange insulation against pipe insulation, and fill voids with insulating cement.
4. Insulate valves up to and including bonnets, without interfering with packing nuts.
5. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.
6. After insulating cement has dried, coat insulated surface with lagging adhesive, and apply 4 oz or 6 oz canvas jacket as required by pipe size.
    a. Lap canvas jacket on itself and adjoining pipe insulation at least 2 inches.
    b. Size entire canvas jacket with lagging adhesive.
7. Exceptions:
    a. In Types E, and F Service Piping Systems: Valves, fittings and flanges may be insulated with premolded PVC fitting jackets, with fibrous glass insulation inserts.
        1) Additional insulation inserts are required for services with operating temperatures over 250 degrees F or where insulation thickness exceeds 1-1/2 inches. The surface temperature of PVC fitting jacket must not exceed 150 degrees F.
    b. In Types E, and F Service Piping Systems: Insulate fittings, valves, and irregular surfaces 3 inch size and smaller with insulating cement covered with 4 oz or 6 oz canvas jacket as required by pipe size.
        1) Terminate pipe insulation adjacent to flanges and unions with insulating cement, trowelled down to pipe on a bevel.
    c. Fittings, Valves, Flanges, and Irregular Surfaces In Concealed Piping, Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Rooms, Unfinished Spaces, and Tunnels: Sizing of canvas surface is not required.

## 3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC FOAM INSULATION

A. Where possible, slip insulation over the pipe, and seal butt joints with adhesive.
    1. Where the slip-on technique is not possible, slit the insulation and install.
    2. Re-seal with adhesive, making sure the mating surfaces are completely joined.

B. Insulate fittings and valves with miter cut sections. Use templates provided by the manufacturer, and assemble the cut sections in accordance with the manufacturer's printed instructions.
    1. Insulate threaded fittings and valves with sleeved fitting covers. Over lap and seal the covers to the adjoining pipe insulation with adhesive.

C. Carefully mate and seal with adhesive all contact surfaces to maintain the integrity of the vapor barrier of the system.

D. Piping Exposed Exterior to a Building, Totally Exposed to the Elements:
1. Apply flexible elastomeric foam insulation to piping with adhesive.
2. Apply reinforcing membrane around piping insulation with adhesive or mastic.
3. Adhesive Applied System: Apply 2 coats of finish. See Section 099103.
4. Mastic Applied System: Apply another coat of mastic over reinforcing membrane.

## 3.07 PIPING INSULATION SCHEDULE

A. Insulate all cold service and hot service piping, and appurtenances except where otherwise specified.

B. Schedule of Items Not to be Insulated:
1. Chrome plated piping, unless otherwise specified.
2. Exposed piping in finished spaces, serving one fixture, or piece of equipment, and which connection from the main, branch, or riser, is 24 inches or less in length.
3. Water heater blow-off piping.
4. Air vents, pressure reducing valves, pilot lines, safety valves, relief valves.
5. Water meters.
6. Piping buried in the ground, unless otherwise specified herein.
7. Items installed by others, unless otherwise specified herein.
8. Sanitary drainage piping, unless otherwise specified herein.
9. Mechanical equipment with factory applied steel jacket.
10. Hot service piping 81 degrees F to 104 degrees F.
11. Flanges and unions in Type E, F, and G service piping systems.
12. Sprinkler and standpipe piping, unless otherwise specified.

## 3.08 COLD SERVICE INSULATION MATERIAL SCHEDULE

| TYPE | SERVICE AND TEMPERATURES | INSULATION MATERIAL | PIPE SIZES (INCHES) | MINIMUM (NOMINAL) INSULATION THICKNESS (INCHES) |
|---|---|---|---|---|
| D | Domestic cold water, and as specified.<br>33 F to 80 F. | Flex. Elastomeric Foam or Fibrous Glass | All Sizes | 1/2 |
| | | | | |

A. **NOTES:**
1. Sprinkler and Standpipe Piping (First 10 feet connected to domestic water main within building): Insulate with same materials and thicknesses specified for domestic cold water.

## 3.09 HOT SERVICE INSULATION MATERIAL SCHEDULE

| | SERVICE AND TEMPERATURES | INSULATION MATERIAL | PIPE SIZES (INCHES) | MINIMUM (NOMINAL) INSULATION THICKNESS (INCHES) |
|---|---|---|---|---|
| E | Water and other fluids 105 F to140 F. | Flex. Elastomeric Foam or Fibrous Glass | 1-1/2 & Less | 1 |
| | | | Over 1-1/2 | 2 |

A. **NOTES:**

1. Insulate piping in tunnels and conduits with insulation of thickness as follows:
   a. Types E, and F Service: Minimum 2 inch thick unless greater thickness is specified in Hot Service Insulation material Schedule above.

**END OF SECTION**

**SECTION 220800**

**CLEANING AND TESTING**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Testing Sprinkler System: NFPA-13.

B. Testing Fire Standpipe System: NFPA-14.

### 1.02 SUBMITTALS

A. Quality Control Submittals
   1. Test Reports (Field Tests): Submit data for each system tested, and/or disinfected; include date performed, description, and test results for each system.

### 1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Perform factory testing of factory fabricated equipment in complete accordance with the agencies having jurisdiction.
   2. Perform field testing of piping systems in complete accordance with the local utilities and other agencies having jurisdiction and as specified.

### 1.04 PROJECT CONDITIONS

A. Protection: During test Work, protect controls, gages and accessories which are not designed to withstand test pressures. Do not utilize permanently installed gages for field testing of systems.

### 1.05 SEQUENCING AND SCHEDULING

A. Transmit written notification of proposed date and time of operational tests to the Director's Representative at least 5 days in advance of such tests.

B. Perform cleaning and testing Work in the presence of the Director's Representative.

C. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction Work, and at other times as directed. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems, or temporary valves or caps as required to perform the Work.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Test Equipment and Instruments: Type and kind as required for the particular system under test.

B. Test Media (air, vacuum, water): As specified for the particular piping or system under test.

C. Cleaning Agent (water): As specified for the particular piping, apparatus or system being cleaned.

## PART 3 EXECUTION

### 3.01 PRELIMINARY WORK

A. Thoroughly clean pipe and tubing prior to installation. During installation, prevent foreign matter from entering systems. Prevent if possible and remove stoppages or obstructions from piping and systems.

### 3.02 PRESSURE TESTS - PIPING

A. Piping shall be tight under test and shall not show loss in pressure or visible leaks, during test operations or after the minimum duration of time as specified. Remove piping which is not tight under test; remake joints and repeat test until no leaks occur.

B. Water Systems:
   1. Domestic water (potable cold, domestic hot and recirculation) inside buildings:
      a. Before fixtures, faucets, trim and accessories are connected, perform hydrostatic test at 125 psig minimum for 4 hours.
      b. After fixtures, faucets, trim and accessories are connected, perform hydrostatic retest at 75 psig for 4 hours.

C. Drainage, Vent, Conductor and Roof Drain Piping (Inside Buildings): Perform tests before fixtures are installed. Test by filling the entire system with water, and allowing to stand for 3 hours, with no noticeable loss of water. Test joints under a minimum head of 10 feet of water, except the uppermost section. Test the uppermost section to overflowing.

### 3.03 TESTING OF EQUIPMENT, APPARATUS AND APPURTENANCES

A. Relief Valves: Increase pressure in equipment or apparatus to relief valve setting, to test opening of valves at required relief pressures.

### 3.04 DISINFECTION OF POTABLE WATER SYSTEMS

A. Disinfect potable water pipe and equipment installed in the Work of this Contract.
   1. Completely fill the piping, including water storage equipment if installed, with a water solution containing 50 mg/L available chlorine, and allow stand for 24 hours. Operate all valves during this period to assure their proper disinfection.
   2. After the retention period, discharge the solution to an approved waste and flush the system thoroughly with water until substantially all traces of chlorine are removed. Drain and flush water storage equipment if installed.

B. Connect plumbing fixtures and equipment and place the system into service. Prevent recontamination of the piping during this phase of the Work.

**END OF SECTION**

**SECTION 221100**

**PLUMBING PIPING**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Through Penetration Firestops: Section 078400.

B. Sealants: Section 079200.

### 1.02 REFERENCES

A. NFPA 13 - Standard for the Installation of Sprinkler Systems.

B. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

### 1.03 SUBMITTALS

A. Product Data:
   1. Catalog sheets and specifications indicating manufacturer name, type, applicable reference standard, schedule, or class for specified pipe and fittings.
   2. Material Schedule: Itemize pipe and fitting materials for each specified application in Pipe and Fittings Schedule in Part 3 of this Section. Where optional materials are specified indicate option selected.

B. Quality Control Submittals
   1. Copy of hydraulic press fitting manufacturer's printed field inspection procedures for hydraulic press joints in copper tubing.
   2. Brazer Qualification Data: Copies of certification; include names, home addresses and social security numbers of brazers.

## PART 2 PRODUCTS

### 2.01 STEEL PIPE AND FITTINGS

A. Steel Pipe for Threading: Standard weight, Schedule 40, black or galvanized; ASTM A 53 or ASTM A 135.

B. Steel Pipe for Roll Grooving: Standard weight, Schedule 40, black or galvanized; ASTM A 53, Grade B, Type F for sizes 3/4 inch to 1-1/2 inch, and Type E or S for sizes 2 inch to 24 inch, or ASTM A 135.

C. Cast Iron Fittings:
   1. Drainage Pattern, Threaded: ASME B16.12.
   2. Flanged Fittings and Threaded Flanges: ASME B16.1.
      a. Standard Weight: Class 125.

b. Extra Heavy: Class 250.

E. Unions: Malleable iron, 250 lb class, brass to iron or brass to brass seats.

F. Couplings: Same material and pressure rating as adjoining pipe, conforming to standards for fittings in such pipe. Use taper tapped threaded type in screwed pipe systems operating in excess of 15 psig.

G. Nipples: Same material and strength as adjoining pipe, except nipples having a length of less than one inch between threads shall be extra heavy.

## 2.02 COPPER AND BRASS PIPE, TUBING AND FITTINGS

A. Copper Tube, Types K, L, and M: ASTM B 88.

C. Wrot Copper Tube Fittings, Solder Joint: ASME B16.22.

D. Cast Copper Alloy Tube Fittings, Solder Joint: ASME B16.18.

E. Drainage Tube, Type DWV: ASTM B 306.

F. Wrot Copper Drainage Tube Fittings, Solder Joint: ASME B16.29.

G. Cast Copper Alloy Drainage Fittings, Solder Joint: ASME B16.23.

H. Chrome Plated Grade A Red Brass Threaded Pipe, Standard Weight: ASTM B 43.
1. Plating: 0.02 mil chromium over 0.2 mil nickel plating, high polish finish.

I. Chrome Plated Cast Brass Threaded Pipe Fittings, 125 lb Class: ASME B16.15.
1. Plating: 0.02 mil chromium over 0.2 mil nickel plating, high polish finish.

J. Unions: Cast bronze, 150 lb Class, bronze to bronze seats, threaded or solder joint.

K. Plumber's Tube: Seamless, semi-annealed, minimum 65 percent copper, No. 18 B & S Gage.

L. Flared Tube Fittings:
1. Water Tube Type: ASME B16.26.

## 2.03 HYDRAULIC PRESS FITTINGS FOR COPPER TUBING

A. Acceptable Fittings:
1. ProPress by Viega, 301 N. Main, Wichita, KS 67202, (877) 843-4262, www.viega.com.

B. Operating Conditions:

1. Maximum Operating Pressure: 200 psi.
2. Operating Temperature Range: 0-250 degrees F.
3. Maximum Test Pressure: 600 psi.
4. Maximum Vacuum: 29.2 inches hg @ 68 degrees F.

C. Features:
1. Fittings: Copper and copper alloy conforming to material requirements of ASME B16.18 or ASME B16.22.
   a. Stainless Steel Grip Ring: Adds strength to the joint without collapsing the interior passageway
2. No flame for soldering required for installation of fittings and valves.
3. Unpressed connections identified during pressure testing when water flows past sealing element.
4. Sealing Elements: Factory installed, EPDM.
5. Fittings that have been pressed can be rotated. If rotated more than 5 degrees, the fitting must be repressed to restore its resistance to rotational movement.
6. Extended fitting end lead allows for twice the retention grip surface, and assists with proper tube alignment.
7. Soldered adapter fittings are not allowed.

## 2.04 CAST IRON PIPE AND FITTINGS

A. Bell and Spigot Soil Pipe: Service Weight, Bitumin coated; ASTM A 74.

B. Bell and Spigot Soil Pipe Fittings: Service Weight, Bitumin coated; ASTM A 74.

C. Hubless Pipe: Bitumin coated; Cast Iron Soil Pipe Institute Standard No. 301.

D. Hubless Pipe Fittings: Drainage Pattern, Bitumin coated; Cast Iron Soil Pipe Institute Standard No. 301.

E. Hubless Joint Couplings: Stainless steel shield and clamp assembly, and elastomer sealing sleeve; CISPI-310.

F. Water Pipe Fittings: Bitumin coated, cement-mortar lined; AWWA C110.

## 2.05 DUCTILE IRON PIPE AND FITTINGS

A. Water Pipe: Bitumin coated and cement-mortar lined; AWWA C151.
1. 3 and 4 Inch Sizes: Class 51.
2. 6 inch Size and Over: Class 50.

B. Fittings: Bitumin coated and cement-mortar lined; AWWA C110.

## 2.06 COUPLINGS AND FITTINGS FOR GROOVED END PIPE

A. Couplings: Grinnell Corp.'s Rigidlok Fig. 7401, or Victaulic Co.'s Style 107, having minimum pressure rating of:

1. 750 psi from 1-1/2 inch to 4 inch.
2. 700 psi for 6 inch.
3. 600 psi for 8 inch.

B. Couplings: Gustin-Bacon Inc.'s No. 100 Gruvagrips, or Victaulic Co.'s Style 77, having pressure rating of:
1. 1000 psi for 3/4 inch to 6 inch.
2. 800 psi for 8 inch to 12 inch.
3. 300 psi for 14 inch to 24 inch.

C. Fittings: By same manufacturer as couplings, having pressure ratings equal to or greater than couplings. Comply with the following standards:
1. Steel: ASTM A 53 or A 106, Grade B.
2. Malleable Iron: ASTM A 47.
3. Ductile Iron: ASTM A 536.

## 2.07 BOLTED MECHANICAL BRANCH CONNECTION

A. Victaulic Co.'s 920 Mechanical T.

## 2.08 JOINING AND SEALANT MATERIALS

A. Thread Sealant:
1. LA-CO Industries', Slic-Tite Paste with Teflon.
2. Loctite Corp.'s No. 565 Thread Sealant.
3. Thread sealants for potable water shall be NSF approved.

B. Thread Sealant (Natural Gas Piping): Rectorseal Corp.'s T Plus 2 non-hardening pipe dope with teflon.

C. Solder: Solid wire type conforming to the following:
1. Type 3: Lead-free tin-silver solder (ASTM B 32 Alloy Grade E, AC, or HB); Engelhard Corp.'s Silvabrite 100, Federated Fry Metals' Aqua Clean, or J.W. Harris Co. Inc.'s Stay-Safe Bridgit.

D. Soldering Flux for Soldered Joints: All-State Welding Products Inc.'s Duzall, Engelhard Corp.'s General Purpose Liquid or Paste, Federated Fry Metals' Water Flow 2000, or J.W. Harris Co. Inc.'s Stay-Clean.

E. Lead for Calking Joints in Cast Iron Soil Pipe: ASTM B 29 for pig lead.

F. Joint Packing:
1. Oiled Oakum: Manufactured by Nupak of New Orleans, Inc., 931 Daniel St., Kenner, LA 70062, (504) 466-1484.
2. Acid Resistant Joint Packing: Sealite Inc.'s Red Stripe, Asbestos-Free Acid-Resistant White Oakum, No. 312.

G. Gaskets For Use With Ductile Iron Water Pipe and Cast Iron Drainage Pipe: Synthetic rubber rings (molded or tubular): Clow Corp.'s Belltite, Tyler Pipe Industries Inc.'s Ty-Seal, or U.S. Pipe and Foundry Co.'s Tyton.

H. Flange Gasket Material:
   1. For Use with Cold Water: 1/16 inch thick rubber.
   2. For Use with Hot Water, Air or Steam: Waterproofed non-asbestos ceramic or mineral fiber, or a combination of metal and water-proofed non-asbestos ceramic or mineral fiber, designed for the temperatures and pressures of the piping systems in which installed.

I. Gaskets For Use With Grooved End Pipes and Fittings: Type and materials as recommended and furnished by the fitting manufacturer, for the service of piping system in which installed.

J. Anti-Seize Lubricant: Bostik Inc.'s Never Seez or Dow Corning Corp.'s Molykote 1000.

## 2.09 PACKING MATERIALS FOR BUILDING CONSTRUCTION PENETRATIONS

A. Oiled Oakum: Manufactured by Nupak of New Orleans, Inc., 931 Daniel St., Kenner, LA 70062, (504)466-1484.

B. Mechanical Modular Seals: Thunderline Corp.'s Link Seal wall and floor seals designed for the service of piping system in which installed.

## 2.10 PIPE SLEEVES

A. Type A: Schedule 40 steel pipe.

B. Type B: No. 16 gage galvanized sheet steel.

C. Type C: Schedule 40 steel pipe with 1/4 inch steel collar continuously welded to pipe sleeve. Size steel collars as required to span a minimum of one cell or corrugation, on all sides of the rough opening thru the metal deck.

D. Type D: No. 16 gage galvanized sheet steel with 16 gage sheet steel metal collar rigidly secured to sleeve. Size metal collars as required to span a minimum of one cell or corrugation, on all sides of the rough opening thru the metal deck.

## 2.11 FLOOR, WALL AND CEILING PLATES

A. Cast Brass: Solid type with polished chrome plated finish, and set screw.
   1. Series Z89 by Zurn, 929 Riverside Drive, Grosvenordale, CT 06255, (800) 243-1830.
   2. Model 127XXXX by Maguire Mfg., Cheshire CT 06410, (203) 699-1801.

B. Stamped Steel: Split type, polished chrome plated finish, with set screw.
   a. Figures 2 and 13 by Anvil International, Portsmouth, NH 03802, (603) 422-8000.

## 2.12 FLEXIBLE CONNECTIONS

A. Underground Application:
   1. Acceptable Companies:
      a. Titeflex Inc., Springfield, MA.
      b. Flex-ing, Sherman, TX.
   2. Features:
      a. Construction: Stainless steel innercore covered with braided Type 304 stainless steel outer jacket.
      b. UL listed for underground fuel storage tank systems.
      c. Connections for unleaded gasoline systems shall be fire rated.
      d. Permanently crimped stainless steel collars with one threaded end and one threaded swivel end.

B. Underground or Above Ground Application:
   1. Acceptable Companies:
      a. Titeflex Inc., Springfield, MA.
      b. Flex-ing, Sherman, TX.
   2. Features:
      a. Construction: Convoluted, Type 321 stainless steel inner core, minimum .012 inch wall thickness covered with braided Type 304 stainless steel outer jacket.
      b. UL listed for above ground and underground use.
      c. Connections for unleaded gasoline systems shall be fire rated.
      d. Factory installed male swivel on one end.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Install piping at approximate locations indicated, and at maximum height.

B. Install piping clear of door swings, and above sash heads.

C. Make allowances for expansion and contraction.

D. Allow for a minimum of one inch free air space around pipe or pipe covering, unless otherwise specified.

E. Install horizontal piping with a constant pitch, and without sags or humps.
   1. Water Piping: Pitch 1/4 inch per 10 feet upward in direction of flow, unless otherwise noted. If it is not possible to maintain constant pitch, establish a new low point and continue. At the low point, provide a 1/2 inch drip leg and gate valve with a hose bibb end. Provide an air vent at the high point.
   2. Drainage Piping: Pitch 1/4 inch per foot downward, in direction of flow, unless otherwise noted.
   3. Vent Piping: Pitch 1/4 inch per foot upward, unless otherwise noted.

F. Install vertical piping plumb.

G. Use fittings for offsets and direction changes, except for Type K soft annealed copper temper water tube.

H. Cut pipe and tubing ends square; ream before joining.

I. Threading: Use American Standard Taper Pipe Thread Dies.
   1. Thread brass pipe with special brass threading dies.

## 3.02 DRAINAGE SYSTEMS

A. Fittings:
   1. Use long turn drainage pattern fittings, unless space conditions prohibit their use; in such cases, short turn pattern fittings may be used.
   2. Vertical Offsets: Make vertical offsets with 45 degree elbows, or 1/8 bends.
   3. Tucker Fittings: Tucker fittings may only be installed in vertical piping.

B. Cleanouts:
   1. Install cleanouts with sufficient side and end clearance to allow for the removal of the cleanout plug, and the use of cleaning tools.
   2. Lubricate cleanout plugs with anti-seize lubricant.

## 3.03 DOMESTIC WATER PIPING SYSTEM

A. Connect runouts to the upper quadrant of the main, and run upward at not less than 45 degrees before extending laterally.

B. Make final connections to plumbing fixtures and equipment with unions, or flanges:
   1. Do not use unions in ferrous piping larger than 3 inches.
   2. Do not use unions in brass or copper piping larger than 2 inches.

## 3.04 FIRE SPRINKLER AND FIRE STANDPIPE PIPING SYSTEM

A. Install piping to be completely drainable.

## 3.05 PIPE JOINT MAKE-UP

A. Threaded Joint: Make up joint with a pipe thread compound applied in accordance with manufacturer's printed application instructions for the intended service.
   1. Chrome Plated Brass Pipe: Tighten joint with a strap or Parmalee wrench; do not mar pipe finish. Install piping so that no threads are visible.

B. Soldered Joint: Thoroughly clean tube end and inside of fitting with emery cloth, sand cloth, or wire brush. Apply flux to the pre-cleaned surfaces. Install

fitting, heat to soldering temperature, and join the metals with type solder specified. Remove residue.

C. Flanged Pipe Joint:
   1. Install threaded companion flanges on steel pipe; flanges on galvanized pipe are not required to be galvanized.
   2. Provide a gasket for each joint.
      a. Hot Water Pipe Gasket: Coat with a thin film of oil before making up joint.
      b. Air Pipe Gasket: Coat with a thin film of oil before making up joint.
   3. Coat bolt threads and nuts with anti-seize lubricant before making up joint.

D. Calked Joint: Pack hub with joint packing specified, and calk. Run 12 ounces molten lead for each inch of pipe diameter. Calk cooled lead ring and face off smoothly.

E. Rubber Ring Push-on Joint: Clean hub, bevel spigot, and make up joint with lubricated gasket in conformance with the manufacturer's printed installation instructions.

F. Grooved Pipe Joint: Roll groove pipe ends, make up joint with grooved end fittings and couplings, in conformance with the manufacturer's printed installation instructions.
   1. Cut grooved end piping is not acceptable.

G. Hubless CI Pipe Joint: Make up joint with hubless fitting and couplings, in conformance with the manufacturer's printed installation instructions.

H. Mechanical Joint: Make up joint in conformance with the manufacturer's printed installation instructions, with particular reference to tightening of bolts.

I. Hydraulic Pressed Joint: Follow manufacturer's printed installation instructions.

J. Dissimilar Pipe Joint:
   1. Joining Bell and Spigot and Threaded Pipe: Install a half coupling on the pipe or tube end to form a spigot, and calk into the cast iron bell.
   2. Joining Dissimilar Threaded Piping: Make up connection with a threaded coupling or with companion flanges.
   3. Joining Dissimilar Non-Threaded Piping: Make up connection with adapters recommended by the manufacturers of the piping to be joined.
   4. Joining Galvanized Steel Pipe and Copper Tubing: Make up connection with a dielectric connector.
   5. Joining FRP and Threaded Pipe: Make up connection with adapters as recommended by manufacturers of piping being joined.

## 3.06 PIPING PENETRATIONS

A. Sleeve Schedule: Unless otherwise shown, comply with the following schedule for the type of sleeve to be used where piping penetrates wall or floor construction:

| | CONSTRUCTION | SLEEVE TYPE |
|---|---|---|
| 1. | Frame construction. | None Required |
| 2. | Foundation walls. | A* |
| 3. | Non-waterproof interior walls. | B* |
| 4. | Non-waterproof interior floors not on metal decks. | B* |
| 5. | Floors not on grade having a floor drain. | A |
| 6. | Floors over mechanical equipment, steam service, machine, and boiler rooms. | A |
| 7. | Floors finished or to be finished with latex composition or terrazzo, and not on metal decks. | A |
| 8. | Fixtures with floor outlet waste piping. | None Required |
| 9. | Non-metal roof decks. | A |

*Core drilling is permissible in lieu of sleeves where marked with asterisks.

B. Diameter of Sleeves and Core Drilled Holes:
   1. Unless otherwise specified, size holes thru floors and walls in accordance with the through penetration fire stopping system being used.
   2. Size holes thru exterior walls or waterproofed walls above inside earth or finished floors, and exterior concrete slabs in accordance with the following:
      a. Uninsulated (Bare) Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of pipe, unless otherwise specified.
      b. Insulated Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of insulation, unless otherwise specified.
      c. Mechanical Modular Seals: Size holes in accordance with the manufacturer's recommendations.
   3. Size holes for sprinkler and fire standpipe piping in accordance with NFPA 13.

C. Length of Sleeves (except as shown otherwise on Drawings):
   1. Walls and Partitions: Equal in length to total finished thickness of wall or partition.
   2. Floors with Finish: Equal in length to total finished thickness of floor and extending 1/2 inch above the finished floor level, except as follows:
      a. In furred spaces at exterior walls, extend sleeve one inch above the finished floor level.
   3. Roofs: Equal in length to the total thickness of roof construction, including insulation and roofing materials, and extending one inch above the finished roof level.

D. Packing of Sleeves and Core Drilled Holes:

1. Unless otherwise specified, pack sleeves or cored drilled holes in accordance with Section 078400 - FIRESTOPPING.
2. Pack sleeves in exterior walls or waterproofed walls above inside earth or finished floors with oakum to within 1/2 inch of each wall face, and finish both sides with Type 1C (one part) sealant. See Section 079200.
    a. Mechanical modular seals may be used in lieu of packing and sealant for sleeves and core drilled holes.

## 3.07 FLOOR, WALL AND CEILING PLATES

A. Install plates for exposed uninsulated piping passing thru floors, walls, ceilings, and exterior concrete slabs as follows:
1. In Finished Spaces:
    a. Piping 4 Inch Size and Smaller: Solid or split, chrome plated cast brass.
    b. Piping Over 4 Inch Size: Split, chrome plated cast brass.
2. Unfinished Spaces (Including Exterior Concrete Slabs): Solid, unplated cast iron.
3. Fasten plates with set screws.
4. Plates are not required in pipe shafts or furred spaces.

## 3.08 PIPE AND FITTING SCHEDULE

A. Where options are given, choose only one option for each piping service. No deviations from the selected option will be allowed.

B. Domestic Water (Above Ground):
1. 3 inch and Under: Type L hard drawn copper tube, with cast copper alloy or wrot copper solder type fittings, and joints made up with Type 3 solder, or hydraulic press joints.
2. 4 inch and Over: Coated ductile iron water pipe and fittings, with mechanical or push-on joints.

C. Domestic Water (Below Ground):
1. 2-1/2 inches and Under: Type K soft annealed copper tube with water tube type flared fittings.
2. 3 inches and Over: Coated ductile iron water pipe and fittings, with mechanical or push-on joints.

D. Drainage (Sanitary) Above Ground:
1. Option No. 1: Standard weight galvanized steel pipe, with galvanized cast iron drainage pattern fittings, and threaded joints.
2. Option No. 2: Service weight, coated, cast iron bell and spigot pipe and fittings with calked joints.
3. Option No. 3: Service weight, coated, cast iron bell and spigot pipe and fittings with rubber ring push-on joints.
4. Option No. 4: Hubless, coated, cast iron pipe, fittings, and joint couplings.
5. Option No. 5: DWV copper tubing, with cast brass or wrot copper drainage pattern fittings, and joints made with Type 3 solder.

E. Fire Standpipe and Sprinkler (Above Ground):
   1. Option No. 1: Standard weight black steel pipe, with standard weight cast iron fittings, and threaded joints.
   2. Option No. 2: Standard weight black steel pipe, with roll grooved ends, grooved pipe fittings, and couplings.

F. Fire Standpipe and Sprinkler (Below Ground): Coated ductile iron water pipe and fittings, with mechanical or push-on joints.

G. Vent Piping: Same materials that are used for piping system to which vent is connected.

**END OF SECTION**

## SECTION 221116

## VACUUM BREAKERS

### PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Air Gap Fittings: Section 220576.

### 1.02 SUBMITTALS

A. Product Data:
   1. Manufacturer's catalog cuts, specifications and installation instructions for each type Vacuum Breaker.

### 1.03 MAINTENANCE

A. Special Tools: One for each type and size vandal resistant fastener.

### PART 2 PRODUCTS

### 2.01 VACUUM BREAKERS

A. Type B: Atmospheric vacuum breaker conforming to ASSE 1001 - Pipe Applied Atmospheric Type Vacuum Breakers.
   1. Non-pressure type with polished chrome plated brass body, disc float, silicone disc, bronze internal trim and maximum working conditions of 125 psi and 210 degrees F.
      a. Operation: Internal disc float drops, closes orifice, and opens atmospheric vent upon back siphonage.
      b. Connections: Female threaded inlet and outlet.

### PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

### 3.02 FIELD QUALITY CONTROL

A. Operation Test:
   1. Check vacuum breaker for leaking under normal operating conditions.
   2. Apply negative pressure to the vacuum breaker inlet, and observe that the device opens to the atmosphere.
   3. Repair or replace any device failing the operation test, and retest.

**END OF SECTION**

## SECTION 221118

## BACKFLOW PREVENTERS

### PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Air Gap Fittings: Section 220576.

### 1.02 SUBMITTALS

A. Product Data:
   1. Manufacturer's catalog sheets, specifications, and installation instructions for each type backflow preventer and test kit.

### 1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with the State Department of Health Sanitary Code for Cross Connection Control, and the other standards listed in Part 2 of this section.
   2. Where conflicts occur between the referenced standards, the most stringent requirements shall apply.

### 1.04 MAINTENANCE

A. Special Tools (as furnished or recommended by the backflow preventer manufacturer). Deliver to the Director's Representative:
   1. Test Kit A: Portable, packaged in a substantially built, compartmented carrying case, containing hose, gauge, and fittings required for testing backflow preventer for proper operation, and printed procedure for conducting test.
   2. Test Kit B: Sight tube, of required length, for testing backflow preventer for proper operation, and printed procedure for conducting test.

### PART 2 PRODUCTS

### 2.01 BACKFLOW PREVENTERS

A. Type A, Domestic water system: Reduced Pressure Zone Principle device, with atmospheric vent, conforming to ASSE Standard 1013, AWWA C-511, USC specifications manual for Cross Connection Control, and listed as acceptable in the State Department of Health, Environmental Health Manual.
   1. Performance: 150 psig, and 130 degrees F maximum working conditions.

2. Assembly: Strainer and gate valve on inlet side, gate valve on outlet side, and four test cocks, all as furnished or recommended by the backflow preventer manufacturer.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install the Work of this section in accordance with the manufacturer's printed installation instructions.

B. Atmospheric Vent: Pipe vent to spill over closest point of drainage, as directed, maintaining a minimum 12 inch air gap above the drain.
   1. Install air gap fitting when shown, or if atmospheric vent must be connected to drainage line. See Section 220576.

### 3.02 FIELD QUALITY CONTROL

A. Operation Test: Test kit as specified under Part 1 of this section may be used. Conduct test in the presence of the Director's Representative.
   1. Type A Backflow Preventer: Test the device with the test kit in accordance with the manufacturer's test procedures.
   2. Type B Backflow Preventer: Test the device with the test kit in accordance with the manufacturer's test procedure.
   3. Type C Backflow Preventer: Test at 125 psi hydrostatic pressure, and hold for four hours; check for leaking.

B. Re-testing: Repair or replace any device failing the operation test, and repeat the test.

**END OF SECTION**

## SECTION 221119

## WATER SUPPLY ACCESSORIES

### PART 1 GENERAL

### 1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications, dimensional data, and installation instructions for each item specified, excluding fasteners.

### 1.02 MAINTENANCE

A. Special Tools: Deliver to the Director's Representative.
   1. Wall Hydrant T-Handle Locking Key: One for each wall hydrant.
   2. Tools For Vandal Resistant Fasteners: One for each type and size.

### PART 2 PRODUCTS

### 2.01 AIR CHAMBERS

A. Water Service Entrance: Same piping material used for above ground domestic water system, complete with drain valve with hose bibb end at bottom of air chamber, and pet cock at top.
   1. Size: Two times water service pipe size, not to exceed 6 inches, and 4'-0" minimum height.

B. Distribution System: Same piping material used for above ground domestic water system.
   1. Riser Air Chamber: Extend riser full size to the ceiling above the highest branch run-out and cap.
   2. Branch Air Chamber: Size 1-1/2 times the branch at the point of installation, and 18 inch minimum height.

### 2.02 WATER HAMMER ARRESTORS

A. Hydropneumatically controlled with permanently sealed expansion chamber pre-charged with non-combustible gas, threaded connection, and conforming to ASME A112.26.1M - Water Hammer Arrestors, and ASSE 1010 - Water Hammer Arrestors.
   1. Bellows Type: Stainless steel construction with elastomer or stainless steel bellows.
   2. Piston Type: Hard drawn copper body with brass piston, cap and adapter; and elastomer seals.

### 2.03 HOSE BIBBS

A. Compression type with polished chrome plated bronze body, renewable units, vacuum breaker with breakaway screw or vandal resistant fastener (ASSE 1011), removable T-handle, and integral threaded wall flange.
   1. Connections: 3/4 inch female threaded inlet, and 3/4 inch hose bibb outlet.

## 2.04 DRAIN VALVE

A. Cast brass body with renewable units, hose bibb vacuum breaker (ASSE 1011) with drainage feature, and removable cast iron handwheel with vandal resistant fastener.
   1. Valve must be completely assembled to make hose connection.
   2. Connections: 1/2 or 3/4 inch threaded or solder end inlet, and 3/4 inch hose bibb outlet.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.
B. Wall Hydrants:
   1. Installation Height: Minimum 18 inches above finished grade.

C. Secure external components in place with vandal resistant fasteners or devices which cannot be removed without special tools.

**END OF SECTION**

**SECTION 223301**

**DOMESTIC WATER HEATER**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Valves: Section 220523.

B. Electric Work: Division 26.

### 1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions for each water heater.

B. Contract Closeout Submittals:
   1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director's Representative.
   2. Warranty: Copy of specified warranty.

### 1.03 REGULATORY REQUIREMENTS

A. Water heater shall be UL listed and labeled.

B. Comply with the State Energy Conservation Construction Code.

### 1.04 WARRANTY

A. Manufacturer's Warranty: Three year warranty for the glass lined water heater tank.

## PART 2 PRODUCTS

### 2.01 WATER HEATER

A. Tank: Welded steel, factory tested at 300 psi and rated for 150 psi working pressure.
   1. Glass lining permanently bonded to tank interior surface.
   2. Tank nipples factory installed.
   3. Renewable magnesium anode.
   4. Corrosion resistant dip tube.
   5. Drain and relief valve tappings.
   6. Renewable bronze boiler drain.

B. Heating Elements: Immersion type, replaceable; 75 watts per square inch maximum watt density.

C. Thermostat: Adjustable, interlocked with overheat control, including automatic shut-off.

D. Wiring: Factory interwired, requiring only a single field electric connection to put the heater into service.

E. Outer Casing: Steel with baked enamel or acrylic finish.
1. Access door for servicing thermostats and heating elements.

F. Pressure-Temperature Relief Valve: AGA Z21.22; bronze body with stainless steel internals and threaded blow-off connection.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install the Work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. Install the water heater on a level, firm base.

C. Install the pressure-temperature relief valve in the dedicated tank tapping. Pipe the relief valve blow-off to a point 6 inches above the floor.

D. Provide gate valves on hot and cold water connections.

E. Make final piping connections with unions.

F. Flush and fill tank. Do not switch on heating elements until tank is full and entrapped air is eliminated.

**END OF SECTION**

**SECTION 224200**

**PLUMBING FIXTURES**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Sealants: Section 079200.

B. Showers: Section 224223.

C. Security Plumbing Fixtures: Section 224600.

### 1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications, roughing dimensions, and installation instructions for each item specified except fasteners.
   1. Deliver cut out data for countertop fixtures to the Director's Representative.

B. Samples:
   1. Water Closet Seat: One seat if other than product specified. Sample will be returned and if approved, may be installed on the Project.

### 1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with applicable requirements of FS WW-P-541, and the following standards:
      a. ANSI/ASME A112.6.1M - Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
      b. ANSI/ASME A112.18.1M - Plumbing Fixture Fittings.
      c. ANSI/ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
      d. ANSI/ASME A112.19.2M - Vitreous China Plumbing Fixtures.
      e. ANSI/ASME A112.19.6 - Hydraulic Requirements for Water Closets and Urinals.
   2. Materials and installations designated as handicapped accessible shall conform with the following:
      a. ANSI A117.1 - Buildings and Facilities - Providing Accessibility and Usability for Physically Handicapped People.
      b. The Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG), (Appendix A to 28 CFR Part 36).
      c. The Uniform Federal Accessibility Standards (UFAS), (Appendix A to 41 CFR Part 101-19.6).
   3. Each fixture carrier support shall be listed by model number in the fixture support manufacturer's Fixture Support Selection Guide as being recommended for support of the appropriate fixture.

B. Plainly and permanently mark each fixture and fitting with the manufacturer's name or trade mark.

## PART 2 PRODUCTS

### 2.01 MATERIALS - GENERAL

A. Vitreous China: First quality, smooth, uniform color and texture, with fused on glaze covering surfaces exposed to view.
   1. Surfaces shall be free of chips, craze, warpage, cracks and discolorations. Surfaces in contact with walls or floors shall be flat, with warpage not to exceed 1/16 inch per foot.
   2. Color: White.

B. Porcelain Enameled Cast Iron: Smooth, uniform color and texture, having fused on glaze covering surfaces exposed to view.
   1. Material shall show no cracks, chips, craze or discolorations.
   2. Enameled surfaces shall be acid resistant unless otherwise specified.
   3. Color: White.

C. Fixture Trim: Brass, bronze, or stainless steel construction; consisting of supply and waste fittings, faucets, traps, stop valves, escutcheons, sink strainers, nipples, supplies, and metal trim.
   1. Brass piping: Ips standard weight, with standard weight, 125 lb cast brass fittings.
   2. Brass tubing: 18 B & S gage.
   3. Stainless steel: 18-8 Type 302 or 304 unless otherwise specified.

D. Fixture Trim Finishes:
   1. Brass or Bronze: Polished or satin finished chrome plating, 0.02 mil chromium over 0.2 mil nickel plating.
   2. Stainless Steel: Invisible welds and seams, and unless otherwise specified, polished to No. 4 commercial finish.

E. Fixture Hold-down Bolts: Steel, plated for corrosion resistance.
   1. Cap nuts: Metal, polished and chrome plated.

F. Combination Faucets: Faucets shall turn counter to each other for the on and off positions.

### 2.02 BATHTUB - RESIDENTIAL/COMMERCIAL TYPE

A. Bathtub: One piece cast iron with bottom pitched to drain, with overflow at the drain end, and tiling bead on built-in sides.
   1. Dimensions: 60 inches x 32 inches x 16 inches high.
   2. Recessed Tub: Built in on three sides; full double shell apron over front.
   3. Slip Resistant Treatment: Integral (not applied).
   4. Finish: Porcelain enamel on surfaces exposed to view.
   5. Tub Hanger: Lucke Co., Wilmette, Illinois.

C. Supply Fittings:
   1. Type C pressure balancing, piston operated mixing valve. See Section 221120.
   2. Over rim spout with diverter.

D. Drain Fitting: Lever operated combination drain and connected overflow having the following features:
   1. Trip lever stop in waste tee and perforated strainer or pop-up waste.
   2. Operating parts removable without disassembling piping.
   3. Drain tee outlet tapped 1-1/2 inch ips.

E. Fixture trap: Cast brass, 1-1/2 inch threaded ends.

F. Curtain Rod: Brass, minimum 18 B & S gage; 1 inch minimum diameter.
   1. Cast brass wall flanges with set screws.
   2. Brass rings (one dozen).
   3. Brass curtain hook and chain.
   4. Finish: Polished and chrome plated.

## 2.04 LAVATORY

A. Fixture: Vitreous china, unitized construction, straight front and sides, flat top graded to bowl, cast-in soap dish, anti-splash rim and front overflow; designed for concealed arm supports.
   1. Dimensions: 20 inches long, 18 inches front to back, 3-1/2 inches front and side apron.
   2. 4 inch high integral back.

B. Supply Fitting: Individual deck mounted, self-closing faucets with the following features:
   1. Maximum Flow: 0.5 gpm at 80 psi.
      a. Exception: Metering faucets shall have a maximum flow of 0.25 gallons per cycle.
   2. Over rim spout with aerator.
   3. Renewable operating units.
   4. Indexed operators.
   5. Vandal resistant assembly.
   6. 1/2 inch inlet lock nut and coupling nut.

C. Waste Fitting: Pop-up type, actuated by a lift knob on the back ledge.
   1. Metal drain plug.
   2. Solid metal lift knob and cast escutcheon.
   3. 1-1/4 inch tailpiece.
   4. Vandal resistant assembly.

D. Trap: Cast brass, non-adjustable P trap, 1-1/4 inch tubing inlet, 1-1/2 inch ips outlet.
   1. Bottom cleanout plug.

2. Ips brass nipple with solid cast brass escutcheon.

E. Supplies: 3/8 inch ips brass with key operated stops and solid cast brass escutcheons.
1. Wall Supplies: Angle stops with keys.
2. Floor Supplies: Straight stops with keys.

## 2.05 COUNTERTOP LAVATORY

A. Fixture: Vitreous china, unitized construction, flat top graded to bowl, cast-in soap dish, front overflow, and self-rimming.
1. Size (approximate):
a. Oval: 20 inches x 17 inches.
b. Rectangular: 21 inches x 19 inches.
c. Round: 19 inches.

B. Lavatory Fitting: Combination faucet and pop-up waste assembly with the following features:
1. Maximum Flow: 2.5 gpm at 80 psi.
2. Over rim spout with aerator.
3. Renewable units.
4. Metal four arm indexed handles set on 8 inch centers, with either integral splines, or ceramic spline inserts. Plastic spline inserts will not be accepted.
5. Pop-up waste with non-removable drain plug.
6. 1-1/4 inch tailpiece.
7. Rigid connectors between spout and valve units; flexible connectors are not acceptable.

C. Trap: Cast brass, non-adjustable P trap, 1-1/4 inch tubing inlet, 1-1/2 inch ips outlet.
1. Bottom cleanout plug.
2. Ips brass nipple with solid cast brass escutcheon.

D. Supplies: 3/8 inch ips brass with key operated stops with solid cast brass escutcheon.
1. Wall Supplies: Angle stops with keys.

## 2.06 FIXTURE SUPPORTS AND SUPPORTING DEVICES FOR LAVATORIES, SINKS, AND EQUIPMENT

A. General: Ferrous metal members of carriers and supporting devices with the exception of chrome plated or porcelain enameled cast iron, shall be factory painted for corrosion resistance.

B. Floor Mounted Carrier Supports: Steel pipe uprights, 1-1/4 inch ips minimum diameter, or 1 inch x 3 inch steel tubing uprights, with cast iron or welded steel feet, drilled for bolting to the floor construction. Each carrier shall be provided

with the appropriate fixture supporting devices specified, or recommended by the carrier manufacturer's Fixture Support Selection Guide.

1. Concealed Arms: Steel, with fixture locking lugs, leveling screws and a means of attaching, positioning and securing the fixture to the carrier.
   a. Trim: Polished, chrome plated metal escutcheon to space fixture two inches from the wall.
2. Exposed Arms: Cast iron or steel, porcelain enamel finished, with locking lugs, and leveling screws. Include studs, nuts and washers for fixture to be supported.
   a. Trim: Polished and chrome plated metal cap nuts and washers.

C. Wood Stud Filler Piece: 2 inch x 8 inch wood planking cut to fit between wood studding. Fasten with four 3/8 inch x 2-1/2 inch lag bolts with washers.

## 2.07 COUNTERTOP SINK

A. Material: 18 gage, seamlessly drawn, Type 302 (18-8) stainless steel.
   1. Features: Self-rimming, extended back ledge, with faucet and spray hose punchings spaced on 4 inch centers. Cove corners 1-3/4 inch minimum radius; fully coat underside with sound deadening and condensation barrier.

B. Supply Fitting: Top mounted deck type mixing faucet, cast brass base and spout; indexed lever handles.
   1. Maximum Flow: 2.5 gpm at 80 psi.
   2. 8 inch swing spout.
   3. 1/2 inch inlets on 8 inch centers.
   4. Renewable units.

C. Drain Assembly:
   1. Stainless steel removable strainer basket with neoprene stopper and 1-1/2 inch tubing tailpiece.
   2. Stainless steel removable strainer basket with neoprene stopper and 1-1/2 inch continuous tubing drain.
   3. 1-1/2 inch cast brass non-adjustable P trap, with bottom cleanout plug.
   4. 1-1/2 inch ips brass trap nipple with cast brass escutcheon.

D. Fastening Devices: Stainless steel spring clip assemblies or clamping devices for securing sink to the countertop.

## 2.18 VITREOUS CHINA WATER CLOSETS

A. Fixtures: Vitreous china, full size, elongated bowl with integral flushing rim and jet; trapway at the rear and the outlet centered between a pair of hold down bolt holes.
   1. Trapway size: Pass minimum ball of 2 inches.
   2. Trap seal: 2 inches minimum.
   3. Water surface area: 12 inches x 10 inches minimum.
   5. Floor Supported Fixture Heights:
      a. Standard Fixture: 14 to 15 inches from finished floor to rim.

B. Operation: Fixture shall flush satisfactorily without extraordinary rise of water level in the bowl.
   1. Maximum gallons of water per flush: 1.6 gallons.

C. Flush Tank: Vitreous china secured to and supported by the closet bowl and separate lift off cover with provisions for locking.
   1. Float valve with nylon seat and vacuum breaker.
   2. Flushing valve.
   3. Metal trip lever.
   4. Supply: 1/2 inch ips brass pipe with a key operated stop and solid cast brass escutcheon.

D. Water Closet Floor Flange:
   1. For Use with DWV Copper Tubing: Cast brass, 48 ounce minimum weight.
   2. For Use with Cast Iron Soil Pipe: Cast iron, 90 ounce minimum weight.

E. Closet Seat: Extra heavy duty, commercial design; Model 1655-C by Bemis Mfg. Co., Model No. 527-CH by Beneke Corp., or Model No. 9500C by Church Seat Co.
   1. Material and Construction: Solid plastic, open front, less cover, molded in one piece with no joints, seams or crevices.
   2. The manufacturer's name shall be molded into the seat.
   3. Metal check hinges shall be integrally molded into the seat. Hinges, inserts, bearings and posts shall be of brass or stainless steel. Cover upper post and metal exposed above fixture rim with plastic to match seat.
   4. Surface shall be hard, polished, impervious to moisture, and not affected by the action of uric acid.
   5. Color: White.

## PART 3 EXECUTION

### 3.01 FIXTURE INSTALLATION

A. Install the Work of this section in accordance with the manufacturer's printed installation instructions.

B. Install fixtures level and at proper height, tighten connections, and install hold-down bolts, cap nuts and cover plates, where required.

D. Bathtubs:
   1. Residential Type:
      a. Caulk joint between fixture wall and floor with Type 1D sealant; strike a neat joint.
      b. Install curtain rod 6'-6" above floor.

I. Lavatories:

1. Mount lavatories 31 inches from finished floor to rim unless otherwise specified.
2. Caulk joint between fixture back and wall with Type 1D sealant; strike a neat joint.

J. Countertop Fixtures:
1. Install fixture with securing devices supplied.
2. Set fixture on bedding of sealant, tighten securing devices and remove excess sealant.

K. Water Closets:
1. Floor Supported Fixtures:
   a. Set fixture in bed of setting compound; remove excess.
   b. Caulk base perimeter with Type 1D sealant; strike a neat joint.
2. After connections are tightened, install cap nuts and washers.
3. Install water closet seats when directed.

## 3.03 CLEANING, FLUSHING AND ADJUSTMENT

A. Clean fixture and trim. Remove grease and dirt; polish surfaces but leave stickers and warning labels intact.

B. Flush supply piping and traps; clean strainers.

C. Adjust stops for proper delivery.

D. Adjust metering faucets for proper timing.

**END OF SECTION**

**SECTION 230529**

**PIPE HANGERS AND SUPPORTS**

## PART 1 GENERAL

### 1.01 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Companion high density filler pieces for installation over the top 180 degree surface of pipe or tubing, at points of support where a combination clevis hanger, insulation shield and high density insulating saddle are installed.

### 1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Piping Insulation: Section 230700.

### 1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Comply with the applicable requirements of the ASME B31 Piping Codes.
   2. Unless otherwise shown or specified, comply with the requirements of the Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58, and SP-69.

## PART 2 PRODUCTS

### 2.01 PIPE HANGERS AND SUPPORTS

A. Combination clevis hanger, pipe insulation shield and vapor barrier jacketed high density insulating saddle with companion high density filler piece.
   1. Insulating saddles and filler pieces shall be of the same thickness and materials as the adjoining pipe insulation. Saddles shall cover the lower 180 degrees of the pipe or tubing, and companion filler pieces shall cover the upper 180 degrees of the pipe or tubing. Physical sizes, gages, etc. of the components of insulated hangers shall be in accordance with the following schedule:

| PIPE OR TUBING SIZE (Inches) | SHIELD LENGTH (Inches) | SHIELD GAGE | SADDLE LENGTH (Inches) | VAPOR BARRIER JACKET LENGTH (Inches) |
|---|---|---|---|---|
| Up to 2-1/2 | 4 | 16 | 6 | 10 |
| | | | | |

B. Pipe Insulation Shields: Fabricated of steel, with a minimum arc of 180 degrees, unless otherwise indicated. Shields for use with hangers and supports, with the exception of combination clevis type hangers, shall be in accordance with the following schedule:

| PIPE OR TUBING SIZE (Inches) | SHIELD LENGTH (Inches) | SHIELD GAGE |
|---|---|---|
| Up to 2-1/2 | 8 | 18 |

D. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.

E. Adjustable Floor Rests and Base Flanges: Steel.

F. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with two nuts at each end for positioning rod and hanger, and locking each in place.

G. Riser Clamps: Malleable iron or steel.

H. Rollers: Cast Iron.

I. Restraints, Anchors, and Supports for Grooved End Piping Systems: As recommended by the grooved end fitting manufacturer, and as required for seismic restraints.

## 2.02 ANCHORS AND ATTACHMENTS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN, HN, or FS Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS Series.

C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips S Series.

D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.

E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS Series.

F. Beam Clamps: Forged steel beam clamp, with weldless eye nut (right hand thread), steel tie rod, nuts, and washers, Grinnell's Fig No. 292 (size for load, beam flange width, and rod size required).

G. Metal Deck Ceiling Bolts: B-Line Systems' Fig. B3019.

## 2.03 VIBRATION ISOLATION FOR PIPING

A. Type: Combination rubber and spring type designed for insertion in a split hanger rod for isolating piping from the overhead construction.
   1. Approved isolators: Amber Booth Type BSSR, Korfund Type VX, Mason Industries, Type DNHS, Vibration Eliminator Co. Type SNRC and Vibration Mountings and Controls Type RSH.

B. To ensure that piping weight is properly distributed and not being supported by equipment flanges, the first three rubber and spring isolators on the inlet shall be of the "position indicating" type.
   1. Approved Isolators: Amber Booth Type PBSS, Korfund Type VXLS, Mason Industries Type PDNHS, Vibration Eliminator Co. Type PR2H and Vibration Mountings and Controls Type RSHP.

## 2.04 FASTENERS

A. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

## 2.05 SHOP PAINTING AND PLATING

A. Hangers, supports, rods, inserts and accessories used for pipe supports, unless chromium plated, cadmium plated or galvanized shall be shop coated with metal primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper pipe or copper tubing.

B. Hanger supports for chromium plated pipe shall be chromium plated brass.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Do not hang or support one pipe from another or from ductwork.
   1. Do not bend threaded rod.

B. Support all insulated horizontal piping conveying refrigerants or other fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.

C. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.

   1. For Copper Pipe and Copper Tubing:

| PIPE OR TUBING SIZE (Inches) | MAXIMUM SPACING (Feet) |
|---|---|
| 1-1/2 and under | 6 |
| 2 and over | 10 |
| | |

4. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.
5. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.
6. For Branch Piping Runs and Runouts Over 5 feet In Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.
7. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.

D. Size hanger rods in accordance with the following:

| PIPE OR TUBING SIZE (Inches) | SINGLE ROD HANGER SIZE (Inches) | | DOUBLE ROD HANGER SIZE (Inches) | |
|---|---|---|---|---|
| | PIPE | TUBING | PIPE | TUBING |
| 1/2 to 2 | 3/8 | 1/4 | 3/8 | 1/4 |

1. Secure hanger rods as follows: Install one nut under clevis, angle or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each rod, two at upper hanger attachment and two at hanger.

E. Vertical Piping:
1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.

## 3.03 UPPER HANGER ATTACHMENTS

A. General:
1. Secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
2. Do not attach hangers to steel decks that are not to receive concrete fill.

3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
4. Do not use flat bars or bent rods as upper hanger attachments.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.
1. Do not use drive-on beam clamps.
2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
3. Do not drill holes in main structural steel members.
4. Beam clamps, with tie rods as specified, may be used as upper hanger attachments for the support of piping, subject to clamp manufacturer's recommended limits.

C. Attachment to Wood Construction: Secure hangers to the sides (only) of wood members, by means of malleable iron side beam connectors, or malleable iron or steel side beam brackets. Do not secure hanger attachments to nailing strips resting on top of steel beams.
1. Secure side beam connectors to wood members with two No. 18 x 1-1/2 inch long wood screws, or two No. 16 x 1-1/2 inch long drive screws. Do not support piping over 1-1/2 inches in size from side beam connectors. Do not hammer in wood screws.
2. Secure side beam brackets to wood members with steel bolts or lag screws. Do not use lag screws in wooden members having a nominal thickness (beam face) under 2 inches in size. Install bolts or lag screws, in the sides of a timber or a joist, at the mid-point or above, not less than 2-1/2 inches from the lower edge when supporting branch lines and not less than 3 inches from the lower edge when supporting mains. Install heavy gage steel washers under all nuts.
3. Secure side beam brackets to wooden beams or joists, with lag screws or bolts of size as follows:

| PIPE SIZE (Inches) | LAG SCREW SIZE (Inches) | BOLT DIAMETER (Inches) |
|---|---|---|
| 2 and under | 3/8 diameter x 1-3/4 | 3/8 |

a. Do not support piping larger than 3 inches with lag screws. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
b. The minimum width of the lower face of wood beams or joints in which lag screws of size as specified may be used is as follows:

| LAG SCREW DIAMETER (Inches) | NOMINAL WIDTH OF BEAM FACE (Inches) |
|---|---|
| 3/8 | 2 |
| 1/2 | 3 |
| | |

**END OF SECTION**

**SECTION 230553**

**PIPE AND VALVE IDENTIFICATION**

## PART 1 GENERAL

### 1.01 REFERENCES

A. ANSI A13.1 - Scheme for Identification of Piping Systems.

### 1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions for each item specified.

## PART 2 PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. W.H. Brady Co., Milwaukee, WI.

B. Emed Co., Buffalo, NY.

C. Panduit Corp., Tinley Park, IL.

D. Seton Nameplate Corp., New Haven, CT.

### 2.02 PIPE MARKERS AND ACCESSORIES

A. Snap-on Marker: One piece wrap around type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, 3/4 inch adhesive strip on inside edge, and 360 degree visibility.

B. Strap-On Marker: Strip type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, factory applied grommets, and pair of stainless steel spring fasteners.

C. Stick-On Marker: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.

D. Pipe Marker Legend and Color Field Sizes:

| OUTSIDE DIAMETER OF PIPE OR INSULATION (Inches) | LETTER SIZE (Inches) | LENGTH OF COLOR FIELD (Inches) |
|---|---|---|

| OUTSIDE DIAMETER OF PIPE OR INSULATION (Inches) | LETTER SIZE (Inches) | LENGTH OF COLOR FIELD (Inches) |
|---|---|---|
| 3/4 to 1-1/4 | 1/2 | 8 |
| 1-1/2 to 2 | 3/4 | 8 |

E. Banding Tapes: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating.
   1. Plain Tape: Unprinted type; color to match pipe marker background.
   2. Flow Arrow Tape: Printed type with integral flow arrows; color to match pipe marker background.

F. Pipe Size Labels: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, vertical reading pipe size in inches, and legend size matching adjacent pipe marker.

**2.03 PIPE SERVICE IDENTIFICATION TAGS**

A. Type: No. 19 B & S gage brass, with 1/4 inch high pipe service abbreviated legend on one line, over 1/2 inch high pipe size legend in inches, both deep stamped and black filled; and 3/16 inch top hole for fastener.

B. Size: 2 inch square tag.

C. Fasteners: Brass "S" hook or brass jack chain of size as required for pipe to which tag is attached.

**2.04 VALVE SERVICE IDENTIFICATION TAGS**

A. Type: No. 19 B & S gage brass, with 1/4 inch high valve service abbreviated lettering on one line over 1/2 inch high valve service chart number, both deep stamped and black filled; and with 3/16 inch top hole for fastener.

B. Sizes:
   1. HVAC Use: 1-1/2 inch dia round.

C. Fasteners: Brass "S" hook or brass jack chain of size as required for valve stem or handle to which tag is attached.

**2.05 VALVE SERVICE IDENTIFICATION CHART FRAMES**

A. Type: Satin finished extruded aluminum frame with rigid clear plastic glazing, size to fit 8-1/2 x 11 inches valve chart.

**PART 3 EXECUTION**

**3.01 PREPARATION**

A. Complete testing, insulation and finish painting work prior to completing the Work of this Section.

B. Clean pipe surfaces with cleaning solvents prior to installing piping identification.

C. Remove dust from insulation surfaces with clean cloths prior to installing piping identification.

## 3.02 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. Stick-On Pipe Markers:
   1. Install minimum of 2 markers at each specified location, 90 degrees apart on visible side of pipe.
   2. Encircle ends of pipe markers around pipe or insulation with banding tape with one inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.

C. Pipe Size Labels: Install labels adjacent to each pipe marker and upstream from flow arrow. Install a minimum of 2 pipe size labels at each specified location, 90 degrees apart on visible side of pipe.

D. Pipe Service Identification Tags: Attach tags to piping being identified with "S" hooks or jack chains.

## 3.03 PIPING IDENTIFICATION SCHEDULE

A. Piping Identification Types:
   1. Piping or Insulation under 3/4 inch od: Pipe identification tags.
   2. Piping or Insulation 3/4 inch to 5-7/8 inch od: Snap-on marker or stick-on marker.
   3. Piping or Insulation 6 inch od and Larger: Strap-on marker or stick-on marker.

B. Locate piping identification to be visible from exposed points of observation.
   1. Locate piping identification at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs.
   2. Where 2 or more pipes run in parallel, place printed legend and other markers in same relative location.

## 3.04 VALVE IDENTIFICATION SCHEDULE

A. Valve Service Identification Tags:

1. Tag control valves, except valves at equipment, with a brass tag fastened to the valve handle or stem, marked to indicate service and numbered in sequence for the following applications:
    a. Domestic water valves controlling mains, risers and branch runouts.

B. Valve Service Identification Charts:
1. Provide 2 framed valve charts for each piping system specified to be provided with valve identification tags. Type charts on 8-1/2 x 11 inches heavy white bond paper, indicating valve number, service and location.
2. Hang framed charts at locations as directed.

**END OF SECTION**

## SECTION 230554

## DUCT AND EQUIPMENT IDENTIFICATION

### PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Mechanical Painting: Section 099103.

### 1.02 DELIVERY, STORAGE AND HANDLING

A. Deliver paint to the Site in original, new unopened containers, bearing manufacturers' printed labels.

B. Store materials at the site where directed. Keep storage space clean and accessible to the Director's Representative at all times.

### PART 2 PRODUCTS

### 2.01 MATERIALS

A. Paint: Type IAL-3 specified in Section 099103.

### PART 3 EXECUTION

### 3.01 PREPARATION

A. Protection: Cover and protect surfaces to be painted, adjacent surfaces not to be painted, and removed furnishings and equipment from existing paint removals, airborne sanding particles, cleaning fluids and paint spills using suitable drop cloths, barriers and other protective devices.

1. Schedule and coordinate surface preparations so as not to interfere with work of other trades or allow airborne sanding dust particle to fall on freshly painted surfaces. Do not perform the Work of this Section until testing, insulation and finish painting Work have been completed.
2. Provide adequate natural or mechanical ventilation to allow surfaces to be prepared and painted in accordance with product manufacturer’s instructions and applicable regulations.
3. Provide and maintain “Wet Paint” signs, temporary barriers and other protective devices necessary to protect prepared and freshly painted surfaces from damages until Work has been accepted.

B. Clean and prepare surfaces to be painted in accordance with specifications, paint manufacturer’s approved product data sheets and printed label instructions. In the event of conflicting instructions or directions, the more stringent requirements shall apply.

1. Cleaners: Use only approved products manufactured or recommended by finish paint manufacturer. Unless otherwise recommended by cleaner manufacturer, thoroughly rinse with clean water to remove surface contaminants and cleaner residue.

## 3.02 DUCT IDENTIFICATION

A. Identify exposed ductwork, bare or insulated, directly connected to air handling apparatus, in the following spaces or rooms, by means of painted stenciled legends:
   1. Mechanical Equipment.

B. Locate stenciled legends to be readily visible from any point of observation. Stencil identification along center line of duct, close to equipment. Where view is unobstructed from two directions, apply two sets of stenciling (both sides), visible from each direction.

C. Letter Size: 1-1/2 inches in height.

D. Samples of Ductwork Identification:
   1. Exhaust Air.

E. Colors: Paint stenciled letters black. Where the background color is dark, paint background white before stenciling.

## 3.03 APPLICATION OF PAINT

A. Stencil Painting: Apply with a brush or aerosol type spray can.

## 3.04 CLEANING

A. Clean adjacent surfaces of paint spatters resulting from the Work of this Section.

**END OF SECTION**

**SECTION 230593**

**CLEANING AND TESTING**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Balancing of Systems: Section 230594.

### 1.02 SUBMITTALS

A. Quality Control Submittals
   1. Test Reports (Field Tests):
      a. Refrigeration Systems: Submit test results on Refrigeration Systems Pressure - Dehydration Tests, Form BDC-228, a sample of which can be obtained from the Director's Representative, or a similar test report form, which includes the data shown on Form BDC-228.

### 1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Perform factory testing of factory fabricated equipment in complete accordance with the agencies having jurisdiction.
   2. Perform field testing of piping systems in complete accordance with the local utilities and other agencies having jurisdiction and as specified.

### 1.04 PROJECT CONDITIONS

A. Protection: During test Work, protect controls, gages and accessories which are not designed to withstand test pressures. Do not utilize permanently installed gages for field testing of systems.

### 1.05 SEQUENCING AND SCHEDULING

A. Transmit written notification of proposed date and time of operational tests to the Director's Representative at least 5 days in advance of such tests.

B. Perform cleaning and testing Work in the presence of the Director's Representative.

C. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction Work, and at other times as directed. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems, or temporary valves or caps as required to perform the Work.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Test Equipment and Instruments: Type and kind as required for the particular system under test.

B. Test Media (air, gas, refrigerant, dry nitrogen, vacuum, water): As specified for the particular piping or system under test.

C. Cleaning Agent (chemical solution, steam, water): As specified for the particular piping, apparatus or system being cleaned.

## PART 3 EXECUTION

### 3.01 PRELIMINARY WORK

A. Thoroughly clean pipe and tubing prior to installation. During installation, prevent foreign matter from entering systems. Prevent if possible and remove stoppages or obstructions from piping and systems.

B. Thoroughly clean compressed air, control air, refrigerant pipe and similar systems prior to pressure or vacuum testing.

1. Refrigerant Piping:
    a. Only use factory sealed refrigerant piping.
    b. Crimp and braze caps on ends of previously cleaned piping at end of the day if piping was cut.
    c. When brazing, purge lines with dry nitrogen.

### 3.02 PRESSURE TESTING OF PIPING

A. Piping shall be tight under test and shall not show loss in pressure or visible leaks, during test operations or after the minimum duration of time as specified. Remove piping which is not tight under test; remake joints and repeat test until no leaks occur.

B. General:

1. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction Work, and at other times as directed.
2. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building.
3. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems, or temporary valves or caps as required to perform the Work.

## 3.03 REFRIGERATION SYSTEMS - TESTING, DEHYDRATION AND CHARGING

A. Leak Test Procedure:
   1. Refrigerant Piping Systems:
      a. Pressurize with dry nitrogen to 50 psig and test for leaks using a bubble type solution.
      b. Release this partial test pressure and correct deficiencies.
      c. Charge system with a trace of refrigerant to 15 psig, then add dry nitrogen until system test pressures are reached and retest for leaks with an electronic leak detector.
      d. Release pressure, repair leaks and retest as necessary until no leaks occur.
      e. Recover refrigerant used for leak testing.
   2. System Test Pressures:
      a. Charge system with dry nitrogen and trace of refrigerant (HFC 134A, HFC 245, HFC 404, HFC 407C, HFC 410A or HFC 507) to 350 psig and retest for leaks with an electronic leak detector. The system must stay at 350 psig pressure for 24 hours to pass the system test pressure test.
      b. Release pressure, repair leaks and retest as necessary until no leaks occur.
      c. Recover refrigerant used for leak testing.

B. Dehydration:
   1. Low and Ultra Low Temperature Refrigeration Systems (-30 degrees F to 32 degrees F:
      a. Following pressure tests, dehydrate each system with a vacuum pump.
      b. Draw and hold an initial vacuum of 800 microns. Break this vacuum by pressurizing with dry nitrogen to 10 psig, and change oil in vacuum pump.
      c. Draw and hold a second vacuum of 500 microns. Break this vacuum by pressurizing with dry nitrogen to 10 psig, and change oil in vacuum pump.
      d. Draw and hold a third vacuum of 250 microns for 8 to 12 hours with an allowable maximum rise of 50 microns. Break this third vacuum by adding liquid refrigerant specified for the equipment to the high side of the system (liquid line).
      e. Verify vacuum obtained with an electronic vacuum gage.
   2. Medium Temperature Refrigeration Systems (33 degrees F to 55degrees F), and Air Conditioning Systems:
      a. Following pressure tests, dehydrate each system with a vacuum pump.
      b. Draw and hold an initial vacuum of 500 microns. Break this vacuum by pressurizing with dry nitrogen to 10 psig, and change oil in vacuum pump.

c. Draw and hold a second vacuum of 500 microns. Break this vacuum by pressurizing with dry nitrogen to 10 psig, and change oil in vacuum pump.
d. Verify vacuum obtained with an electronic vacuum gage.

C. Refrigerant Charging: Follow equipment manufacturer's printed charging directions unless otherwise specified.
1. Introduce refrigerant of type and quantity required through a filter/drier installed in the temporary charging line.
a. Purge small amount of liquid out of the system side of the charging hose.
b. Prevent moisture and other contaminants from entering the system.
2. Charge liquid refrigerant through a charging valve provided in the high pressure side of the system.
a. Small amounts of gaseous refrigerant may be charged through the compressor suction service valve port.
3. No bubbles shall appear at the moisture-liquid indicator when the system is fully charged and operational. Do not overcharge.
4. Record the weight in pounds of refrigerant charged into each system and submit this record to the Director's Representative.

D. Compressor Oil Charge: Pump oil into the compressor after the last vacuum has been preformed. Follow all Manufactures Recommended for oil type and amount to be installed.

E. Adjustments and Operational Testing:
1. Adjustments: Place the system in operation with automatic controls functioning. Adjust controls and apparatus for proper operation. Test thermometers and gages for accuracy over the entire range. Remove and replace items found defective.
a. Check belts, fan blades, fittings, TXV bulbs, and electrical connections for tightness before start up.
b. Check TXV bulb for proper location should be between 8 and 10 o'clock or 2 & 4 o'clock.
c. Seal off all holes in the condition space as specified.
d. Provide a point to point control check of the system to ensure that the specified inputs and outputs are receiving the signal from the proper sensors or controlling the proper device.
e. Set pressure controls and safety controls.
f. Close or de-energize all solenoids, and start up the system.
g. Check that all controls and safety switches are operating properly.
h. Adjust TXV for proper super heat back to the compressors.
i. Clean TXV strainers as many times as required.
j. After one week of run time, change the liquid cores if they are the replaceable type.
k. After one month of run time, replace the liquid cores and compressor suction socks. Replace the liquid cores as required. Clean the TXV's as required.

2. Operational Test:
   a. Place system in operation, with final connections to equipment and with automatic controls operating, and operate for a minimum of 120 consecutive hours.
   b. Operational test shall prove to the satisfaction of the Director's Representative that the system can produce the cooling effect required by the drawings and the specifications.

**END OF SECTION**

**SECTION 230700**

**PIPING INSULATION**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Through Penetration Firestops: Section 078400.

B. Pipe Hangers and Supports: Section 230529.

### 1.02 ABBREVIATIONS

A. FS: Federal Specification.

B. K: Thermal Conductivity, i.e., maximum Btu per inch thickness per hour per square foot.

C. pcf: Pounds per cubic foot.

D. PVC: Polyvinylchloride.

### 1.03 SUBMITTALS

A. Product Data: Manufacturer's catalog sheets, specifications and installation instructions for the following:
   1. Insulation Materials.
   2. Jacket Materials.

B. Quality Control Submittals:
   1. Installers Qualification Data:
      a. Name of each person who will be performing the Work, and their employer's name, business address and telephone number.
      b. Furnish names and addresses of the required number of similar projects that each person has worked on which meet the qualifications.

### 1.04 QUALITY ASSURANCE

A. Qualifications: The persons installing the Work of this Section and their Supervisor shall be personally experienced in mechanical insulation work and shall have been regularly employed by a company installing mechanical insulation for a minimum of 5 years.

B. Regulatory Requirements:
   1. Insulation installed inside buildings, including laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.

## PART 2 PRODUCTS

### 2.01 PIPING INSULATION

A. Flexible Elastomeric Foam Insulation:
   1. FM tested and approved, meeting the following:
      a. Maximum Water Vapor Transmission: 0.10 perm - inch based on ASTM E 96, Procedure A.
      b. K of 0.27 at 75 degrees F based on ASTM C 518 or C 177.
      c. Fire Spread/Smoke Developed Rating: 25/50 or less based on ASTM E 84.
   2. Pipe Insulation: ASTM C 534, Type I.
   3. Polyethylene and polyolefin insulation is not acceptable.

### 2.02 INSULATION JACKETS

A. Metal Jacketing:
   1. Aluminum: ASTM B 209, Alloys 1100, 30003, 3105 or 5005, Temper H14, 0.016 inch thick.
      a. Factory Pre-formed Sectional Pipe Jacketing:
         1) Smooth outer finish with integral bonded laminated polyethylene film - kraft paper moisture barrier underside.
         2) Pittsburgh or modified Pittsburgh longitudinal lock seams.
         3) 2 inch overlapping circumferential joints with integral locking clips, or butt joints sealed with 2 inch wide mastic backed aluminum snap bands.
      b. Fastening Devices:
         1) Strapping: Type 18-8 stainless steel, 0.020 inch thick, 1/2 and 3/4 inch wide as specified.
         2) Wing Seals: Type 18-8 stainless steel, 0.032 inch thick.
         3) Sheet Metal Screws: Panhead, Type A, hardened aluminum, and stainless steel.

### 2.03 ADHESIVES, MASTICS, AND SEALERS

A. Adhesive (Flexible Elastomeric Foam): Armstrong's 520, Childers' CP-82, Epolux's Cadoprene 488, Foster's 85-75. 5 gallon cans only

B. Weather Barrier Breather Mastic (Reinforcing Membrane): Childers' VI-CRYL CP-10/11, Foster's Weatherite 46-50.

C. Sealant (Metal Pipe Jacket): Non hardening elastomeric sealants. Foster Elastolar 95-44, Childers Chil Byl CP-76, Pittsburgh Corning 727

## PART 3 EXECUTION

## 3.01 PREPARATION

A. Perform the following before starting insulation Work:
   1. Install hangers, supports and appurtenances in their permanent locations.
   2. Complete testing of piping.
   3. Clean and dry surfaces to be insulated.

## 3.02 INSTALLATION, GENERAL

A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions unless otherwise specified.

B. Provide continuous piping insulation and jacketing when passing thru interior wall, floor, and ceiling construction.
   1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed. See Section 078400.
      a. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.

C. Do not intermix different insulation materials on individual runs of piping.

## 3.03 INSTALLATION AT HANGERS AND SUPPORTS

A. Reset and realign hangers and supports if they are displaced while installing insulation.

B. Install high density jacketed insulation inserts at hangers and supports for insulated piping.

## 3.04 INSTALLATION OF FLEXIBLE ELASTOMERIC FOAM INSULATION

A. Where possible, slip insulation over the pipe, and seal butt joints with adhesive.
   1. Where the slip-on technique is not possible, slit the insulation and install.
   2. Re-seal with adhesive, making sure the mating surfaces are completely joined.

B. Insulate fittings and valves with miter cut sections. Use templates provided by the manufacturer, and assemble the cut sections in accordance with the manufacturer's printed instructions.
   1. Insulate threaded fittings and valves with sleeved fitting covers. Over lap and seal the covers to the adjoining pipe insulation with adhesive.

C. Carefully mate and seal with adhesive all contact surfaces to maintain the integrity of the vapor barrier of the system.

D. Piping Exposed Exterior to a Building, Totally Exposed to the Elements:

1. Apply flexible elastomeric foam insulation to piping with adhesive.
2. Apply reinforcing membrane around piping insulation with adhesive or mastic.
3. Adhesive Applied System: Apply 2 coats of finish. See Section 099103.
4. Mastic Applied System: Apply another coat of mastic over reinforcing membrane.

## 3.05 INSTALLATION OF SHEET METAL JACKETING ON PIPING

A. Secure jacketing to insulated piping with preformed aluminum snap straps and stainless steel strapping installed with special banding wrench.

B. Jacket exposed insulated fittings, valves and flanges with mitred sections of aluminum jacketing.
1. Seal joints with sealant and secure with preformed aluminum bands.
2. Substitution: Factory fabricated, preformed, sectional aluminum fitting covers or premolded polyvinylchloride fitting covers may be used in lieu of mitred sections of aluminum jacketing for covering fittings, valves and flanges.

## 3.06 PIPING INSULATION SCHEDULE

A. Insulate all cold service except where otherwise specified.

B. Schedule of Items Not to be Insulated:
1. Do not insulate the following cold service items:
   a. Actual heat transfer surfaces.
   b. Refrigerant liquid piping, unless sub-cooled below 70 degrees F.
2. Do not insulate items installed under other Contracts.
3. Do not insulate mechanical equipment with a factory applied insulated steel jacket.

## 3.07 COLD SERVICE INSULATION MATERIAL SCHEDULE

| TYPE | SERVICE AND TEMPERATURES | INSULATION MATERIAL | PIPE SIZES (INCHES) | MINIMUM (NOMINAL) INSULATION THICKNESS (INCHES) |
|---|---|---|---|---|
| A & B | Refrigerants, Brine, and Fluids below 40 F. | Flex. Elastomeric Foam | 1& less<br><br>1-1/4 and Up | 1<br><br>1-1/2 |
| | | | | |

A. **NOTES:**
1. Double the insulation thickness above for piping, installed in tunnels and conduits.

2. Condensate Drain Piping: Insulate with same materials and thicknesses specified for domestic cold water.
    a. Piping connected to drain pans under cooling coils within unit enclosure, except where over drain pans.
    b. Horizontal condensate drain piping outside unit enclosures.
    c. Vertical condensate drain piping of less than one story immediately following horizontal run.

## 3.08 SCHEDULE OF METAL JACKETING FOR INSULATED PIPE

A. Piping Exterior to Building: Jacket insulated piping with circumferentially corrugated aluminum jacketing.
    1. Lap longitudinal and circumferential joints a minimum of 2 inches.
    2. Secure jacketing in place with 1/2 inch x 0.020 inch thick aluminum bands secured with aluminum wing type seals, on maximum 12 inch centers.
    3. Cover insulated fittings, valves, and offsets with mitered sections of jacketing. Seal joints with metal pipe jacket sealant, and secure with aluminum strapping and wing seals.
    4. Factory fabricated, preformed fitting covers of same material as jacketing may be used instead of mitered jacketing.
    5. Install jacketing so as to avoid trapping condensation and precipitation.

**END OF SECTION**

**SECTION 232000**

**HVAC PIPING**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Through Penetration Firestops: Section 078400.

B. Sealants: Section 079200.

### 1.02 SUBMITTALS

A. Product Data:
   1. Catalog sheets and specifications indicating manufacturer name, type, applicable reference standard, schedule, or class for specified pipe and fittings.
   2. Material Schedule: Itemize pipe and fitting materials for each specified application in Pipe and Fittings Schedule in Part 3 of this Section. Where optional materials are specified indicate option selected.

B. Quality Control Submittals:
   1. Installers Qualification Data:
      a. Brazer Qualification Data for Refrigerant Piping: State refrigerant piping brazing experience; include names, home addresses and social security numbers of brazers.

### 1.03 QUALITY ASSURANCE

A. Qualifications of Brazers: Comply with the following:
   1. Refrigerant Piping: The persons performing the brazing and their Supervisors shall be personally experienced in refrigerant piping brazing procedures.

### 1.05 DELIVERY, STORAGE, AND HANDLING

A. Pipe Storage:
   1. Upon the receipt of each shipment of pipe on the job, maintain the pipe marking, and store pipe in accordance with ASTM material specifications, and method of manufacture (seamless, etc.) of each length of pipe.
   2. Pipe markings shall be clearly readable at the time of pipe installation.
   3. If at the time of its installation, any length of pipe not readily identifiable will be subject to rejection, or arbitrary downgrading by the Director's Representative to the lowest grade which has been received on the job to that date.
   4. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, bell and-spigot, and clay pipe.

a. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

## PART 2 PRODUCTS

### 2.01 COPPER AND BRASS PIPE, TUBING AND FITTINGS

A. ACR Tube: ASTM B 280.

B. Wrot Copper Tube Fittings, Solder Joint: ASME B16.22.

C. Flared Tube Fittings:
1. Refrigerant Tube Type: SAE J513.

D. Flanges: Conform to the Standards for fittings used in systems.
1. Brazing Flanges: ASME B16.24, hubs modified for brazing ends.

### 2.02 JOINING AND SEALANT MATERIALS

A. Brazing Alloys:
1. Type 1: AWS A5.8, Class BCup-5, for brazing copper to brass, bronze, or copper; Engelhard's Silvaloy 15, J.W. Harris Co. Inc.'s Stay-Silv 15, and Handy & Harman's Sil-Fos.
2. Type 2: AWS A5.8, Class BAg-7, for brazing copper to steel or stainless steel; Engelhard's Silvaloy-56T, J.W. Harris Co. Inc.'s Safety-Silv 56, and Handy & Harman's Braze 560.

B. Brazing Flux: AWS Type FB3A; Handy & Harman's Handy Flux or J.W. Harris Co. Inc.'s Stay-Silv.

### 2.03 PACKING MATERIALS FOR BUILDING CONSTRUCTION PENETRATIONS

A. Oiled Oakum: Manufactured by Nupak of New Orleans, Inc., 931 Daniel St., Kenner, LA 70062, (504)466-1484.

### 2.04 PIPE SLEEVES

A. Type A: Schedule 40 steel pipe.

B. Type B: No. 16 gage galvanized sheet steel.

C. Type C: Schedule 40 steel pipe with 1/4 inch steel collar continuously welded to pipe sleeve. Size steel collars as required to span a minimum of one cell or corrugation, on all sides of the rough opening thru the metal deck.

D. Type D: No. 16 gage galvanized sheet steel with 16 gage sheet steel metal collar rigidly secured to sleeve. Size metal collars as required to span a minimum of one cell or corrugation, on all sides of the rough opening thru the metal deck.

## PART 3 EXECUTION

### 3.01 INSTALLATION - GENERAL

A. Install piping at approximate locations indicated, and at maximum height.

B. Install piping clear of door swings, and above sash heads.

C. Make allowances for expansion and contraction.

D. Allow for a minimum of one inch free air space around pipe or pipe covering, unless otherwise specified.

E. Install vertical piping plumb.

F. Use fittings for offsets and direction changes, except for Type K soft annealed copper tube.

G. Cut pipe and tubing ends square; ream before joining.

H. Threading: Use American Standard Taper Pipe Thread Dies.
   1. Thread brass pipe with special threading dies.

I. Make final connections to equipment with unions, flanges, or mechanical type joint couplings.

### 3.02 PIPE JOINT MAKE-UP

A. Brazed Joint: Thoroughly clean tube end and inside of fitting with emery cloth, sand cloth, or wire brush. Apply flux to the pre-cleaned surfaces. Install fitting, heat to brazing temperature, and join the metals with brazing alloy. Remove residue.

B. Refrigerant Pipe Joint:
   1. Hard Drawn Tubing, Brazed Joint: Make up joint with appropriate type of brazing alloy. Sweep piping interior with dry nitrogen at a rate of 1 to 3 cfm during brazing operation.
   2. Hard Drawn Tubing, Soldered Joint: Solder joints with Type 2 solder at valves, controls, and other locations where brazing temperatures could cause damage.

### 3.03 PIPING PENETRATIONS

A. Sleeve Schedule: Unless otherwise shown, comply with the following schedule for the type of sleeve to be used where piping penetrates wall, floor, or roof construction:

| CONSTRUCTION | SLEEVE TYPE |
|---|---|

| | | |
|---|---|---|
| 1. | Frame construction. | None Required |
| 2. | Foundation walls. | A* |
| 3. | Non-waterproof interior walls. | B* |
| 4. | Non-waterproof interior floors on metal decks. | D* |
| 5. | Non-waterproof interior floors not on metal decks. | B* |
| 6. | Floors not on grade having a floor drain. | A |
| 7. | Floors over mechanical equipment, steam service, machine, and boiler rooms. | A |
| 8. | Floors finished or to be finished with latex composition or terrazzo, and on metal decks. | D* |
| 9. | Floors finished or to be finished with latex composition or terrazzo, and not on metal decks. | A |
| 10. | Non-metal roof decks. | A |

*Core drilling is permissible in lieu of sleeves where marked with asterisks.

B. Diameter of Sleeves and Core Drilled Holes:
   1. Unless otherwise specified, size holes thru floors and walls in accordance with the through penetration fire stopping system being used.
   2. Size holes thru exterior walls or waterproofed walls above inside earth or finished floors, and exterior concrete slabs in accordance with the following:
      a. Uninsulated (Bare) Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of pipe, unless otherwise specified.
      b. Insulated Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of insulation, unless otherwise specified.
      c. Mechanical Modular Seals: Size holes in accordance with the manufacturer's recommendations.

C. Length of Sleeves (except as shown otherwise on Drawings):
   1. Walls and Partitions: Equal in length to total finished thickness of wall or partition.
   2. Floors, Finished: Equal in length to total finished thickness of floor and extending 1/2 inch above the finished floor level, except as follows:
      a. In furred spaces at exterior walls, extend sleeve one inch above the finished floor level.
   3. Roofs: Equal in length to the total thickness of roof construction, including insulation and roofing materials, and extending one inch above the finished roof level.

D. Packing of Sleeves and Core Drilled Holes:
   1. Unless otherwise specified, pack sleeves or cored drilled holes in accordance with Section 078400 - FIRESTOPPING.

2. Pack sleeves in exterior walls or waterproofed walls above inside earth or finished floors with oakum to within 1/2 inch of each wall face, and finish both sides with sealant. See Section 079200.

## 3.04 PIPE AND FITTING SCHEDULE

A. Abbreviations: The following abbreviations are applicable to the Pipe and Fitting Schedule:

| | |
|---|---|
| BS | Black steel. |
| CI | Cast iron. |
| FRP | Fibrous glass reinforced plastic piping. |
| GE | Grooved end. |
| GGE | Galvanized grooved end. |
| GMI | Galvanized malleable iron. |
| GS | Galvanized steel. |
| HDPE | High density polyethylene pipe. |
| MI | Malleable iron. |
| PE | Polyethylene pipe. |
| SE | Screwed end. |
| ST | Steel. |
| SW | Standard weight. |
| WE | Weld end. |
| XH | Extra heavy weight. |

B. Where options are given, choose only one option for each piping service. No deviations from selected option will be allowed.

C. Schedule of Pipe and Fittings for the different piping services is as follows:
   1. Refrigerants (RS, RL, HG & RD) 350 psig and less:
      a. All Sizes: Type ACR hard drawn copper tubing with wrot copper fittings, and brazing alloy, unless otherwise specified.
      b. 3/4 inch o.d. size and Less (for final connection within 24 inches of refrigerant equipment): Soft annealed Type ACR copper tubing with refrigerant tube type flared fittings.
   2. Drain Piping:
      a. Condensate Drain Piping: Type M hard drawn copper tubing with wrot copper or cast copper alloy solder fittings, and Type 3 solder.

**END OF SECTION**

## SECTION 233113

## METAL DUCTWORK

### PART 1 GENERAL

### 1.01 REFERENCES

A. American Conference of Governmental Industrial Hygienists (ACGIH).

B. National Fire Protection Association (NFPA).

C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

### 1.02 SUBMITTALS

A. Shop Drawings:
   1. Layouts for areas in which it may be necessary to deviate substantially from layout shown on the Drawings. Show major relocation of ductwork and major changes in size of ducts. Minor transitions in ductwork, if required due to job conditions, need not be submitted as long as the duct area is maintained.
   2. Layout and fabrication details for cooking equipment exhaust ductwork.
   3. Layouts of mechanical equipment rooms and penthouses.
   4. Details of intermediate structural steel members required to span main structural steel for the support of ductwork.
   5. Method of attachment of duct hangers to building construction.
   6. Coordinate shop drawings with related contracts prior to submission.

B. Product Data: Material, gage, type of joints, sealing materials, and reinforcing for each duct size range, including sketches or SMACNA plate numbers for joints, method of fabrication and reinforcing. Include ACGIH figure numbers for hoods if applicable.

### 1.03 QUALITY ASSURANCE

A. SMACNA: Gages of materials, fabrication, reinforcement, sealing requirements, installation, and method of supporting ductwork shall be in accordance with the following SMACNA manuals, unless otherwise shown or specified:
   1. HVAC Duct Construction Standards.

B. Unless otherwise shown or specified, follow the Hood Design Data, and Construction Guidelines for Local Exhaust Systems from the ACGIH Industrial Ventilation Manual.

C. Conform to the applicable requirements of NFPA 90A, 90B, 91, 96, and 101.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Sheet Metal:
   1. Aluminum: ASTM B-209, Alloy 3003, Temper H-14.
   2. Copper: ASTM B-370.
   3. Galvanized Steel: ASTM A653, Class LFQ (lock forming quality), coating designation G-90.
   4. Monel: ASTM B-127.
   5. Stainless Steel: AISI Types 302, 304 and 316, as specified.

B. Duct Hangers:
   1. Strap Hangers: Same material as ducts, except that hangers for stainless steel ducts in unfinished spaces may be galvanized steel.
   2. Rod Type Hangers: Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end, with 2 removable nuts each end for positioning and locking rod in place. Unless stainless steel, galvanized or cadmium plated; shop coat with metal primer.

C. Miscellaneous Fasteners and Upper Hanger Attachments:
   1. Sheet Metal Screws, Machine Bolts and Nuts: Same material as duct, unless otherwise specified.
   2. Concrete Inserts: Steel or malleable iron, galvanized; continuously slotted or individual inserts conforming with MSS SP-58, Types 18 & 19, Class A-B.
   3. C Clamps: Fee & Mason Co.'s 255L with locking nut, and 255S with retaining strap.
   4. Metal Deck Ceiling Bolts: B-Line Systems, Inc.'s Fig. B3019.
   5. Welding Studs: Erico Fastening Systems, capacitor discharge, low carbon steel, copper flashed.
   6. Structural (carbon) Steel Shapes and Steel Plates: ASTM A36, shop primed.
   7. Stainless Steel Shapes and Plates: ASTM A276 and ASTM A666.
   8. Machine Bolt Expansion Anchors:
      a. Non-caulking single unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 1.
      b. Non-caulking double unit type: FS FF-S-325, Group II, Type 2, Class 2, Style 2.
      c. Self-drilling type: FS FF-S-325, Group III, Types 1 and 2.

### 2.02 FABRICATION - GENERAL

A. Fabricate ductwork from galvanized sheet metal, except as follows:
   1. Fabricate the following ductwork from aluminum:
      a. Inlet and discharge ductwork connected to cooling towers and evaporative condensers.
      b. Exhaust ductwork from shower, locker, can washing and steam service rooms, and swimming pool areas.
   2. Fabricate the following ductwork from stainless steel:

a. Supply, return, and recirculated air ductwork connected to inlet or outlet devices installed in surgical operating, surgical scrub-up, surgical recovery and surgical work rooms. Use AISI Type 302 or 304 stainless steel.

b. Exhaust ductwork connected to cooking equipment, dishwashing, and other scullery equipment hoods. Install stainless steel from the individual hood to its respective fan and from the fan to the point of discharge to the outside air. Use AISI Type 302 or 304 stainless steel.

c. Exhaust ductwork connected to laboratory exhaust fume hoods. Install stainless steel from the individual hood to its respective fan and from the fan to the point of discharge to the outside air. Use AISI Type 316 stainless steel.

d. Use stainless steel with a No. 4 finish where installed exposed in finished rooms and No. 2B finish in other locations. Use stainless steel fasteners for ductwork installed exposed in finished rooms and where fastener penetrates duct. Galvanized fasteners may be used in unfinished spaces for non-penetrating service.

## PART 3 EXECUTION

### 3.01 INSTALLATION - GENERAL

A. Install ductwork to allow maximum headroom. Properly seam, brace, stiffen, support and render ducts mechanically airtight. Adjust ducts to suit job conditions. Dimensions may be changed as approved, if cross sectional area is maintained.

B. Pitch horizontal ducts connected to hoods downward toward hood not less than 1 inch in 10 feet.

C. Provide necessary transformation pieces, and flexible fabric connections for ductwork connected to air handling equipment or air inlet and outlet devices.

### 3.02 SEALING SEAMS, JOINTS, AND PENETRATIONS

A. Seal ductwork in accordance with the SMACNA Manual except for the following:

1. Ductwork Specified to be Insulated: Conform with Seal Class A for all pressure classes.

B. Duct Sealants: Water based, non-fibrated: Foster 32-19, Childers CP-146, Duro Dyne SAS.

### 3.03 HANGERS FOR DUCTS, UNDER 2 INCHES W.G.

A. Install hangers for ducts as specified in the SMACNA Manual, with the following exceptions:

1. Rectangular ducts up to 42 inches wide, not having welded or soldered seams, and supported from overhead construction; extend strap hangers

down over each side of the duct and turn under bottom of duct a minimum of 2 inches. Secure hanger to duct with 3 full thread sheet metal screws, one in the bottom and 2 in the side of the duct.

2. Rectangular ducts 43 inches wide and over, and all sizes of duct with welded or soldered seams, and supported from overhead construction; use trapeze hangers.
3. Prime coat plain steel rods threaded at the site immediately after installation with metal primer.

## 3.04 UPPER HANGER ATTACHMENTS

A. General:
   1. Secure upper hanger attachments to structural steel or steel bar joists wherever possible.
   2. Do not use drive-on beam clamps, flat bars or bent rods, as upper hanger attachments.
   3. Do not attach hangers to steel decks which are not to receive concrete fill.
   4. Do not attach hangers to precast concrete planks less than 2-3/4 inches thick.
   5. Avoid damage to reinforcing members in concrete construction.
   6. Metallic fasteners installed with electrically operated or powder driven tools may be used as upper hanger attachments, in accordance with the SMACNA Manual, with the following exceptions:
      a. Do not use powder driven drive pins or expansion nails.
      b. Do not attach powder driven or welded studs to structural steel less than 3/16 inch thick.
      c. Do not support a load, in excess of 250 lbs from any single welded or powder driven stud.
      d. Do not use powder driven fasteners in precast concrete.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by ductwork support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of 5.
   1. Secure upper hanger attachments to steel bar joists at panel points of joists.
   2. Do not drill holes in main structural steel members.

C. Attachment to Concrete Filled Steel Decks:
   1. New Construction: Install metal deck ceiling bolts.
   2. Existing Construction: Install welding studs (except at roof decks).
   3. Do not attach hangers to decks less than 2-1/2 inches thick.

D. Attachment to Existing Cast-In Place Concrete:
   1. Secure hangers to overhead construction with self drilling type expansion anchors and machine bolts.
   2. Secure hanger attachments required to be supported from wall or floor construction with single unit expansion anchors or self drilling type expansion anchors and machine bolts.

E. Attachment to Cored Precast Concrete Decks (Flexicore, Dox Plank, Spancrete, etc.): Toggle bolts may be installed in cells for the support of ducts up to a maximum of 60 inches in width.

F. Attachment to Hollow Block or Hollow Tile Filled Concrete Decks:
   1. New Construction: Omit block or tile and pour solid concrete with cast-in-place inserts.
   2. Existing Construction: Break out block or tile to access, and install machine bolt anchors at highest practical point on side of web.

G. Attachment to Waffle Type Concrete Decks:
   1. New Construction: Install cast-in-place inserts.
   2. Existing Construction: Install machine bolt expansion anchors at highest practical point on side of web.

H. Attachments to Precast Concrete Tee Construction:
   1. Secure hangers to tees by any of the following methods:
      a. Tee hanger inserts between adjacent flanges.
      b. Install double unit expansion anchors and machine bolts at highest practical point on side of web.

I. Attachment to Wood Construction:
   1. Secure strap hangers to the sides of wood beams with one No. 18 x 1-1/2 inch long (minimum) wood screws or 2 No. 16 x 1-1/2 inch long (minimum) drive screws. Do not hammer in wood screws.
   2. Secure rod hangers to angle iron clip angles, bolted or screwed to the sides of the wood beams with 3/8 inch bolts or 3/8 inch lag screws. Install hanger rods with a threaded end through a hole in the angle, secured with a double nut, one above and one below the angle. Do not use lag screws in wood beams, having a nominal face width under 2 inches. Install bolts or lag screws in the side of beams at mid-point or above.
   3. Pre-drill holes for lag screws 1/8 inch in diameter less than the root diameter of the lag screw thread.
   4. Where wood trusses are approved to support ductwork, hangers may be attached only to the bottom chord. Method of attachment must be specifically approved.
   5. Do not secure hanger attachments to nailing strips resting on top of steel beams.

**END OF SECTION**

**SECTION 233300**

**DUCTWORK ACCESSORIES**

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Metal Ductwork: Section 233113.

### 1.02 REFERENCES

A. ACGIH: American Conference of Governmental Industrial Hygienists.

B. AMCA: Air Movement and Control Association.

C. NFPA: National Fire Protection Association.

D. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.

E. UL: Underwriters Laboratories, Inc.

### 1.03 SUBMITTALS

A. Product Data: Catalog sheets, diagrams, standard schematic drawings, and installation instructions for each manufactured product. Submit SMACNA Figure Numbers for each shop fabricated item.

B. Samples: When directed, submit one complete unit for each type of proposed air inlet and outlet device. Approved samples will be delivered to the job site for installation.

### 1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Unless otherwise shown or specified, comply with the applicable requirements of the following:
      a. SMACNA: Gages of materials, fabrication, sealing, and installation shall be in accordance with the SMACNA Manuals.
         1) HVAC Duct Construction Standard.
      b. ACGIH: Follow the Hood Design Data, and Construction Guidelines for Local Exhaust Systems from the Industrial Ventilation Manual.
      c. AMCA: Certify damper and/or louver ratings in accordance with AMCA 511.
      d. NFPA: Standards Nos. 90A, 90B, 91, 96, and 101.
      e. UL: Standards No. UL181, UL555, and UL555S.

## PART 2 PRODUCTS

### 2.01 SEALANTS

A. Acceptable Manufacturers: Duro Dyne Corp.; Foster Products Div., H.B. Fuller Co.; Hardcast Inc.; United Sheet Metal Div., United McGill Corp.

B. U.L. Listed adhesives (liquid or mastic), scrim, tapes, or combinations thereof, as required for pressure class; suitable for system operating temperatures; compatible with media conveyed within, insulation (if any), and ambient conditions.

### 2.02 FLEXIBLE DUCT

A. Conform to NFPA 90A, and UL181 Class I:
   1. Uninsulated Type: Factory assembled duct consisting of continuous, seamless, metalized polyester tear resistant duct with encapsulated steel helix.
   2. Pre-insulated Type: Factory assembled.
      a. Internal Core: Continuous material suitable for service, with encapsulated steel helix that completely shields fiberglass insulation from air stream.
      b. Outer Vapor Barrier Jacket: Seamless, tear resistant metalized polyester.

## PART 3 EXECUTION

### 3.01 INSTALLATION - GENERAL

A. Unless otherwise shown or specified, install the Work of this Section in accordance with the manufacturer's printed installation instructions and the SMACNA Manual.

**END OF SECTION**

## SECTION 233420

## RESIDENTIAL EXHAUST FANS

### PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Metal Ductwork: Section 233113.

B. Wiring for Motors and Motor Controllers: Section 260523.

### 1.02 SUBMITTALS

A. Product Data: Manufacturer's catalog sheets and installation instructions for each size fan.

### 1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Electrical components shall be UL listed.

### PART 2 PRODUCTS

### 2.01 MANUFACTURERS/COMPANIES

A. Fasco Industries.

B. Nutone, Division of Scovill.

C. Penn Ventilator Co.

### 2.02 EXHAUST FANS

A. General Design: Fans shall be complete with sheet steel unit casing, air intake grille, electric motor, electrical terminal box, wall switch and wall cap.

B. Components:

1. Fan Wheel: Centrifugal type, with a corrosion resistant coating, direct connected to an electric motor. Fan scroll shall be fabricated of sheet steel with a corrosion resistant coating. The entire fan assembly shall be easily removable from unit casing.
2. Unit Casing: Heavy gage sheet steel with a corrosion resistant coating. Discharge outlet shall be complete with discharge damper.
3. Motor: Complete with built-in thermal overload protection, designed to operate on 120 volt, 60 Hz, 1 phase service. Motor shall be complete with electric cord, plug and electrical receptacle inside housing.
4. Inlet Air Grille: Silver anodized aluminum or chromium plated steel.
5. Wall Cap: Anodized aluminum or sheet steel with a corrosion resistant coating, complete with built-in back draft damper.

6. Motor Control: Wall switch as furnished by the fan manufacturer, with a chromium plated wall plate, for use with a standard electrical wall box.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install ceiling fan units and related components in accordance with manufacturer's printed instructions and approved shop drawings.

**END OF SECTION**

## SECTION 238113

## AIR CONDITIONERS

## PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Pipe and Pipe Fittings: Section 232000.

B. Insulation: Section 230719.

### 1.02 SUBMITTALS

A. Product Data: Manufacturer's catalog sheets, brochures, performance charts, test data, standard schematic drawings, specifications and installation instructions for each type unit.

B. Contract Closeout Submittals:
   1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director's Representative.

### 1.03 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Units shall be factory tested and the design, construction and installation shall be in accordance with the following: ARI, UL and NFPA and all State and Local codes or regulations having jurisdiction.
   2. Rate cooling capacities in accordance with the ARI.
   3. Electrical components shall be UL listed and factory wiring shall conform to the UL Specifications.

## PART 2 PRODUCTS

### 2.01 AIR CONDITIONERS

A. Furnish equipment totally piped and wired, including all controls. Upon placement in their permanent location in the building, only remote equipment piping and electrical power connections shall be required to make the unit(s) operable.

B. Cooling Section: Factory sealed refrigerant system consisting of compressors and evaporator section designed for use with Refrigerant R-410A.
   1. Compressors: Accessible, semi-hermetic, reciprocating, direct- driven, constant speed, 1750 RPM industrial type with suction strainer and reversible oil pumps for pump down control and forced lubrication to all bearing surfaces. Mount compressors on vibration isolators and provide with built-in overloads, oil sight glass, high pressure switch with manual

reset and low pressure switch for pump down. Isolate compressors in a compartment separate from the conditioned air space.

2. Evaporator Coil: DX coil, fabricate coils from seamless copper tubing with aluminum fins mechanically bonded to tubing. Provide a condensate drain pan under the evaporator coil, with threaded drain piping connection in bottom.

## 2.02 REMOTE AIR COOLED CONDENSER

A. General: Provide an air cooled refrigerant condenser of the draw-through vertical discharge type. Furnish unit complete with a multiple circuit coil; direct driven electric motor operated propeller fans, all totally protected by a heavy duty sheet metal casing, complete with a structural metal stand and wire fan guards. Furnish unit completely factory assembled and provided with all the necessary control and accessories, for operation in ambient air temperatures down to -30 degrees F.

B. Fabrication:

1. Casing: Heavy gage galvanized steel or aluminum sheet metal, reinforced and bolted or welded to assure rigidity. Provide gasketed access panels as required for servicing the motors and all components.
2. Fan Assembly: Propeller type fans arranged for vertical discharge, with aluminum blades and center hubs of zinc coated steel with a corrosion-resistant coating. Coat fan shafts with a weather- resistant coating. Furnish drip-proof fan motors, resiliently mounted and designed for year-round operation, with permanently lubricated ball bearings.
3. Coil: Multiple circuit high capacity type, fabricated of seamless copper tubing with aluminum fins mechanically bonded to tubing. Furnish a maximum fin spacing of 10 per inch.
4. Finish: Provide all exposed surfaces of condenser with a factory applied corrosion-resistant baked enamel finish.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Unless otherwise shown or specified. install the Work of this Section in accordance with the manufacturer’s printed installation instructions.

B. Provide all piping and electrical connections to units through knock-out openings in bottom of units.

## 3.02 FIELD QUALITY CONTROL

A. Air Conditioning System Pre-Start-Up and Start-Up:

1. Upon completion of air conditioner installations, the Company Field Advisor shall visit the site, inspect the installations and notify the Director’s Representative of any Work which must be done or modified prior to start-up.

2. Upon completion of required Work, or modifications to installed Work and miscellaneous testing, all as required by the particular air conditioning system or apparatus, the Company Field Advisor shall supervise the conditioner start-up.
3. Start-up the system and conduct a preliminary test, for the purpose of checking the general operation of the air conditioner, proving mechanical and electrical controls and making necessary adjustments.
4. Provide pre-start-up check list, start-up list and operating instructions for air conditioner, framed under rigid plastic and place where directed in the Computer Room.

**END OF SECTION**

## SECTION 260501

## BASIC ELECTRICAL MATERIALS AND METHODS

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.
   1. For fire rated construction, prove that materials and installation methods proposed for use are in accordance with the listing requirements of the classified construction.

## PART 2 PRODUCTS

### 2.01 RACEWAYS, FITTINGS AND ACCESSORIES

A. Rigid Ferrous Metal Conduit: Steel, hot dipped galvanized on the outside and inside, UL categorized as Rigid Ferrous Metal Conduit (identified on UL Listing Mark as Rigid Metal Conduit - Steel or Rigid Steel Conduit), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.

B. Intermediate Ferrous Metal Conduit: Steel, galvanized on the outside and enameled on the inside, UL categorized as Intermediate Ferrous Metal Conduit (identified on UL Listing Mark as Intermediate Metal Conduit or IMC), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.

C. Electrical Metallic Tubing: Steel, galvanized on the outside and enameled on the inside, UL categorized as Electrical Metallic Tubing (identified on UL Listing Mark as Electrical Metallic Tubing), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.

D. Flexible Metal Conduit: Galvanized steel strip shaped into interlocking convolutions, UL categorized as Flexible Metal Conduit (identified on UL Listing Mark as Flexible Steel Conduit or Flexible Steel Conduit Type RW), by AFC Cable Systems Inc., Anamet Electrical Inc., Electri-Flex Co., or International Metal Hose Co.

E. Liquid-tight Flexible Metal Conduit: UL categorized as liquid-tight flexible metal conduit (identified on UL Listing Mark as Liquid-Tight Flexible Metal Conduit, also specifically marked with temperature and environment application data), by AFC Cable Systems Inc., Anamet Electrical Inc., Electri-Flex Co., or Universal Metal Hose Co.

F. Surface Metal Raceway, Fittings and Accessories: By Thomas & Betts Corp., Mono-Systems Inc. or Wiremold Co. Area and conductor capacity indicated for each size raceway is for reference. Follow manufacturer's recommended raceway capacity for all types and sizes of conductors:
   1. Size 1: Nominal area .3 sq. in. min., 4 No. 12 THW max.; Thomas & Betts B400, Mono-Systems SMS 700, or Wiremold's V700.

2. Size 2: Nominal area .75 sq. in. min., 11 No. 12 THW max.; Thomas & Betts SR250, Mono-Systems SMS2100, Wiremold's 2100.
3. Size 3: Nominal area 2.8 sq. in. min., 43 No. 12 THW max.; Thomas & Betts SR500, Mono-Systems SMS3200, or Wiremold's G3000.

G. Wireways, Fittings and Accessories:
1. NEMA 1 (Without Knockouts): Hoffman Enclosures Inc. Bulletin F-40, Hubbell/Wegmann's HSK, Lee Products Co.'s S Series, Rittal/Electromate's EW & EWHC Lay-In Wireway System, or Square D Co.'s Square-Duct Class 5100.

H. Insulated Bushings, Plastic Bushings, and Insulated Grounding Bushings: By Appleton Electric Co., Cooper/Crouse-Hinds, OZ/Gedney Co., or Thomas & Betts Corp.

I. Connectors and Couplings:
1. Locknuts: UL, steel/zinc electroplate; Appleton Electric Co.'s BL-50 Series, Cooper/Crouse-Hinds' 11 Series, OZ/Gedney Co.'s 1-50S Series, Raco Inc.'s 1002 Series, Steel City/T&B Corp.'s LN-101 Series, or Thomas & Betts Corp.'s 141 Series.
2. Couplings (For Rigid Metal and IMC Conduit): Standard galvanized threaded couplings as furnished by conduit manufacturer, Allied Tube & Conduit Corp.'s Kwik-Couple, or Thomas & Betts Corp.'s Shamrock.
3. Three Piece Conduit Coupling (For Rigid Metal and IMC Conduit): Steel, malleable iron, zinc electroplate; Allied Tube & Conduit Corp.'s Kwik-Couple, Appleton Electric Co.'s EC-50 Series, Cooper/Crouse-Hinds' 190M Series, OZ/Gedney Co.'s 4-50 Series, Raco Inc.'s 1502 Series, Steel City/T & B Corp.'s EK-401 Series, or Thomas & Betts Corp.'s 675 Series.
4. Electrical Metallic Tubing Couplings and Insulated Connectors: Compression type, steel/zinc electroplate; Appleton Electric Co.'s TW-50CS1, TWC-50CS Series, Cooper/Crouse-Hinds' 1650, 660S Series, Raco Inc.'s 2912, 2922 Series, Steel City/T & B Corp.'s TC-711 Series, or Thomas & Betts Corp.'s 5120, 5123 Series.
5. Flexible Metal Conduit Connectors: Arlington Industries Inc.'s Saddle-Grip, OZ/Gedney Co.'s C-8T, 24-34T, ACV-50T Series, or Thomas & Betts Corp.'s Nylon Insulated Tite-Bite Series.
6. Liquid-tight Flexible Metal Conduit Connectors:
   a. Dry, Damp Locations: Steel, malleable iron, zinc electroplate, insulated throat; Appleton Electric Co.'s STB Series, Cooper/Crouse-Hinds' LTB Series, OZ/Gedney Co.'s 4Q-50T Series, Raco Inc.'s 3512 Series, Steel City/T & B Corp.'s LT-701 Series, or Thomas & Betts Corp.'s 5332 Series.
   b. Wet Locations: OZ/Gedney Co.'s 4Q-TG Series (hot-dip/mechanically galvanized), or Thomas & Betts Corp.'s 3322 Series (PVC coated).

J. Conduit Bodies (Threaded):
1. Dry, Damp Locations: Zinc electroplate malleable iron or cast iron alloy bodies with zinc electroplate steel covers; Appleton Electric Co.'s

Unilets, Cooper/Crouse-Hinds' Condulets, OZ/Gedney Co.'s Conduit Bodies, or Thomas & Betts Corp.'s Conduit Bodies.

2. Wet Locations: Malleable iron or cast iron alloy bodies and covers with hot dipped galvanized or other specified corrosion resistant finish; Cooper/Crouse-Hinds' Condulets (Corro-free epoxy powder coat), Thomas & Betts Corp.'s Conduit Bodies (hot dipped galvanized), or OZ/Gedney Co.'s Conduit Bodies (hot dipped galvanized). Stainless steel cover screws, covers gasketed to suit application.

K. Expansion Fittings:
   1. Dry, Damp Locations:
      a. Malleable iron, zinc electroplate finish: Appleton Electric Co.'s XJ or OZ/Gedney Co.'s AX (TX for EMT), with external bonding jumper.
      b. Electrogalvanized Steel: Cooper/Crouse-Hinds' XJG (XJG-EMT for EMT), or Thomas & Betts Corp.'s XJG, with internal grounding.
   2. Wet Locations: Cooper/Crouse-Hinds XJG (Corro-free epoxy powder coat), OZ Gedney Co.'s AX, EXE (end type, hot dipped galvanized), or Thomas & Betts Corp.'s XJG (hot dipped galvanized).

L. Deflection Fittings:
   1. Dry, Damp Locations: Appleton Electric Co.'s DF, Cooper/Crouse-Hinds' XD, or OZ/Gedney Co.'s Type DX.
   2. Wet Locations: Ductile iron couplings with hot dipped galvanized finish, neoprene sleeve, and stainless steel bands, Appleton Electric Co.'s CF; or bronze couplings, neoprene sleeve, and stainless steel bands, OZ/Gedney Co.'s Type DX.

M. Sealing Fittings:
   1. Dry, Damp Locations: Appleton Electric Co.'s EYS, ESU w/Kwiko sealing compound and fiber filler, Cooper/Crouse-Hinds' EYS, EZS w/Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EY, EYA with EYC sealing compound and EYF damming fiber, or Thomas & Betts Corp.'s. EYS w/Chico A sealing compound and Chico X filler.
      a. Other Type Fittings: As required to suit installation requirements, by Appleton Electric Co., Cooper/Crouse-Hinds, OZ/Gedney Co, or Thomas & Betts Corp.
   2. Wet Locations: Malleable iron body with hot dipped/mechanically galvanized finish, neoprene sleeve, and stainless steel bands, Appleton electric Co.'s CF; or bronze couplings, neoprene sleeve, and stainless steel bands, OZ/Gedney Co.'s Type DX.
      a. Horizontal: Cooper/Crouse-Hinds' EYS with Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EYD with EYC sealing compound and EYF damming fiber, or Thomas & Betts Corp.'s. EYS w/Chico A sealing compound and Chico X filler.
      b. Vertical (with Drain): Cooper/Crouse-Hinds with Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EY, EYA with EYC sealing compound and EYF damming fiber, or Thomas & Betts Corp.'s. w/Chico A sealing compound and Chico X filler.

c. Other Type Fittings. As required to suit installation requirements, by Cooper/Crouse-Hinds, OZ/Gedney Co., or Thomas & Betts Corp. with hot dipped/mechanically galvanized finish or epoxy powder coat.

N. Sealant for Raceways Exposed to Different Temperatures: Sealing compounds and accessories to suit installation; Appleton Electric Co.'s DUC, or Kwiko Sealing Compound with fiber filler, Cooper/Crouse-Hinds' Chico A Sealing Compound with Chico X fiber, Electrical Products Division 3M Scotch products, OZ Gedney Co.'s DUX or EYC sealing compound with EYF damming fiber, or Thomas & Betts Corp.'s Blackburn DX.

O. Vertical Conductor Supports:
1. Dry, Damp Locations: Kellems/Hubbell Inc.'s Conduit Riser Grips, or OZ/Gedney Co.'s Type M, Type R.
2. Wet Locations: Kellems/Hubbell Inc.'s Conduit Riser Grips (stainless steel or tin coated bronze), or OZ/Gedney Co.'s hot dipped galvanized finish Type CMT or Type W.

## 2.02 OUTLET, JUNCTION, AND PULL BOXES

A. Galvanized Steel Outlet Boxes: Standard galvanized steel boxes and device covers by Appleton Electric Co., Beck Mfg./Picoma Industries, Cooper/Crouse-Hinds, Raco/Div. of Hubbell , or Steel City/T & B Corp.

B. Galvanized Steel Junction and Pull Boxes: Code gage, galvanized steel screw cover boxes by Delta Metal Products Inc., Hoffman Enclosures Inc., Hubbell Wiegmann, Lee Products Co., or Rittal/Electromate.

C. Threaded Type Boxes:
1. Outlet Boxes:
a. For Dry, Damp Locations: Zinc electroplate malleable iron or cast iron alloy boxes by Appleton Electric Co., Cooper/Crouse-Hinds Co., OZ/ Gedney Co., or Thomas & Betts Corp. with zinc electroplate steel covers to suit application.
b. For Wet Locations: Malleable iron or cast iron alloy boxes with hot dipped galvanized or other specified corrosion resistant finish as produced by Cooper/Crouse-Hinds (hot dipped galvanized or Corro-free epoxy powder coat), OZ/Gedney Co. (hot dipped galvanized), or Thomas & Betts Corp. (hot dipped galvanized) with stainless steel cover screws, and malleable iron covers gasketed to suit application.
2. Junction And Pull Boxes:
a. For Dry, Damp Locations: Zinc electroplate cast iron boxes by Appleton Electric Co., Cooper/Crouse-Hinds, OZ/Gedney Co., or Thomas & Betts Corp. with zinc electroplate steel or cast iron cover.
b. For Wet Locations: Cast iron boxes by Cooper/Crouse-Hinds' (hot dipped galvanized or Corro-free epoxy powder coat), OZ/Gedney Co. (hot dipped galvanized), or Thomas & Betts

Corp. (hot dipped galvanized) with stainless steel cover screws and cast iron cover gasketed to suit application.

3. Conduit Bodies, Threaded (Provided with a Volume Marking):
   a. For Dry, Damp Location: Zinc electroplate malleable iron or cast iron alloy bodies with zinc electroplate steel covers; Appleton Electric Co.'s Unilets, Cooper/Crouse-Hinds' Condulets, OZ/Gedney Co.'s Conduit Bodies, or Thomas & Betts Corp.'s Conduit Bodies.
   b. For Wet Locations: Malleable iron or cast iron alloy bodies with hot dipped galvanized or other specified corrosion resistant finish; Cooper/Crouse-Hinds' Condulets (hot dipped galvanized or Corro-free epoxy power coat), OZ/Gedney Co.'s Conduit Bodies (hot dipped galvanized), or Thomas & Betts Corp.'s Conduit Bodies (hot dipped galvanized) with stainless steel cover screws and malleable iron covers gasketed to suit application.

D. Specific Purpose Outlet Boxes: As fabricated by equipment manufacturers for mounting their equipment thereon.

E. Outlet Boxes and Related Products for Fire Rated Construction:
   1. Parameters For Use of Listed Metallic Outlet or Switch Boxes: UL Electrical Construction Equipment Directory - Metallic Outlet Boxes (QCIT).
   2. Wall Opening Protective Materials: As listed in UL Fire Resistance Directory - Wall Opening Protective Materials (CLIV), or UL Electrical Construction Equipment Directory - Wall Opening Protective Materials (QCSN).

## 2.03 CONDUCTORS AND ACCESSORIES

A. Date of Manufacture: No insulated conductor more than one year old when delivered to the site will be acceptable.

B. Acceptable Companies: American Insulated Wire Corp., BICC General Cable Industries Inc., Cerro Wire & Cable Co. Inc., Pirelli Cable Corp., Rome Cable Corp., or Southwire Co..

C. Conductors: Annealed uncoated copper or annealed coated copper in conformance with the applicable standards for the type of insulation to be applied on the conductor. Conductor sizes No. 8 and larger shall be stranded.

D. Types:
   1. Electric Light and Power Wiring:
      a. General: Rated 600V, NFPA 70 Type FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, XHHW-2.
      b. THWN Gasoline and Oil Resistant: Polyvinylchloride insulation rated 600 V with nylon jacket conforming to UL requirements for type THWN insulation, with the words "GASOLINE AND OIL RESISTANT II" marked thereon.

c. USE, USE-2: Dual rated heat and moisture resistant insulation rated 600 V with jacket or dual purpose insulation/protective covering conforming to UL requirements for type USE service entrance cables.

2. Class 1 Wiring:
   a. No. 18 and No. 16 AWG: Insulated copper conductors suitable for 600 volts, NFPA 70 types KF-2, KFF-2, PAFF, PF, PFF, PGF, PGFF, PTFF, SF-2, SFF-2, TF, TFF, TFN, TFFN, ZF, or ZFF.
   b. Larger than No. 16 AWG: Insulated copper conductors suitable for 600 volts, in compliance with NFPA 70 Article 310.
   c. Conductor with other types and thickness of insulation may be used if listed for Class 1 circuit use.
3. Class 2 Wiring:
   a. Multiconductor Cables: NFPA 70 Article 725, Types CL2P, CL2R, CL2.
   b. Other types of cables may be used in accordance with NFPA 70 Table 725-61 "Cable Uses and Permitted Substitutions", as approved.
4. Class 3 Wiring:
   a. Single Conductors No. 18 and No. 16 AWG: Same as Class 1 No. 18 and No. 16 AWG conductors, except that:
      1) Conductors are also listed as CL3.
      2) Voltage rating not marked on cable except where cable has multiple listings and voltage marking is required for one or more of the listings.
   b. Multiconductor Cables: NFPA 70 Article 725, Types CL3P, CL3R, CL3.
   c. Other types of cables may be used in accordance with NFPA 70, Table 725-61 "Cable Uses and Permitted Substitutions", as approved.

E. Connectors:
1. General: Connectors specified are part of a system. Furnish connectors and components, and use specific tools and methods as recommended by connector manufacturer to form complete connector system.
2. Splices:
   a. Spring Type:
      1) Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s B-Cap, Electrical Products Div./3M's Scotchlok Type Y, R, G, B, O/B+, R/Y+, or B/G+, or Ideal Industries Inc.'s Wing Nuts or Wire Nuts.
      2) Rated 150° C, 600V; Ideal Industries Inc.'s High Temperature Wire-Nut Model 73B, 59B.
   b. Indent Type with Insulating Jacket:
      1) Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s Crimp Connectors, Ideal Industries Inc.'s Crimp Connectors, Penn-Union Corp.'s Penn-Crimps, or Thomas & Betts Corp.'s STA-KON.
   c. Indent Type (Uninsulated): Anderson/Hubbell's Versa-Crimp, VERSAtile, Blackburn/T&B Corp.'s Color-Coded Compression

Connectors, Electrical Products Div./3M's Scotchlok 10000, 11000 Series, Framatome Connectors/Burndy's Hydent, Penn-Union Corp.'s BCU, BBCU Series, or Thomas & Betts Corp.'s Compression Connectors.

d. Connector Blocks: NIS Industires Inc.'s Polaris System, or Thomas & Betts Corp.'s Blackburn AMT Series.

e. Resin Splice Kits: Electrical Products Div./3M's Scotchcast Brand Kit Nos. 82A Series, 82-B1 or 90-B1, or Scotchcast Brand Resin Pressure Splicing Method.

f. Heat Shrinkable Splices: Electrical Products Div./3M's ITCSN, Raychem Corp.'s Thermofit Type WCS, or Thomas & Betts Corp.'s SHRINK-KON Insulators.

g. Cold Shrink Splices: Electrical Products Div./3M's 8420 Series.

2. Gutter Taps: Anderson/Hubbell's GP/GT with GTC Series Covers, Blackburn/T&B Corp.'s H-Tap Type CF with Type C Covers, Framatome Connectors/Burndy's Polytap KPU-AC, H-Crimpit Type YH with CF-FR Series Covers, ILSCO's GTA Series with GTC Series Covers, Ideal Industries Inc.'s Power-Connect GP, GT Series with GIC covers, NSI Industries Inc.'s Polaris System, OZ/Gedney Co.'s PMX or PT with PMXC, PTC Covers, Penn-Union Corp.'s CDT Series, or Thomas & Betts Corp.'s Color-Keyed H Tap CHT with HTC Covers.

3. Terminals: Nylon insulated pressure terminal connectors by Amp-Tyco/Electronics, Electrical Products Div./3M, Framatome Connectors/Burndy, Ideal Industries Inc., Panduit Corp., Penn-Union Corp., Thomas & Betts Corp., or Wiremold Co.

4. Lugs:

a. Single Cable (Compression Type Lugs): Copper, one or 2 hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Framatome Connectors/Burndy's Hylug YA, Electrical Products Div./3M Scotchlok 31036 or 31145 Series, Ideal Industires Inc.'s CCB or CCBL, NSI Industries Inc.'s L, LN Series, Penn-Union Corp.'s BBLU Series, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.

b. Single Cable (Mechanical Type Lugs): Copper, one or 2 hole style (to suit conditions); Blackburn/T&B Corp.'s Color-Keyed Locktite Series, Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Locktite Series.

c. Multiple Cable (Mechanical Type Lugs): Copper, configuration to suit conditions; Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Color-Keyed Locktite Series.

F. Tapes:

1. Insulation Tapes:

a. Plastic Tape: Electrical Products Div./3M's Scotch Super 33+ or Scotch 88, Plymouth Rubber Co.'s Plymouth/ Bishop Premium 85CW.

b. Rubber Tape: Electrical Products Div./3M's Scotch 130C, or Plymouth Rubber Co.'s Plymouth/Bishop W963 Plysafe.

2. Moisture Sealing Tape: Electrical Products Div./3M's Scotch 2200 or 2210, or Plymouth Rubber Co.'s Plymouth/Bishop 4000 Plyseal-V.
3. Electrical Filler Tape: Electrical Products Div./3M's Scotchfil, or Plymouth Rubber Co.'s Plymouth/Bishop 125 Electrical Filler Tape.
4. Color Coding Tape: Electrical Products Div./3M's Scotch 35, or Plymouth Rubber Co.'s Plymouth/Bishop Premium 37 Color Coding.
5. Arc Proofing Tapes:
   a. Arc Proofing Tape: Electrical Products Div./3M's Scotch 77, Mac Products Inc.'s AP Series, or Plymouth Rubber Co.'s Plymouth/Bishop 53 Plyarc.
   b. Glass Cloth Tape: Electrical Products Div./3M's Scotch 27/Scotch 69, Mac Products Inc.'s TAPGLA 5066, or Plymouth Rubber Co.'s Plymouth/Bishop 77 Plyglas.
   c. Glass-Fiber Cord: Mac Products Inc.'s MAC 0527.

G. Wire-Pulling Compounds: To suit type of insulation; American Polywater Corp.'s Polywater Series, Electric Products Div./3M's WL, WLX, or WLW, Greenlee Textron Inc.'s Y-ER-EAS, Cable Cream, Cable Gel, Winter Gel, Ideal Industries Inc.'s Yellow 77, Aqua-Gel II, Agua-Gel CW, or Thomas & Betts Corp.'s Series 15-230 Cable Pulling Lubricants, or Series 15-631 Wire Slick.

H. Wire Management Products: Cable clamps and clips, cable ties, spiral wraps, etc., by Catamount/T&B Corp., or Ideal Industries Inc.

## 2.04 WIRING DEVICES

A. Local Switches:
1. Single Pole, 15A, 120/277 V ac: Bryant's 4801, Crouse-Hinds/AH's 1891, General Electric's GE5931-1G, Hubbell's 1201, Leviton's 1201, Pass & Seymour's 15AC1, or Slater's 710-BR.
2. Double Pole, 15A, 120/277 V ac: Bryant's 4802, Crouse-Hinds/AH's 1892, General Electric's GE5932-1G, Hubbell's 1202, Leviton's 1202, Pass & Seymour's 15AC2, or Slater's 712-BR.
3. Three-Way, 15A, 120/277 V ac: Bryant's 4803, Crouse-Hinds/AH's 1893, General Electric's GE5933-1, Hubbell's 1203, Leviton's 1203, Pass & Seymour's 15AC3, or Slater's 713-BR.
4. Four-Way, 15A, 120/277 V ac: Bryant's 4804, Crouse-Hinds/AH's 1894, General Electric's GE5934-1G, Hubbell's 1204, Leviton's 1204, Pass & Seymour's 15AC4, or Slater's 714-BR.

B. Receptacles:
1. Single Receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W): Bryant's 5251, Crouse-Hinds/AH's 5251, General Electric's 5251-1, Hubbell's 5251, Leviton's 5251, Pass & Seymour's 5251, or Slater's 5361-AG-BR.
2. Duplex Receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W): Bryant's 5262, Crouse-Hinds/AH's 5252-S, General Electric's GEN5252-1, Hubbell's 5252, Leviton's 5252, Pass & Seymour's 5252,or Slater's 5252-AG-BR.

3. Ground Fault Interrupter Receptacle Rated 15A (NEMA 5-15R), Circuit-Ampacity 20A: Bryant's GFR52FT, Crouse-Hinds/AH's 1591-F, General Electric's TGTR15B, Leviton's 6194, Pass & Seymour's 1591-F, or Slater's SIR-15-F-BR.

C. Wall Plates:
1. Stainless Steel Wall Plates (Type 302 stainless steel with satin finish): Bryant's 93 _____ Series, Crouse-Hinds/AH's 93 _____ Series, General Electric's 93 _____ Series, Hubbell's 93 _____ Series, Leviton's 910 _____ -40 Series, or Pass & Seymour's 93 _____ Series.
2. Chrome Wall Plates (.040 inch thick brass with polished chromium finish): General Electric's GE894 _____ -5 Series, Hubbell's 94 _____ Series, Pass & Seymour's 94 _____ Series.
3. Weatherproof Covers: Crouse-Hinds' WLRS, WLRD, Hubbell's 52_____, 74 _____ Series, or Pass & Seymour's 45 _____ Series, or Thomas & Betts Corp.'s Red Dot Series
4. Covers for Threaded Type Boxes: Stamped sheet steel, gasketed device covers as produced by Crouse-Hinds Co., OZ/Gedney Co., or Thomas & Betts Corp.

## 2.05 SUPPORTING DEVICES

A. Fasteners: Furnish all fasteners and hardware compatible with the materials and methods required for attachment of supporting devices.
1. Slotted Type Concrete Inserts: Galvanized pressed steel plate complying with ASTM A 283; box-type welded construction with slot designed to receive steel nut and with knockout cover, hot-dipped galvanized in compliance with ASTM A 123.
2. Masonry Anchorage Devices: Expansion shields complying with FS FF-S-325, as follows:
   a. Furnish lead expansion shields for machine screws and bolts 1/4 inch and smaller; head-out embedded nut type, single unit class, Group I, Type l, Class 1.
   b. Furnish lead expansion shields for machine screws and bolts larger than 1/4 inch in size; head-out embedded nut type, multiple unit class, Group I, Type 1, Class 2.
   c. Furnish bolt anchor expansion shields for lag bolts, zinc alloy, long-shield anchors class, Group II, Type 1, Class 1.
   d. Furnish bolt anchor expansion shields for bolts, closed-end bottom bearing class, Group II, Type 2, Class 1.
3. Toggle Bolts: Tumble-wing type, complying with FS FF-B-588C, Type, class and style as required.
4. Nuts, Bolts, Screws, Washers:
   a. General: Furnish zinc-coated fasteners, with galvanizing complying with ASTM A 153 for exterior use or where built into exterior walls. Furnish fasteners for the type, grade and class required for the particular installation.
   b. Standard Nuts and Bolts: Regular hexagon head type, complying with ASTM A 307, Grade A.
   c. Lag Bolts: Square head type, complying with FS FF-B-561C.

d. Machine Screws: Cadmium plated steel, complying with FS FF-S-92.
e. Wood Screws: Flat head carbon steel, complying with FS FF-S-111.
f. Plain Washers: Round, general assembly grade carbon steel, complying with FS FF-W-92.
g. Lock Washers: Helical spring type carbon steel, complying with FS FF-W-84.

B. "C" Beam Clamps:
1. For 1 inch Conduit Maximum: B-Line Systems Inc.'s BG-8-C2, BP-8-C1 Series, or Caddy Fastener Div./Erico Products Inc.'s BC-8P and BC-8PSM Series.
2. For 3 inch Conduit Maximum: Appleton Electric Co.'s BH-500 Series beam clamp with H50WB Series hangers, Kindorf/T&B Corp.'s 500 Series beam clamp with 6HO-B Series hanger, or OZ/Gedney Co.'s IS-500 Series beam clamp with H-OWBS Series hanger.
3. For 4 inch Conduit Maximum: Kindorf/T&B Corp.'s E-231 beam clamp and E-234 anchor clip and C-149 series lay-in hanger, or Unistrut Corp.'s P2676 beam clamp and P-1659A Series anchor clip with J1205 Series lay in hanger.
4. For Threaded Rods (100 lbs. load max.): Caddy Fastener Div./Erico Products Inc.'s BC-4A.
5. For Threaded Rods (200 lbs. load max.): Appleton Electric Co.'s BH-500 Series, Kindorf/T&B Corp.'s 500 Series, or OZ/Gedney Co.'s IS-500 Series.
6. For Threaded Rods (300 lbs. load max.): Kindorf/T&B Corp.'s E-231 beam clamp and E-234 anchor clip, or Unistrut Corp.'s P2676 beam clamp and P-1659A Series anchor clip.

C. Fastener Fittings for Wood and Existing Masonry: Kindorf/T&B Corp.'s E-243, E-244, E-245, E-170, or Versabar Corp.'s VX-4310, VX-2308, VX-4308, VX-4309.

D. Pipe Straps: Two hole steel conduit straps; Kindorf/T&B Corp.'s C-144 or C-280 Series.

E. Pipe Clamps: One-hole malleable iron type clamps; Kindorf/T&B Corp.'s HS-400 Series, or OZ/Gedney Co.'s 14-50 Series.

F. Channel Support System and Accessories: 12 gage galvanized steel channel and accessories; B-Line System Inc.'s B-22 (1-5/8 x 1-5/8 inches), B-12 (1-5/8 x 2-7/16 inches), B-11 (1-5/8 x 3-1/4 inches), Kindorf/T&B Corp.'s B-900 (1-1/2 x 1-1/2 inches), B-901 (1-1/2 x 1-7/8 inches), B-902 (1-1/2 x 3 inches), Unistrut Corp.'s, P-3000 (1-3/8 x 1-5/8 inches), P-5500 (1-5/8 x 2-7/16 inches), P-5500 (1-5/8 x 3-1/4 inches), or Versabar Corp.'s VA-1 (1-5/8 x 1-5/8 inches), VA-3 (1-5/8 x 2-1/2 inches).

G. Supporting Fasteners (Metal Stud Construction): Metal stud supports, clips and accessories as produced by Caddy/Erico Products Inc.

## 2.06 SAFETY SWITCHES (SINGLE THROW)

A. NEMA 1, 3R, 4 (Stainless Steel), 12: Cutler-Hammer Inc.'s DH, Federal Pacific Electric Co.'s Class 1240, General Electric Co.'s Type TH, Square D Co.'s Heavy Duty Series, or Westinghouse Electric Corp.'s H-600; having:
   1. Fuses or unfused as indicated on drawings.
   2. Fused switches equipped with fuseholders to accept only the fuses specified (UL Class RK-1, RK-5, or L).
   3. NEMA 1 enclosure unless otherwise indicated on drawing.
   4. 240 V rating for 120 V, 208 V, or 240 V circuits.
   5. 600 V rating for 277 V, or 480 V circuits.
   6. Solid neutral bus when neutral conductor is included with circuit.
   7. Ground bus when equipment grounding conductor is included with circuit.
   8. Current rating and number of poles as indicated on drawings.

B. NEMA 4X: Crouse-Hinds Co.'s NST, Cutler-Hammer Inc.'s DH, General Electric Co.'s Type TH, Square D Co.'s Heavy Duty Series, or Westinghouse Electric Corp.'s H-600; having:
   1. Fuses, or unfused as indicated on drawings.
   2. Fused switches equipped with fuseholders to accept only the fuses specified (UL Class RK-l, RK-5, or L).
   3. Molded fiberglass-reinforced polyester NEMA 4X enclosure.
   4. 240 V rating for 120 V, 208 V, or 240 V circuits.
   5. 600 V rating for 277 V, or 480 V circuits.
   6. Solid neutral bus when neutral conductor is included with circuit.
   7. Ground bus when equipment grounding conductor is included with circuit.
   8. Current rating and number of poles as indicated on drawings.

C. Fuses for Motor Circuits:
   1. Cartridge Type (250 Volts, 600 Amperes or Less): Dual element time-delay, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity:
      a. Bussmann Mfg. Div./McGraw Edison Co.'s Type FRN-R.
      b. Gould Inc. Circuit Protection Div. (Chase-Shawmut) Type AT-DER.
      c. Littlefuse Inc.'s Type FLNR.
   2. Cartridge Type (600 Volts, 600 Amperes or Less): Dual element time-delay, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity:
      a. Bussmann Mfg. Div./McGraw Edison Co.'s Type FRS-R.
      b. Gould Inc. Circuit Protection Div. (Chase-Shawmut) Type ATS-DER.
      c. Littlefuse Inc.'s Type FLSR.

D. Fuses for Lighting and Heating Circuits:
   1. Cartridge Type (250 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity:
      a. Bussmann Mfg. Div./McGraw Edison Co.'s Type KTN-R.

b. Gould Inc. Circuit Protection Div. (Chase-Shawmut) Type A2KR.
c. Littlefuse Inc.'s Type KLNR.

2. Cartridge Type (600 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity:
a. Bussmann Mfg. Div./McGraw Edison Co.'s Type KTS-R.
b. Gould Inc. Circuit Protection Div. (Chase-Shawmut) Type A6KR.
c. Littlefuse Inc.'s Type KLSR.

## 2.07 GROUNDING AND BONDING

A. Ground Clamps (Cable to Pipe): Blackburn/T&B Corp.'s GUV, Framatome Connectors/Burndy Corp.'s GAR, GD, GP, GK, or OZ/Gedney Co.'s ABG, CG.

B. Ground Clamps (Cable to Rod): Blackburn/T&B Corp.'s GG, GGH, JAB, JABH, GUV, Dossert Corp.'s GN, GPC, Framatome Connectors/Burndy Corp.'s GP, GX, GRC, or OZ/Gedney Co.'s ABG.

C. Ground Lugs: Copper, one or 2 hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Framatome Connectors/Burndy's Hylug YA, Electrical Products Div./3M Scotchlok 31036 or 31145 Series, Ideal Industries Inc.'s CCB or CCBL, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.

D. Exothermic Type Weld: Erico Inc.'s Cadweld Process, or Furseweld/T&B Corp.'s Exothermic Welding System.

E. Compression Connectors: Amp Inc.'s Ampact Copper Grounding System, or Burndy Corp.'s Hyground System.

F. Rod Electrodes: Copper clad (minimum .010 jacket) ground rods minimum 5/8 inches diameter by 8'-0" long.

G. Plate Electrodes: Copper plates minimum 0.06 inches thick by 2'-0" square feet of surface area.

H. Grounding Electrode Conductors and Bonding Conductors: Copper conductors, bare or insulated with THW, THW-2, XHHW, XHHW-2, THWN, THWN-2 or THHN insulation.

I. Hardware: Silicon-bronze bolts, nuts, flat and lock washers etc. by Dossert Corp., Framatome Connectors/Burndy Corp., or OZ/Gedney Co.

## 2.08 NAMEPLATES AND TAGS

A. General: Precision engraved letters and numbers with uniform margins, character size minimum 3/16 inch high.
1. Phenolic: Two color laminated engraver's stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).

2. Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.
3. Materials for Outdoor Applications: As recommended by nameplate manufacturer to suit environmental conditions.

## PART 3 EXECUTION

### 3.01 RACEWAY INSTALLATION

A. Number of Raceways: Do not change number of raceways to less than the number indicated on the drawings.
   1. Each raceway shall enclose one circuit unless otherwise indicated on the drawings.

B. Number of Raceways: Do not change number of raceways to less than the number indicated on the drawings except when appropriate for advantageous reuse of existing exposed and concealed raceways (The contract documents do not indicate location, number, size or condition of existing raceways). Existing raceways may be reused if the following conditions are met:
   1. The existing raceway must be of adequate size for the new conductors to be installed therein (NFPA 70 Chapter 9, Tables 1, 4, & 5; Appendix C, Tables C1-C12a). More circuits may be enclosed by existing raceways than the circuiting shown on the drawings provided conductor sizes are increased to compensate for derating (adjustment factors) and other considerations required by NFPA 70 Article 310-15.
   2. Remove existing conductors.
   3. Demonstrate to the Director's Representative that the existing raceway is clear of obstructions and in good condition.
   4. Check ground continuity. When ground continuity of existing raceway is inadequate install insulated grounding bushings, grounding wedges, bonding straps, grounding jumpers or equipment grounding conductors to establish effective path to ground.
   5. Install insulated bushings to replace damaged or missing bushings. Replace non-insulated bushings with insulated bushings on raceway sizes 1 inch and larger.
   6. Install vertical conductor supports to replace existing or missing vertical conductor supports.
   7. Install extension rings on existing boxes when the number of new conductors installed therein exceeds NFPA 70 requirements.
   8. Furnish the Director's Representative with marked up drawings showing size and routing of existing raceways with number and size of new conductors installed therein. The drawings will be forwarded to the design engineer for verification of NFPA 70 compliance.

C. Conduit Installed Concealed:
   1. Install conduit concealed unless otherwise indicated on the drawings.
   2. Existing Construction:
      a. Run conduit in existing chases and hung ceilings.

b. If conduit cannot be installed concealed due to conditions encountered in the building, report such conditions and await approval in writing before proceeding.

3. New Construction:
   a. Run conduit in the ceilings, walls, and partitions.
4. If any portions of the conduit system cannot be installed concealed due to conditions encountered in the building, report such conditions and await approval in writing before proceeding.

D. Conduits Penetrating Concrete Floor Slabs (Concrete slabs that are both ceilings and floors shall be treated as floor slabs):
   1. Provide a minimum of 2 inches between conduits that vertically penetrate elevated concrete slabs.
   2. Provide firestopping and spray on fireproofing at locations where conduits penetrate surface of floor slab and slab is part of fire rating required for construction.

E. Conduit Installed Exposed:
   1. Install conduit exposed where indicated on the drawings. If not indicated, conduit may be installed exposed, as approved, in:
      a. Unfinished spaces, and finished spaces housing mechanical or electrical equipment that is generally accessible only to facility maintenance personnel.
      b. Areas where existing conduits have been installed exposed.
      c. Areas where conduit cannot be installed concealed.
   2. Install conduit tight to the surface of the building construction. Exception:
      a. Where otherwise indicated or directed.
   3. Install vertical runs perpendicular to the floor.
   4. Install runs on the ceiling perpendicular or parallel to the walls.
   5. Install horizontal runs parallel to the floor.
   6. Do not run conduits near heating pipes.
   7. Installation of conduit directly on the floor will not be permitted.

F. Conduit Size: Not smaller than 1/2 inch electrical trade size. Where type FEP, THHN, THWN, THWN-2, XHH, XHHW, or XHHW-2 conductors are specified for use, the minimum allowable conduit size for new Work shall be based on Type THW conductors.

G. Raceways Exposed to Different Temperatures: Where portions of an interior raceway system are exposed to widely different temperatures, seal interior and exterior of raceway to prevent circulation of air from a warmer to a colder section through the raceway installation.
   1. Refrigerated Rooms: Install conduit body or junction box in the raceway system on warm side of refrigerated room. After conductors are installed, seal interior of the raceway at the conduit body or junction box.
   2. Heated Areas to Unheated Areas: After conductors are installed, seal interior of the raceway at the nearest conduit body, outlet or junction box in the heated area adjoining the unheated area.

H. Conduit for Prefabricated Walk-In Refrigeration Boxes:

1. Install box wiring in conduit. Run conduit exposed on exterior of box unless project conditions require conduit to be run exposed on interior of box.
    a. Install rigid ferrous metal conduit and galvanized fittings where the metal surfaces are galvanized steel.
    b. Install rigid stainless steel conduit and fittings where the metal surfaces are stainless steel.
2. Create a thermal break where penetrating the box by installing maximum of 12 inches of Schedule 40 high density polyethylene conduit within the conduit run at the penetration. Seal the penetration.
3. Install equipment grounding conductor in each conduit.
4. Seal raceway as specified for raceways exposed to different temperatures.

I. Conduit in Waterproofed Floors: Install conduit runs in waterproof floors to avoid penetrating the waterproofing. Avoid penetration of waterproofing with conduit risers so far as practicable.
1. Where it is necessary to puncture the waterproofing for a conduit riser, install a standard weight steel pipe sleeve extending one inch above the finished floor level. Flash the steel pipe sleeve to the waterproofing with 16 ounce copper. Construct the flashing with a copper tube extending the full height of the sleeve, soldered to a copper base extending 6 inches in all directions from the sleeve.
2. The flashing will be integrated into the waterproofing by the Construction Contractor. Provide solid cast brass floor plates with chromium finish where pipe sleeves are exposed in rooms.

J. Conduit in Hazardous Areas: Install Work in hazardous areas in accordance with NFPA 70.
1. Install sealing fittings in concealed conduit runs in a recessed box with blank face plate to match other face plates in the area.

K. Raceway Schedule:
1. Rigid Ferrous Metal Conduit: Install in all locations unless otherwise specified or indicated on the drawings.
2. Intermediate Ferrous Metal Conduit: May be installed in all dry and damp locations except:
    a. Hazardous areas.
    b. Where other type raceways are specified or indicated on the drawings.
3. Electrical Metallic Tubing:
    a. May be installed concealed as branch circuit conduits above suspended ceilings where conduit does not support fixtures or other equipment.
    b. May be installed concealed as branch circuit conduits in hollow areas in dry locations, including:
        1) Hollow concrete masonry units, except where cores are to be filled.
        2) Drywall construction with sheet metal studs, except where studs are less than 3-1/2 inches deep.

c. May be installed exposed as branch circuit conduits in dry non-hazardous locations at elevations over 10'-0" above finished floor where conduit does not support fixtures or other equipment.

4. Flexible Metal Conduit: Install equipment grounding conductor in the flexible metal conduit and bond at each box or equipment to which conduit is connected:
   a. Use for final conduit connection to recessed lighting fixtures in suspended ceilings. Use 4 to 6 feet of flexible metal conduit (minimum size 1/2 inch) between junction box and fixture. Locate junction box at least 1 foot from fixture and accessible if the fixture is removed.
   b. Use 1 to 3 feet of flexible metal conduit for final conduit connection to:
      1) Emergency lighting units.
      2) Dry type transformers.
      3) Motors with open, drip-proof or splash-proof housings.
      4) Equipment subject to vibration (dry locations).
      5) Equipment requiring flexible connection for adjustment or alignment (dry locations).
   c. Use for concealed branch circuit conduits above existing non-removable suspended ceilings where rigid type raceways cannot be installed due to inaccessibility of space above ceiling.
   d. May be installed concealed as branch circuit conduits in drywall construction with sheet metal studs, except where studs are less than 3-1/2 inches deep.
5. Liquid-tight Flexible Metal Conduit: Install equipment grounding conductor in liquid-tight flexible metal conduit and bond at each box or equipment to which conduit is connected:
   a. Use 1 to 3 feet of liquid-tight flexible metal conduit (UL listed and marked suitable for the installation's temperature and environmental conditions) for final conduit connection to:
      1) Motors with weather-protected or totally enclosed housings.
      2) Equipment subject to vibration (damp and wet locations).
      3) Equipment requiring flexible connection for adjustment or alignment (damp and wet locations).
6. Surface Metal Raceway: Use as exposed raceway system in finished spaces at locations indicated on the drawings.
   a. Use surface metal raceway system of size required for number of wires to be installed therein. (Use specific size when indicated on the drawings).
   b. Do not run raceway through walls that have a plaster finish nor through masonry walls or floors. Install a pipe sleeve, or a short length of conduit with junction boxes or adapter fittings for raceway runs through such areas. Run raceway along top of baseboards, care being taken to avoid telephone and other signal wiring. Where raceway crosses chair railing or picture molding, cut the chair railing or picture molding to permit the raceway to lie flat against the wall. Run raceway around door frames and

other openings. Run raceway on ceiling or walls perpendicular to or parallel with walls and floors.

c. Secure one piece raceway every 30 inches alternately with 2 hole straps, and support clips (2 hole strap, support clip, 2 hole strap, etc.). Secure 2 piece raceway every 30 inches alternately with 2 hole straps and fasteners through back of raceway (2 hole strap, fastener through back, 2 hole strap, etc.).

d. Secure raceway at intervals not exceeding 36 inches.

e. Install separate equipment grounding conductor for grounding of equipment. The raceway alone will not be considered suitable for use as an effective path to ground.

f. Outlet box covers for pendant mounted fluorescent fixtures may be omitted if the fixture canopy is notched to receive the raceway and the canopy fits snugly against the ceiling.

g. Where equipment is mounted on an outlet box and the equipment base is larger than the outlet box, provide finishing collar around equipment base and outlet box or provide finishing collar/outlet box:

1) Finishing Collar: Same finish and peripheral dimensions as the equipment base, including provisions for mounting, slots to fit over raceway and of depth to cover outlet box and extend back to ceiling or wall.

2) Combination Finishing Collar/Outlet Box: Same finish and peripheral dimensions as the equipment base to be mounted thereon, gage or thickness of metal as required by National Electrical Code, including provision for mounting and knockouts for entrance of raceway.

7. Wireways: May be used indoors in dry locations for exposed raceway between grouped, wall mounted equipment.

L. Fittings and Accessories Schedule:

1. General:

a. Use fittings and accessories that have a temperature rating equal to, or higher than the temperature rating of the conductors to be installed within the raceway.

b. Use zinc electroplate or hot dipped galvanized steel/malleable iron or cast iron alloy fittings and accessories in conjunction with ferrous raceways in dry and damp locations, unless otherwise specified or indicated on the drawings.

c. Use malleable iron or cast iron alloy fittings and accessories having hot dipped/mechanically galvanized finish or other specified corrosion resistant finish in conjunction with ferrous raceways in wet locations, unless otherwise specified or indicated on the drawings.

d. Use insulated grounding bushings or grounding wedges on ends of conduit for terminating and bonding equipment grounding conductors (when required) if cabinet or boxes are not equipped with grounding/bonding screws or lugs.

e. Use caps or plugs to seal ends of conduits until wiring is installed (to exclude foreign material).

f. Use insulated grounding bushings on the ends of conduits that are not directly connected to the enclosure (such as stub-ups under equipment, etc.), and bond between bushings and enclosure with equipment grounding conductor.
g. Use expansion fittings where raceways cross expansion joints.
h. Use deflection fittings where raceways cross expansion joints that move in more than one plane.
i. Use 2 locknuts and an insulated bushing on end of each conduit entering sheet metal cabinet or box in dry or damp locations.
1) Plastic bushing may be used in lieu of insulated bushing on 1/2 and 3/4 inch conduit.
2) Terminate conduit ends within cabinet/box at the same level.

2. For Rigid and Intermediate Metal Conduit: Use threaded fittings and accessories. Use 3 piece conduit coupling where neither piece of conduit can be rotated.
3. For Electrical Metallic Tubing: Use compression type connectors and couplings.
4. For Flexible Metal Conduit: Use flexible metal conduit connectors.
5. For Liquid-tight Flexible Metal Conduit: Use liquid-tight connectors.
6. For Surface Metal Raceway: Use raceway manufacturer's standard fittings and accessories.
7. For Wireways: Use wireway manufacturer's standard fittings and accessories.

## 3.02 OUTLET, JUNCTION AND PULLBOX INSTALLATION

A. Mounting Position of Wall Outlets For Wiring Devices: Unless otherwise indicated, install boxes so that the long axis of each wiring device will be vertical.

B. Height of Wall Outlets: Unless otherwise indicated, locate outlet boxes with their center lines at the following elevations above finished floor:

| | **MOUNTING HEIGHT** |
|---|---|
| Lighting Fixtures | 6'-0" |
| Lighting Fixtures in Stairway | 7'-6" |
| Exit Lights | 8'-0" where ceiling height allows a minimum of 6 inch clearance between ceiling and top of exit light. Otherwise mount exit light so that it's top is 6 inches below finished ceiling. Adjust height and clearances as required to suit installation over doors. |
| Night Lights | 2'-0" |
| Hose Cabinet Lights | 1'-0" above top of cabinet |
| Switches | 4'-0" |
| Single & Duplex Receptacles | 1'-6"* |
| Water Cooler Receptacles | 2'-0" |
| Clock Receptacles | 7'-6" |
| Range Receptacle | 1'-6" |

| | |
|---|---|
| Special Purpose Receptacles | 4’-0” |
| Thermostats | 5’-0” |
| Manual Fire Alarm Boxes | 4’-0” |
| Audible Notification Appliances | 8’-0” where ceiling height allows a minimum of 6 inch clearance between ceiling and top of appliance. Otherwise mount appliance so that it’s top is 6 inches below finished ceiling. |
| Visible Notification Appliances | Install outlet so that the bottom of the visible lens will be 6’-8”AFF. |
| Combination Audible/Visible Notification Appliances | Install outlet so that the bottom of the visual lens will be 6’-8” AFF, and the audible section will be above the visible section. |
| Radio | 2’-0” |
| Television | 2’-0” |
| Telecommunications | 2’-0” |
| Telephone | 2’-0” |
| Telephone Marked W.T. | Install outlet so that the highest operable part of the wall mounted telephone will not be more than 4’-0” AFF. |

*In areas containing heating convectors, install outlets above convectors at height indicated on drawings.

C. Supplementary Junction and Pull Boxes: In addition to junction and pull boxes indicated on the drawings and required by NFPA 70, provide supplementary junction and pull boxes as follows:
   1. When required to facilitate installation of wiring.
   2. At every third 90 degree turn in conjunction with raceway sizes over 1 inch.
   3. At intervals not exceeding 100 feet in conjunction with raceway sizes over 1 inch.

D. Box Schedule for Concealed Conduit System:
   1. Non-Fire Rated Construction:
      a. Depth: To suit job conditions and comply with NFPA 70 Article 370.
      b. For Lighting Fixtures: Use galvanized steel outlet boxes designed for the purpose.
         1) For Fixtures Weighing 50 lbs. or Less: Box marked “FOR FIXTURE SUPPORT”.
         2) For Fixtures More Than 50 lbs: Box listed and marked with the weight of the fixture to be supported (or support fixture independent of the box).
      c. For Ceiling Suspended Fans:
         1) For Fans Weighing 35 lbs or Less: Marked “Acceptable for Fan Support.”
         2) For Fans Weighing More Than 35 lbs, up to 70 lbs: Marked “Acceptable for Fan Support up to 70 lbs (or support fan independent of the box).”

d. For Junction and Pull Boxes: Use galvanized steel boxes with flush covers.

e. For Switches, Receptacles, Etc:

1) Plaster or Cast-In-Place Concrete Walls: Use 4 inch or 4-11/16 inch galvanized steel boxes with device covers.

2) Walls Other Than Plaster or Cast-In-Place Concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.

2. Recessed Boxes in Fire Rated (2 hour maximum) Bearing and Nonbearing Wood or Steel Stud Walls (Gypsum Wallboard Facings):

a. Use listed single and double gang metallic outlet and switch boxes. The surface area of individual outlet or switch boxes shall not exceed 16 square inches.

b. The aggregate surface area of the boxes shall not exceed 100 square inches per 100 square feet of wall surface.

c. Securely fasten boxes to the studs. Verify that the opening in the wallboard facing is cut so that the clearance between the box and the wallboard does not exceed 1/8 inch.

d. Separate boxes located on opposite sides of walls or partitions by a minimum horizontal distance of 24 inches. This minimum separation distance may be reduced when wall opening protective materials are installed according to the requirements of their classification.

e. Use wall opening protective material in conjunction with boxes installed on opposite sides of walls or partitions of staggered stud construction in accordance with the classification requirements for the protective material.

3. Other Fire Rated Construction: Use materials and methods to comply with the listing requirements for the classified construction.

E. Box Schedule for Exposed Conduit System:

1. Dry and Damp Locations: Use zinc electroplate or hot dipped galvanized threaded type malleable iron or cast iron alloy outlet, junction, and pullboxes or conduit bodies provided with a volume marking in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.

a. Galvanized steel boxes may be used in conjunction with conduit sizes over 1 inch in non-hazardous dry and damp locations.

b. Galvanized steel boxes may be used in conjunction with electrical metallic tubing where it is allowed (specified) to be installed exposed as branch circuit conduits at elevations over 10’-0” above finished floor.

2. Wet Locations: Use threaded type malleable iron or cast iron alloy outlet junction, and pullboxes or conduit bodies (provided with a volume marking) with hot dipped galvanized or other specified corrosion resistant coating in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.

a. Use corrosion resistant boxes in conjunction with plastic coated rigid ferrous metal conduit.

3. Finishing Collar or Combination Finishing Collar/Outlet Box (Surface Mounted Equipment Used With Exposed Raceway):
    a. Use finishing collar where surface mounted equipment is installed on an exposed raceway outlet box and the equipment base is larger than the outlet box.
    b. Use combination finishing collar/outlet box where surface mounted equipment is not indicated to be installed on an exposed raceway outlet box, but raceway cannot be run directly into equipment body due to equipment design.

F. Specific Purpose Outlet Boxes: Use to mount equipment when available and suitable for job conditions. Unless otherwise specified, use threaded type boxes with finish as specified for exposed conduit system, steel (painted) for surface metal raceway system and galvanized steel for recessed installations.

## 3.03 CONDUCTOR INSTALLATION

A. Install conductors in raceways after the raceway system is completed.

B. Do not change, group or combine circuits other than as indicated on the drawings.

C. Do not change, group or combine circuits other than as indicated on the drawings except as permitted when reusing existing raceways.

D. Common Neutral Conductor:
1. A common neutral may be used for 2 or 3 branch circuits where the circuits are indicated on the drawings to be enclosed within the same raceway, provided each branch circuit is connected to a different phase in the panelboard.
2. Exceptions: The following circuits shall have a separate neutral:
    a. Circuits containing ground fault circuit interrupter devices.
    b. Circuits containing solid state dimmers.
    c. Circuits recommended by equipment manufacturers to have separate neutrals.

E. Conductor Size: Install conductors of size shown on drawings. Where size is not indicated, the minimum size allowed is:
1. For Electric Light and Power Branch Circuits: No. 12 AWG.
2. For Class 1 Circuits:
    a. No. 18 and No. 16 AWG may be used provided they supply loads that do not exceed 6 amps (No. 18 AWG), or 8 amps (No. 16 AWG).
    b. Larger than No. 16 AWG: Use to supply loads not greater than the ampacities given in NFPA 70 Section 310-15.
3. For Class 2 Circuits: Any size to suit application.
4. For Class 3 Circuits: No. 18 AWG.

F. Color Coding:
1. Color Coding for 120/208 Volt Electric Light and Power Wiring:
    a. Color Code:

1) 2 wire circuit - black, white.
2) 3 wire circuit - black, red, white.
3) 4 wire circuit - black, red, blue, white.

b. White to be used only for an insulated grounded conductor (neutral). If neutral is not required use black and red, or black, red and blue for phase to phase circuits.
1) "White" for Sizes No. 6 AWG or Smaller:
a) Continuous white outer finish, or:
b) Three continuous white stripes on other than green insulation along its continuous length.
2) "White" for Sizes Larger Than No. 6 AWG:
a) Continuous white outer finish, or:
b) Three continuous white stripes on other than green insulation along its continuous length, or:
c) Distinctive white markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install white color coding tape at terminations, and at 1' 0" intervals in gutters, pullboxes, and manholes.

c. Colors (Black, Red, Blue):
1) For Branch Circuits: Continuous color outer finish.
2) For Feeders:
a) Continuous color outer finish, or:
b) Color coding tapes encircling the conductors, installed on the conductors at time of their installation. Install color coding tapes at terminations, and at 1' 0" intervals in gutter, pullboxes, and manholes.

2. Color Coding For 277/480 Volt Electric Light and Power Wiring:
a. Color Code:
1) 2 wire circuit - brown, gray.
2) 3 wire circuit - brown, yellow, gray.
3) 4 wire circuit - brown, yellow, orange, gray

b. Gray to be used only for an insulated grounded conductor (neutral). If neutral is not required use brown and yellow, or brown, yellow and orange for phase to phase circuits.
1) "Gray" For Sizes No. 6 AWG or Smaller.
a) Continuous gray outer finish.
2) "Gray" For Sizes Larger Than No. 6 AWG:
a) Distinctive gray markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install gray color coding tape at terminations, and at 1' 0" intervals in gutters, pullboxes, and manholes.

c. Colors (Brown, Yellow, Orange):
1) For Branch Circuits: Continuous color outer finish.
2) For Feeders:
a) Continuous color outer finish, or:
b) Color coding tapes encircling the conductors, installed on the conductors at the time of their installation. Install color coding tapes at

terminations, and at 1' 0" intervals in gutters, pullboxes, and manholes.

3. More Than One Nominal Voltage System Within A building: Permanently post the color coding scheme at each branch-circuit panelboard.
4. Existing Color Coding Scheme: Where an existing color coding scheme is in use, match the existing color coding if it is in accordance with the requirements of NFPA 70.
5. Color Code For Wiring Other Than Electric Light and Power: In accordance with ICEA/NEMA WC-30 "Color Coding of Wires and Cables". Other coding methods may be used, as approved.

G. Identification: Use tags to identify feeders and designated circuits. Install tags so that they are easily read without moving adjacent feeders or require removal of arc proofing tapes. Attach tags with non-ferrous wire or brass chain.
1. Interior Feeders: Identify each feeder in pullboxes and gutters. Identify by feeder number and size.
2. Exterior Feeders: Identify each feeder in manholes and in interior pullboxes and gutters. Identify by feeder number and size, and also indicate building number and panel designation from which feeder originates.
3. Street and Grounds Lighting Circuits: Identify each circuit in manholes and lighting standard bases. Identify by circuit number and size, and also indicate building number and panel designation from which circuit originates.

H. Use wire management products to bundle, route, and support wiring in junction boxes, pullboxes, wireways, gutters, channels, and other locations where wiring is accessible.

I. Equipment Grounding Conductor:
1. Install equipment grounding conductor:
   a. Where specified in other Sections or indicated on the drawings.
   b. In conjunction with circuits recommended by equipment manufacturers to have equipment grounding conductor.
2. Equipment grounding conductor is not intended as a current carrying conductor under normal operating circumstances.
3. Color Coding For Equipment Grounding Conductor:
   a. Color Code: Green.
   b. "Green" For sizes No. 6 AWG or Smaller:
      1) Continuous green outer finish, or:
      2) Continuous green outer finish with one or more yellow stripes, or:
      3) Bare copper (see exception below).
   c. "Green" For Sizes Larger Than No. 6:
      1) Stripping the insulation or covering from the entire exposed length (see exception below).
      2) Marking the exposed insulation or covering with green color coding tapes.
      3) Identify at each end and at every point where the equipment grounding conductor is accessible.

J. Arc Proofing: Arc proof feeders installed in a common pullbox or manhole as follows:
   1. Arc proof new feeders.
   2. Arc proof existing feeders that are spliced to new feeders.
   3. Arc proof each feeder as a unit (except feeders consisting of multiple sets of conductors).
   4. Arc proof feeders consisting of multiple sets of conductors by arc proofing each set of conductors as a unit.
   5. Arc proof feeders with half-lapped layer of 55 mils thick arc proofing tape, random wrapped or laced with glass cloth tape or glass-fiber cord. For arc proofing tape less than 55 mils thick add layers to equivalent of 55 mils thick arc proofing tape.

K. Conductor Schedule - Types and Use:
   1. Electric Light and Power Circuits:
      a. FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, or XHHW-2: Wiring in dry or damp locations (except where special type insulation is required).
      b. THWN, THWN-2, XHHW, XHHW-2, USE, or USE-2: Wiring in wet locations (except where type USE or USE-2 insulated conductors are specifically required, or special type insulation is required).
      c. THHN, THWN or THWN-2: Wiring installed in existing raceway systems (except where special type insulation is required).
      d. THHN, THW-2, THWN-2, XHHW, or XHHW-2: Wiring for electric discharge lighting circuits (fluorescent, HID), except where fixture listing requires wiring rated higher than 90° C.
      e. THWN Marked “Gasoline and Oil Resistant”: Wiring to gasoline and fuel oil pumps.
      f. USE, or USE-2: Wiring indicated on the drawings to be direct burial in earth.
      g. USE, or USE-2 Marked “Sunlight Resistant”:
         1) Service entrance wiring from overhead service to the service equipment.
         2) Wiring exposed to the weather and unprotected (except where special type insulation is required).
   2. Class 1 Circuits: Use Class 1 wiring specified in Part 2 (except where special type insulation is required).
   3. Class 2 Circuits: Use Class 2 wiring specified in Part 2 (except where special type insulation is required).
   4. Class 3 Circuits: Use Class 3 wiring specified in Part 2 (except where special type insulation is required).

L. Connector Schedule - Types And Use:
   1. Temperature Rating: Use connectors that have a temperature rating, equal to, or greater than the temperature rating of the conductors to which they are connected
   2. Splices:
      a. Dry Locations:

1) For Conductors No. 8 AWG or Smaller: Use spring type pressure connectors, indent type pressure connectors with insulating jackets, or connector blocks (except where special type splices are required).
2) For Conductors No. 6 AWG or Larger: Use connector blocks or uninsulated indent type pressure connectors. Fill indentions in uninsulated connectors with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with heat shrinkable splices or cold shrink splices.
3) Gutter Taps in Panelboards: For uninsulated type gutter taps fill indentions with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with gutter tap cover.

b. Damp Locations: As specified for dry locations, except apply moisture sealing tape over the entire insulated connection (moisture sealing tape not required if heat shrinkable splices or cold shrink splices are used).

c. Wet Locations: Use uninsulated indent type pressure connectors and insulate with resin splice kits, cold shrink splices or heat shrinkable splices. Exception: Splices above ground which are totally enclosed and protected in NEMA 3R, 4, 4X enclosures may be spliced as specified for damp locations.

3. Terminations:

a. For Conductors No. 10 AWG or Smaller: Use terminals for:
1) Connecting wiring to equipment designed for use with terminals.

b. For Conductors No. 8 AWG or Larger: Use compression or mechanical type lugs for:
1) Connecting cables to flat bus bars.
2) Connecting cables to equipment designed for use with lugs.

c. For Conductor Sizes Larger Than Terminal Capacity On Equipment: Reduce the larger conductor to the maximum conductor size that terminal can accommodate (reduced section not longer than one foot). Use compression or mechanical type connectors suitable for reducing connection.

## 3.04 WIRING DEVICE INSTALLATION

A. Local Switches:
1. Install switches indicated Sa, Sb, Sc, etc, for control of outlets, with corresponding letters on the same circuit.
2. Where more than one switch occurs at same location in a 120 volt system, arrange switches in gangs and cover with one face plate.
3. Install switches in a 277 volt system in separate single boxes if voltage between exposed live metal parts of adjacent switches exceeds 300 volts.
4. Install single and double pole switches so that switch handle is up when switch is in the “On” position.

B. Receptacles:

1. Install receptacles with ground pole in the down position.

C. Wall Plates:
1. Install wall plates on all wiring devices in dry locations, with finish to match hardware in each area.
2. Install 5/8 inch bushed wall plates on telephone outlets.

D. Weatherproof Covers: Install weatherproof covers on wiring devices in damp and wet locations.

E. Nameplates: Install phenolic or embossed aluminum nameplate on each special purpose receptacle indicating phase, ampere and voltage rating of the circuit. Attach nameplate with rivets or vandal resistant fasteners to wall plate or to wall above receptacle. Wall plates may be engraved with required data in lieu of separate nameplates.

F. Mats: Where flush plates are required over outlet boxes that cannot be set deep enough for the plates to fit closely over the finished wall surfaces, provide oak mats to fill the space between the finished wall surface and the plate.

## 3.05 SUPPORTING DEVICE INSTALLATION

A. Attachment of Conduit System:
1. Wood Construction: Attach conduit to wood construction by means of pipe straps with wood screws or lag bolts.
2. Masonry Construction: Attach conduit to masonry construction by means of pipe straps and masonry anchorage devices.
3. Steel Beams: Attach conduit to steel beams by means of "C" beam clamps and hangers.
4. Multiple Parallel Conduit Runs: Use channel support system.
5. Conduit Above Suspended Ceiling: Do not rest conduit directly on runner bars, T-bars, etc. Support conduit from ceiling supports or from construction above suspended ceiling.

B. Metal Stud Construction: Attach raceways and boxes to metal studs by means of supporting fasteners manufactured specifically for the purpose.
1. Support and attach outlet boxes so that they cannot torque/twist. Either:
a. Use bar hanger assembly, or;
b. In addition to attachment to the stud, also provide far side box support.

C. Support of Lighting Fixtures:
1. General: Support fixtures with suitable accessories.
2. Number of Supports (Fluorescent Fixtures):
a. Support individual fluorescent fixtures less than 2 feet wide at 2 points. Support continuous row fluorescent fixtures less than 2 feet wide at points equal to the number of fixtures plus one. Uniformly distribute the points of suspension over the row of fixtures.
b. Support individual fluorescent fixtures 2 feet or wider at 4 corners. Support continuous row fluorescent fixtures 2 feet or

wider at points equal to twice the number of fixtures plus 2. Uniformly distribute the points of suspension over the row of fixtures.

## 3.06 SAFETY SWITCH INSTALLATION

A. Install switches so that the maximum height above the floor to the center of the operating handle does not exceed 6'-6".

B. Identify each safety switch, indicating purpose or load served:
   1. NEMA 1 Enclosures: Rivet or bolt nameplate to the cover.
   2. NEMA 12 Enclosures: Rivet or bolt and gasket nameplate to the cover.
   3. NEMA 3R, 4, 4X Enclosures: Attach nameplate to the cover using adhesive specifically designed for the purpose, or mount nameplate on wall or other conspicuous location adjacent to switch. Do not penetrate enclosure with fasteners.

C. Paint switches used for the fire protective signaling system with red paint and identify - "FIRE ALARM CIRCUIT CONTROL".

D. Paint switches used for oil burner emergency switch with red paint and identify "OIL BURNER".

## 3.07 GROUNDING AND BONDING

A. Connections:
   1. Make grounding and bonding connections, except buried connections, with silicone-bronze hardware and ground clamps, ground lugs or compression connectors, to suit job conditions.
   2. For buried connections use exothermic type weld or compression connectors.

**END OF SECTION**

**SECTION 260526**

**SERVICE GROUNDING AND BONDING**

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

## PART 2 PRODUCTS

### 2.01 MATERIALS

A. Ground Clamps (Cable to Pipe): Blackburn/T&B Corp.'s GUV, Burndy's GAR, GD, GP, GK, or OZ/Gedney Co.'s ABG, CG.

B. Ground Clamps (Cable to Rod): Blackburn/T&B Corp.'s GG, GGH, JAB, GUV, Burndy's GP, GX, GRC, or OZ/Gedney Co.'s ABG.

C. Ground Lugs: Copper, one or 2 hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Burndy's Hylug YA, 3M Scotchlok 31036 or 31145 Series, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.

D. Exothermic Type Weld: Erico Inc.'s Cadweld Process, or Furseweld/T&B Corp.'s Exothermic Welding System.

E. Compression Connectors: Amp Inc.'s Ampact Copper Grounding System, or Burndy's Hyground System.

F. Rod Electrodes: Copper clad (minimum .010 jacket) ground rods minimum 5/8 inches diameter by 8'-0" long.

G. Plate Electrodes: Copper plates minimum 0.06 inches thick by 2'-0" square feet of surface area.

H. Grounding Electrode Conductors and Bonding Conductors: Copper conductors, bare or insulated with THW, THW-2, XHHW, XHHW-2, THWN, THWN-2 or THHN insulation.

I. Hardware: Silicon-bronze bolts, nuts, flat and lock washers etc. as manufactured by Burndy, or OZ/Gedney Co.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Connections:
   1. Make grounding and bonding connections, except buried connections, with silicon-bronze hardware and ground clamps, ground lugs or compression connectors, to suit job conditions.
   2. For buried connections use exothermic type weld or compression connectors.

**END OF SECTION**

**SECTION 262416**

**PANELBOARDS**

## PART 1 GENERAL

### 1.01 REFERENCES

A. The latest edition of: NEMA PB-1, UL-50, UL-67, ANSI C37.81.

### 1.02 SUBMITTALS

A. Waiver of Submittals: The "Waiver of Certain Submittal Requirements" in Section 013300 does not apply to this Section.

B. Submittal Packages: Submit the shop drawings, and the product data specified below at the same time as a package.

C. Shop Drawings; include the following for each panelboard:
   1. Cabinet and gutter size.
   2. Voltage and current rating.
   3. Panelboard short circuit rating: Fully rated equipment is required
   4. Circuit breaker enumeration (frame, ATE, poles, I.C.).
      a. Indicate circuit breakers are suitable for the panelboards' fully rated equipment rating. Series rated combinations will not be considered.
   5. Cable terminal sizes
   6. Power and Energy Meter.
   7. Locks.
   8. Accessories.

D. Product Data:
   1. Catalog sheets, specifications and installation instructions.
   2. Bill of materials.

E. Contract Closeout Submittals:
   1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director's Representative.

## PART 2 PRODUCTS

### 2.01 PANELBOARDS

A. The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.

B. As produced by Cutler-Hammer/Eaton Corp. with LT Trim (Eaton EZ Trim shall not be considered), General Electric Co., Siemens or Square D Co., having:
   1. Flush or surface type cabinets as indicated on the drawings.
   2. Increased gutter space for gutter taps, sub-feed wiring, through-feed wiring, oversize lugs.
   3. UL label "SUITABLE FOR USE AS SERVICE EQUIPMENT" where used as service equipment.
   4. Door and one piece trim. Door fastened to trim with butt or piano hinges. Trim fastened to cabinet with devices having provision for trim adjustment.
   5. Yale No. 511S locks with brass cylinder rosette, blind fastened from inside of door. 2 No. 47 keys with each lock (Exception: Not more than 7 keys, total).
   6. Ratings as indicated on the drawings.
   7. Full capacity copper neutral bus in panelboards where neutrals are required.
   8. Copper equipment grounding bus.
   9. Sections designated "space" or "provision for future breaker" equipped to accept future circuit breakers.
   10. Lock on devices for exit light, fire alarm, stair well circuits.
   11. Provisions for padlocking circuit breaker handle in OFF position where indicated.
   12. Directory.
   13. Short circuit rating not less than indicated on panelboard schedule. Furnish fully rated equipment (the short circuit rating of the panelboard is equal to the lowest interrupting rating of any device installed in the panelboard).
   14. Thermal magnetic, molded case, bolt-on circuit breakers:
      a. Mounting: Individually mounted main circuit breaker (when MCB is required), and group mounted branch/feeder circuit breakers to accommodate the circuit breaker style and panelboard construction.
      b. Single pole and two pole 15, 20, and 30 ATE circuit breakers rated for high intensity discharge lighting loads when applicable.

## 2.02 SURGE PROTECTIVE DEVICES

A. General: Where indicated on the drawings, the panelboards shall be provided with factory installed directly to bus, internal modular Surge Protective Device (SPD) equipment having:
   1. ANSI/UL 1449 3rd Edition compliant – Listed Category C, Type 2 with protected modes for 208/120 volt, 3 phase, 4 wire Wye configured system: L-G, L-N, L-L and N-G.
   2. Rating (ANSI / IEEE C62.41 location Category C): The minimum surge current capacity the device is capable of withstanding shall be 250 kA per phase, 125 kA per mode minimum.

## 2.03 MICROPROCESSOR BASED MULTIFUNCTION POWER AND ENERGY METERS

A. Where indicated on the drawings, provide a factory installed Panel Mounted Power and Energy Meter on panelboards with main bus bars rated 800 amperes and above with the following parameters:
   1. Same manufacturer as the panelboard.
   2. LCD or LED display.
   3. 120 VAC control power.
   3. True RMS voltage and current measurement.
   4. Metered parameters:
      a. Instantaneous, minimum, and maximum: Phase current, neutral current, line voltage, phase voltage, frequency, power factor per phase and three phase total, real power per phase and total, reactive power per phase and total, apparent power per phase and total.
      b. Total real energy, reactive energy, apparent energy.
      c. User configured sliding window for real, reactive and apparent power peak demand with date and time stamp.
      d. Phase voltage percent total harmonic distortion.
      e. Phase current percent total harmonic distortion.
   5. Accuracy:
      a. Energy, and demand power: 0.2% in accordance with ANSI C12.20.
   6. Instrument current transformers shall be factory wired to shorting blocks or other approved method to prevent open-circuiting the current transformers under energized conditions. The meter shall also be user programmable for current to any CT ratio.
   7. Capable of metering up to 600 volts without external potential transformers. The meter shall also be user programmable for voltage range to any PT ratio.
   8. Embedded web server that includes real time circuit information in both numeric and graphical visual formats.
   9. Communications: Ethernet TCP/IP, 10/100 Base T, RJ-45 connection.
   10. The meter shall have a real-time clock with the added capability to synchronize with a network time server to maintain time accuracy.
   11. Out of limit event triggers and logging.
   12. Historical Trending: Historical trend logging for graphical viewing from an embedded WEB server. The graphical views of historical data shall support both pan and zoom functions.
   13. The meter shall have I/O expandability provisions through an optional card slot on the back.

B. Where indicated on the drawings, provide a factory installed Panel Mounted Power and Energy Meter on panelboards with main bus bars rated below 800 amperes with the following parameters:
   1. Same manufacturer as the panelboard. DIN rail mounted.
   2. LCD or LED display.
   3. 120 VAC control power.
   4. True RMS voltage and current measurement.

5. Metered parameters: Phase current, line voltage, phase voltage, frequency, power factor per phase and three phase total, real power per phase and total, reactive power per phase and total, apparent power per phase and total, total real energy, total reactive energy, total apparent energy, user configured sliding window for real, reactive and apparent power peak demand.
6. Accuracy:
   a. Energy, and demand power: 0.5% in accordance with ANSI C12.20.
7. Instrument current transformers shall be factory wired to shorting blocks or other approved method to prevent open-circuiting the current transformers under energized conditions. The meter shall also be user programmable for current to any CT ratio.
8. Capable of metering up to 480 volts without external potential transformers. The meter shall also be user programmable for voltage range to any PT ratio.
9. Communications: Modbus RTU.

## 2.04 NAMEPLATES

A. General: Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inch high.
   1. Phenolic: Two color laminated engravers stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).
   2. Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.
   3. Materials for Outdoor Applications: As recommended by nameplate manufacturer to suit environmental conditions.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Install panelboards in accordance with NEMA Publication No. PB1.1 “General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less”.

B. Flush Cabinets: Set flush cabinets so that edges will be flush with the finished wall line. Where space will not permit flush type cabinets to be set entirely in the wall, set cabinet as nearly flush as possible, and cover the protruding sides with the trim extending over the exposed sides of the cabinet and back to the finished wall line.

C. Directory: Indicate on typewritten directory the equipment controlled by each circuit breaker, and size of feeder servicing panelboard. For power panelboards also include ATE rating and feeder size for each breaker.

D. Remove the neutral to ground main/system bonding jumper unless the panelboard is used for a service entrance or if the panel if fed by a separately derived system. Turn the bonding jumper over to the Director's Representative.

E. Identification:

1. Use nameplates, or stencil on front of each panelboard with white paint, "LP-l, PP-l, etc." in 1/2 inch lettering corresponding to panelboard designations on the drawings, and electrical parameters (phase, wire, voltage).
2. Install a nameplate on each panelboard which explains the means of identifying each ungrounded system conductor by phase and system. Examples of nameplate statements:
   a. Identification of 120/240 Volt Circuit Conductors:
      1) 2 wire circuit - white*, black.
      2) 3 wire circuit - white*, black, red.
      3) 4 wire circuit - white*, black, red, blue.

   *White is used only as neutral. Where neutral is not required, black, red, or black, red, blue is used for phase to phase circuits.

   b. Identification of 277/480 Volt Circuit Conductors:
      1) 2 wire circuit - natural gray**, brown.
      2) 3 wire circuit - natural gray**, brown, yellow.
      3) 4 wire circuit - natural gray**, brown, yellow, orange.

   **Natural gray is used only as neutral. Where neutral is not required, brown, yellow, or brown, yellow, orange is used for phase to phase circuits.

**END OF SECTION**

**SECTION 262726**

**WIRING DEVICES**

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

## PART 2 PRODUCTS

### 2.01 SWITCHES

A. Local Switches, Single Pole:
   1. 15A, 120/277 V ac; Bryant's 4801, Crouse-Hinds/AH's 1891, Hubbell's 1201/1101, Leviton's 1201/1101, Pass & Seymour's 15AC1, or Woodhead's 1891.
   2. 20A, 120/277 V ac; Bryant's 4901, Crouse-Hinds/AH's 1991, Hubbell's 1121/1221, Leviton's 1121/1221, Pass & Seymour's 20AC1, or Woodhead's 1991.
   3. 30A, 120/277 V ac; Bryant's 3001, Crouse-Hinds/AH's 3991, Hubbell's 3031, Leviton's 3031, or Pass & Seymour's 30AC1.

B. Local Switches, Double Pole:
   1. 15A, 120/277 V ac; Bryant's 4802, Crouse-Hinds/AH's 1892, Hubbell's 1202/1102, Leviton's 1202/1102, Pass & Seymour's 15AC2, or Woodhead's 1892.
   2. 20A, 120/277 V ac; Bryant's 4902, Crouse-Hinds/AH's 1992, Hubbell's 1222/1122, Leviton's 1222/1122, Pass & Seymour's 20AC2, or Woodhead's 1992.
   3. 30A, 120/277 V ac; Bryant's 3002, Crouse-Hinds/AH's 3992, Leviton's 3032, or Pass & Seymour's 30AC2.

C. Local Switches, Three-Way:
   1. 15A, 120/277 V ac; Bryant's 4803, Crouse-Hinds/AH 1893, Hubbell's 1203/1103, Leviton's 1203/1103, Pass & Seymour's 15AC3, or Woodhead's 1893.
   2. 20A, 120/277 V ac; Bryant's 4903, Crouse-Hinds/AH's 1993, Hubbell's 1223/1123, Leviton's 1223-2/1123-2, Pass & Seymour's 20AC3, or Woodhead's 1993.
   3. 30A, 120/277 V ac; Bryant's 3003, Crouse-Hinds/AH's 3993, Leviton's 3033, or Pass & Seymour's 30AC3.

D. Dimmer Switches (Incandescent, 120 V ac):
   1. 600 Watts; Lutron's C-600.
   2. 1000 Watts; Lutron's C-1000
   3. 1500 Watts; Lutron's C-1500.
   4. 2000 Watts; Lutron's C-2000.

## 2.02 RECEPTACLES

A. Specification Grade Receptacles:
   1. Single receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Bryant's 5251, Crouse-Hinds/AH's 5251, Hubbell's 5251, Leviton's 5251, or Pass & Seymour's 5251.
   2. Duplex receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Bryant's 5252/5242, Crouse-Hinds/AH's 5252/5242, Hubbell's 5252/5242, Leviton's 5252/5242, Pass & Seymour's 5252/5242.
   3. Single receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5361/5351, Crouse-Hinds/AH's 5361/5351, Hubbell's 5361/5351, Leviton's 5361/5351, or Pass & Seymour's 5351.
   4. Duplex receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5362, Crouse-Hinds/AH's 5352/5342, Hubbell's 5352, Leviton's 5352, or Pass & Seymour's 5352.

B. Federal Spec./NEMA Grade Receptacles:
   1. Single receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Bryant's 5261, Crouse-Hinds/AH's 5261, Hubbell's 5261, Leviton's 5261, or Pass & Seymour's 5261.
   2. Duplex receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Bryant's 5262, Crouse-Hinds/AH's 5262, Hubbell's 5262, or Pass & Seymour's 5262.
   3. Single receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5361, Crouse-Hinds/AH's 5361, Hubbell's 5361, Leviton's 5361, or Pass & Seymour's 5361.
   4. Duplex receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5362, Crouse-Hinds/AH's 5739-S, Hubbell's 5362, Leviton's 5362, Pass & Seymour's 5362, or Daniel Woodhead's 5362 DW.

C. Ground Fault Interrupter Receptacles:
   1. Duplex receptacle rated 15A (NEMA 5-15R), circuit-ampacity 20A; Bryant's GFR52FT, Crouse-Hinds/AH's GF5242, Hubbell's GF5252, Leviton's 6599, Pass & Seymour's 1591S, or Daniel Woodheads 5252GF.
   2. Duplex receptacle rated 20A (NEMA 5-20R), circuit ampacity 20A; Bryant's GFR53FT, Crouse-Hind/AH's GF5342, Hubbell's GF 5352, Leviton's 6899, Pass & Seymour's 2091S, or Daniel Woodheads 5352GF.

D. Weather Resistant Ground Fault Interrupter Receptacles:
   1. Duplex receptacle rated 15A (NEMA 5-15R), circuit-ampacity 20A; Cooper's WRVGF15W or Leviton's 002-W7599-00W.
   2. Duplex receptacle rated 20A (NEMA 5-20R), circuit ampacity 20A; Cooper's WRVGF20W or Leviton's 002-W7899-00W.

E. Isolated Ground Receptacles:
   1. Single receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Bryant's 5261-IG, Crouse-Hinds/AH's IG5261, Hubbell's IG4710 &, Leviton's 5261-IG, or Pass & Seymour's IG5261.

2. Duplex receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Bryant's 5262-IG, Crouse-Hinds/AH's IG-5262, Hubbell's IG-5262, Leviton's 5262-IG, Pass & Seymour's IG-6200.
3. Single receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's _____, Crouse-Hinds/AH's _____, Hubbell's _____, Leviton's _____, or Pass & Seymour's _____.
4. Duplex receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's _____, Crouse-Hinds/AH's _____, Hubbell's _____, Leviton's _____, or Pass & Seymour's _____.

F. Corrosion Resistant Receptacles:
1. Duplex receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W): Bryant's 5262-CR, Crouse-Hinds/AH's 5262CR, Hubbell's 5262-ILH or Pass & Seymour's CR6200.

G. Special Purpose Receptacles: Furnish matching nylon, polycarbonate or armored plug with each receptacle. Furnish matching wall plate with each receptacle (.040" brass, Type 302 stainless steel, weatherproof, threaded box type, as required):
1. Type F, Dryer: NEMA 10-30R (3P, 3W, 30A, 125/250 V); Bryant's 9303, Crouse-Hinds/AH's 9344N, Hubbell's 9350, Leviton's 5207, or Pass & Seymour's 3860.
2. Type G, Oven Range: NEMA 10-50R (3P, 3W, 50A, 125/250 V); Bryant's 9306, Crouse-Hinds/AH's 7985N, Hubbell's 7962, Leviton's 5206GR, or Pass & Seymour's 3890.

## 2.03 WALL PLATES

A. Brass Wall Plates: .040 inch thick brass with brush brass finish; Bryant's 518 Series, Hubbell's B _____ Series or 94 _____ Series, Leviton's 81 _____ Series, or Pass & Seymour's B Series.

B. Stainless Steel Wall Plates: Type 302 stainless steel with satin finish; Bryant's 93 _____ Series, Crouse-Hinds/AH's 93 _____ Series, Hubbell's 93 _____ Series, Leviton's 910 _____ -40 Series, or Pass & Seymour's 93 _____ Series.

C. Chrome Wall Plates: .040 inch thick brass with polished chromium finish; Bryant's 54 _____.

D. Weatherproof Covers: Crouse-Hinds WLRS, WLRD, Hubbell's 52 _____, 74 _____ Series, or Pass & Seymour's 45 _____ Series.

E. Weatherproof While In Use Covers:
1. Polycarbonate: Cooper Crouse-Hinds TP7488W or Pass & Seymour's (Legrand) WIUC10C.
2. Metallic: Hubbell's WP826 or WP826H, Thomas and Betts' (Red Dot) CKMUV or CKMU, or Leviton's M5979-0GY or M5999-0GY

F. Covers for Threaded Type Boxes: Stamped sheet steel, gasketed device covers as produced by Crouse-Hinds Co., or OZ/Gedney Co.

## 2.04 NAMEPLATES

A. Phenolic Type: Standard phenolic nameplates with 3/16 inch minimum size lettering engraved thereon.

B. Embossed Aluminum: Standard stamped or embossed aluminum tags, 3/16 inch minimum size lettering, as produced by Seton Name Plate Corp. or Tech Products Inc.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Install wiring devices in outlet boxes.

B. Local Switches:
1. Install local switches rated 15A, 120/277 V ac for switches unless otherwise shown on the drawings or specified.
2. Install switches indicated Sa, Sb, Sc, etc, for control of outlets, with corresponding letters on the same circuit.
3. Where more than one switch occurs at same location in a 120 volt system, arrange switches in gangs and cover with one face plate.
4. Install switches in a 277 volt system in separate single boxes if voltage between exposed live metal parts of adjacent switches exceeds 300 volts.
5. Install single and double pole switches so that switch handle is up when switch is in the “On” position.
6. Install key operated switches where shown on the drawings.

C. Receptacles:
1. Install Specification Grade receptacles, NEMA 5-15R, 15A, 125 V, 2P, 3W, for duplex receptacles and single receptacles unless otherwise shown on the drawings or specified.
2. Install receptacles with ground pole in the down position.
3. Install Weather Resistant Ground Fault Interrupter Receptacles in wet and damp locations.

D. Wall Plates:
1. Install wall plates on all wiring devices in dry locations, with finish to match hardware in each area.
2. Install hospital wall plates on Type HG receptacles.
3. Install blank wall plates on outlet boxes which are for future equipment except telephone outlets.
4. Install 5/8 inch bushed wall plates on telephone outlets.

E. Weatherproof Covers: Install weatherproof covers on wiring devices in damp locations.

F. Weatherproof While In Use Covers: Install weatherproof while in use covers on wiring devices in wet locations.

G. Nameplates: Provide phenolic or embossed aluminum nameplate for each special purpose receptacle indicating phase, ampere and voltage rating of the circuit. Attach nameplate with rivets or tamperproof fasteners to wall plate or to wall above receptacle. Wall plates may be engraved with required data in lieu of separate nameplates.

H. Mats: Where flush plates are required over outlet boxes that cannot be set deep enough for the plates to fit closely over the finished wall surfaces, provide oak mats to fill the space between the finished wall surface and the plate.

**END OF SECTION**

## SECTION 265200

## EMERGENCY LIGHTING - UNIT EQUIPMENT

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Waiver of Submittals: The "Waiver of Certain Submittal Requirements" in Section 013300 does not apply to this Section.

B. Submittal Package: Submit the product data items specified below at the same time as a package.

C. Product Data:
1. Catalog sheets, specifications and installation instructions.
2. Battery warranty.
3. Name, address and telephone number of nearest fully equipped service organization.

D. Project Closeout Submittals:
1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director's Representative. Include name, address and telephone number of the nearest fully equipped service organization.

### 1.02 QUALITY ASSURANCE

A. List of Completed Installations: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for 3 years.

B. Service Availability: A fully equipped service organization shall be available to service the completed Work.

## PART 2 PRODUCTS

### 2.01 EMERGENCY LIGHTING UNITS

A. Type LA: Dual-Lite Co.'s AS-BC, Emergi-Lite's ILC Series, or Exide Electronics' Emergency Lighting L-100, with:
1. Six volt maintenance free battery (sealed lead-calcium free electrolyte or sealed pure lead cells); Eagle-Picher Industries Inc.'s Carefree/Carefree Magnum, Exide's LEC, or Gates Energy Products Inc's BC Cell. Batteries shall be of suitable rating and capacity to supply and maintain at not less than 87-1/2 percent of the nominal battery voltage for the total lamp load associated with the unit for a period of at least 1-1/2 hours. Exception: Capacity not less than 24Ah at 77 degrees F (25 degrees C),

8 hour rate, to 87-1/2 percent nominal battery voltage (1.75 volts per cell).

2. Low battery voltage cut-off (not less than 80 percent of nominal battery voltage).
3. Electronic or sealed dust-tight transfer relay.
4. Six volt, 12 watt integral tungsten halogen lighting heads.
5. Input circuit suitable for operation on 120 volt, 60 Hz circuit.
6. Cabinet door having vandal resistant fasteners or lockable device and continuous piano hinge.
7. Voltmeter to indicate battery voltage.
8. Mounting shelf or bracket.
9. Time delay device for units installed in areas illuminated with high intensity discharge lighting fixtures. Emergency lighting units shall remain illuminated 15 minutes after normal power is restored.
10. Wire guard to cover unit, where indicated on drawings.

## 2.02 REMOTE LIGHTING FIXTURES

A. Six volt, 12 watt tungsten halogen lighting fixtures with mounting accessories; Dual-Lite Co.'s EXT-P5SB-T, Emergi-Lite's EF-18, or Exide Electronic's Emergency Lighting Model H.

# PART 3 EXECUTION

## 3.01 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed instructions.

B. Insert a copy of the battery warranty in each unit and mark on batteries the date placed in service.

**END OF SECTION**

## SECTION 265300

## EXIT LIGHT FIXTURES

## PART 1 GENERAL

### 1.01 SUBMITTALS

A. Waiver of Submittals: The "Waiver of Certain Submittals Requirements" in Section 013300 does not apply to this Section.

B. Product Data: Catalog sheets, specifications and installation instructions.

C. Samples: One of each product if different from Company or catalog number specified.

### 1.02 QUALITY ASSURANCE

A. List of Installations: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for one year.

### 1.03 MAINTENANCE

A. Special Tools: Furnish 2 tools to remove and install fasteners on fixtures equipped with vandal resistant fasteners.

## PART 2 PRODUCTS

### 2.01 EXIT LIGHT FIXTURES

A. Type XL: Exitronix's Series 600, Siltron Illumination Inc.'s VX series, or Cooper Lighting Company's EXL series, having:
   1. Bronze finish.
   2. Directional arrows where indicated on drawings.
   3. Red light emitting diodes (L.E.D.s) with protective polycarbonate clear lens to protect L.E.D.s. Fixtures shall not contain optical or light diffusing panels.
   4. Downlight (except recessed fixtures).
   5. Vandal resistant fasteners.
   6. Mounting designed for:
      XL1 - Wall, recessed.
      XL2 - Wall, surface.
      XL3 - Wall, extended (end mount), single face.
      XL4 - Ceiling, single face.
      XL5 - Stem (to mount fixture 8 feet AFF), single face.
      XL6 - Wall, extended (end mount), double face.
      XL7 - Ceiling, double face.
      XL8 - Stem (to mount fixture 8 feet AFF),double face.

B. Type XLE: Exitronix's Series 600, Siltron Illumination Inc.'s VX series, or Cooper Lighting Company's EXL series, having:
   1. Bronze finish.
   2. Directional arrows where indicated on drawings.
   3. Red light emitting diodes (L.E.D.s) with protective polycarbonate clear lens to protect L.E.D.s. Fixtures shall not contain optical or light diffusing panels.
   4. Downlight (except recessed fixtures).
   5. Nickel cadmium or lead acid battery pack which illuminates L.E.D lamps upon failure of normal source and maintains not less than 60 percent of the initial emergency illumination for a period of at least 1-1/2 hours.
   6. Vandal resistant fastener.
   7. Mounting designed for:
      XLE1 - Wall, recessed.
      XLE2 - Wall, surface.
      XLE3 - Wall, extended (end mount), single face.
      XLE4 - Ceiling, single face.
      XLE5 - Stem (to mount fixture 8 feet AFF), single face.
      XLE6 - Wall, extended (end mount), double face.
      XLE7 - Ceiling, double face.
      XLE8 - Stem (to mount fixture 8 feet AFF), double face.

C. Type XEVR: Kenall Mfg. Co.'s MMEX Series, L.C. Doan Co.'s XTL Series having:
   1. Red light emitting diodes (L.E.D.s) with protective polycarbonate clear lens to protect L.E.D.s. Fixtures shall not contain optical or light diffusing panels.
   2. Battery pack which illuminates LED lamp upon failure of normal source and maintains not less than 60 percent of the initial emergency illumination for a period of at least l-l/2 hours.
   3. Directional arrows where indicated on drawings.
   4. Vandal resistant fasteners.
   5. Gasket.
      XEVR 2 - Wall, surface.
      XEVR 3 - Wall, extended (end mount), single face.
      XEVR 4 - Ceiling, single face.
      XEVR 6 - Wall, extended (end mount), double face.
      XEVR 7 - Ceiling, double face.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed instructions.

**END OF SECTION**

## SECTION 283101

## PROTECTED PREMISES FIRE ALARM SYSTEM

### PART 1 GENERAL

### 1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Video Training Programs: Section 017900.

### 1.02 REFERENCES

A. Underwriters Laboratories Inc.

B. National Fire Protection Association Standard 72 and 13.

### 1.03 DEFINITIONS

A. Initiating Device Circuit: A circuit to which automatic or manual initiating devices are connected where the signal received does not identify the individual device operated. Example:
   1. Circuits from FACP to non-addressable signal initiating devices.

B. Notification Appliance Circuit: A circuit or path directly connected to a notification appliance. Example:
   1. Circuits from FACP to notification appliances.

C. Signaling Line Circuit: A circuit or path between any combination of circuit interfaces, control units, or transmitters over which multiple system input signals or output signals, or both are carried. Examples:
   1. Circuits between FACP's.
   2. Circuits from FACP to addressable devices.

D. Operating Mode:
   1. Private Mode:
      a. Audible and visible signaling only to those persons directly concerned with the implementation and direction of emergency action initiation and procedure in the area protected by the fire alarm system, and:
      b. Audible and visible signaling only to those persons within special designated areas where private mode operation is specified to be applicable.
   2. Public Mode: Audible and visible signaling to occupants or inhabitants of the area protected by the fire alarm system.

### 1.04 SYSTEM DESCRIPTION

A. The system operates as a multiplexed protected premises fire alarm monitoring and control system.

1. In Building With One Fire Alarm Control Panel: Changes in the status of monitored points are indicated at the microprocessor based main fire alarm control panel (MFACP).
    a. The MFACP continually monitors the communications and data processing cycles of the micro-processor. Upon MFACP failure, an audible and visible alarm activates at the MFACP.
2. Smoke detectors and smoke sensors operate in conjunction with the systems' alarm verification program.
    a. The alarm verification operation is selectable by zone for smoke detectors and by individual devices for smoke sensors.
    b. The activation of any smoke detector within its zone initiates the alarm verification program.
        1) The panel resets the activated detector and waits for a second alarm activation. If within one minute a second alarm is reported from any detector within the zone, the system alarms. If no second alarm within one minute, the system resumes normal operation.
    c. The system can display the number of times (tally) a smoke detector zone or smoke sensor has gone into a verification mode. A trouble condition occurs when the tally reaches a pre-programmed number.
4. Smoke sensors act as intelligent and addressable devices. The smoke sensor converts the condition of its smoke sensing chamber to an analog value. This analog value is digitized and transmitted to the FACP(s).
    a. Actual smoke density and temperature measurements are referenced from average sample measurements and are compared to programmable values of threshold sensitivity.
    b. Sensor "dirty" and "excessively dirty" trouble conditions are reported automatically through a maintenance advisory and alert program procedure.
    c. The system continuously performs an automatic self-test routine on each sensor that checks sensor electronics to ensure the accuracy of the values being transmitted to the FACP(s). Sensors that fail are identified and indicate a trouble condition.
    d. System automatically performs NFPA 72 sensor sensitivity testing by:
        1) Frequent routine individual sensor alarm simulation testing.
        2) Trouble signal when sensor is outside its acceptable sensitivity range.
5. System individually identifies each addressable initiating device and other addressable monitor functions using multiplexing techniques.
6. System is capable of individually operating each alarm notification appliance, and other control functions, using multiplexing techniques.
7. Alarms are processed by the system at 3 levels of priority:
    a. Fire alarms, supervisory, and trouble signals take precedence in that respective order of priority, over all other signals.
    b. Other alarms that require interaction by the attendant have the second level of priority.

c. Monitored points that do not require interaction by the attendant are the third level of priority.

8. Alarms, supervisory signals, and trouble signals are distinctively and descriptively annunciated.
   a. Fire alarm signals are distinctive in sound from other signals, and this sound is not used for any other purpose.
   b. Supervisory signals are distinctive in sound from other signals.
      1) System differentiates between supervisory device activation and trouble (wiring faults) on independent supervisory service initiating circuits.
   c. Trouble signals are indicated by distinctive audible signals. Exception: The same sound may be used for both supervisory signal and trouble signal if distinction is made between signals by visible annunciation.

9. Switches for silencing audible trouble and supervisory signals transfers the audible signal to an identified lamp or other visible indicator adjacent to the switches. The visible indication persists until the condition has been corrected. The audible signal sounds when the switch is in its silence position and no trouble or supervisory condition exists.
   a. Trouble silencing switch does not prevent sounding of supervisory signal. Subsequent supervisory signals from other zones causes the supervisory signal to resound. A switch left in the silence position where there is no supervisory off-normal signal operates a visible signal silence indicator and causes the trouble signal to sound until the switch is returned to normal.
   b. A silenced audible trouble signal resounds at programmable time intervals (every 24 hours or less) as a reminder that the trouble condition has not been corrected. Re-sounded signal is retransmitted to all locations required of the original trouble signal.

10. System visible and audible trouble signals and supervisory signals and visible indication of their restoration is indicated at the MFACP.
    a. Monitoring of ground fault conditions indicate a ground fault trouble condition at the MFACP.

11. Access to the system functions are controlled thru at least 3 levels of access security to prevent program modifications or use by unauthorized personnel:
    a. At the lowest level of access the system automatically receives, displays and prints alarms, and performs control-by-event life safety functions. The attendant has minimum access to the system functions:
       1) Alarm acknowledge.
       2) Silence alarms.
       3) Perform other basic system functions that require interaction by the attendant (cannot change program parameters).
    b. At mid-level of access, the attendant may change user programmable parameters and print all summaries.

c. At the highest level of access, programs may be modified by the system manager (life safety control-by-event programs may be field or factory modified).

12. Summary reports are displayed at the MFACP upon appropriate function command. Active control points are identified by an assigned message. Spare control points are identified by a point number. The summary reports can be interrupted and terminated and the system returned to normal operation by a manual reset control or automatically if the system senses a change of status signal. The summary reports include:
    a. Current Alarm, Trouble, and Supervisory Conditions: Lists all points not in normal state (print and display).
    b. Alarm historical log report.
    c. Trouble and supervisory historical log report.
    d. All Points: Lists every point in the system and current status of the point.
    e. Control by Event Programs: Lists data for event initiated programs.
    f. Control by Time Programs: Lists data for time initiated programs.
    g. Diagnostics:
        1) Alarm verification cycles initiated by a smoke detector zone or individual smoke sensors.
        2) Smoke sensor service report: Device number, device type, custom label, presently selected alarm set point information, present average value, present value, peak observed values, service status.
        3) Smoke sensor status report: Device number, device type, custom label, present sensitivity in % for smoke sensors and in degrees for temperature sensors, present status, and sensor range (normal, almost dirty, dirty).
        4) Devices that fail automatic tests.
        5) Walk test reports.
13. Life safety control-by-event functions are retained in a non-volatile programmable memory and are not alterable through normal operation of the system.
    a. The life safety control-by-event control points may be manually operated at any time by authorized personnel thru appropriate system commands.
14. User programmable control-by-event functions may be programmed thru appropriate system commands to automatically activate any user programmable control point upon a status change from any programmable monitor point.
    a. The user programmable control-by-event control points may be manually operated at any time by the authorized personnel thru appropriate system commands.
15. User programmable parameters for automatic time-initiated functions (start/stop, on/off, secure/access, etc.) may be added, omitted and altered thru appropriate system commands.

a. The time-initiated user programmable control points may be manually operated at any time by authorized personnel thru appropriate system commands.

16. Touchscreen and mouse commands:
    a. Personnel having the proper system level of access may program and modify all system functions and parameters thru use of touchscreen commands, and mouse “point and click” commands in addition to keyboard commands.
    b. Life safety control-by-event control points, user programmable control-by-event functions, and user programmable automatic time initiated functions in addition to keyboard commands, may also be operated manually thru touchscreen commands and mouse “point and click” commands.
    c. Summary reports, in addition to keyboard commands, may also be displayed and printed thru touchscreen commands and mouse “point and click” commands.
17. An attendant at a remote IBM compatible personal computer may dial in over a telephone line to access the system data. The attendant has minimum access to the following system summary reports:
    a. Standby battery and UPS condition summary.
    b. Alarm summary.
    c. Supervisory signal summary.
    d. Trouble condition summary.
    e. Control-by-event summary.
    f. Programmable automatic time initiated-event summary.
18. One person may test the system (walk test).
    a. When in testing mode:
        1) Alarm activation of an initiating device circuit is silently logged as an alarm condition in the historical data file. The system automatically resets after logging each alarm.
        2) The momentary disconnection of an initiating device or notification appliance circuit is silently logged as a trouble condition in the historical data file. The system automatically resets after logging each trouble condition.
        3) The person testing the system may also choose to have the system activate the alarm notification appliances for a maximum of two seconds upon initiating device testing and a maximum of four seconds upon trouble condition testing.
        4) If in the test mode for an inappropriate (programmable) amount of time, the system automatically reverts to normal mode.
        5) The municipal or remote station connection is bypassed.
        6) The system shows a trouble condition.
        7) Control relay functions are bypassed.
    b. Testing groups allow portions of the system to be placed in test mode while the non-test groups remain in normal mode.

B. The MFACP activates immediately and performs its alarm functions upon receipt of system alarm condition thru actuation of automatic or manual initiating devices:
   1. The MFACP sounds its audible alarm and illuminates its system alarm lamp or flashing display.
      a. The audible alarm pulses until the system acknowledge button is depressed.
      b. The system alarm lamp remains illuminated until the alarm condition has been corrected and the system reset.
   2. The MFACP displays the point and type of alarm condition. Addressable devices are individually identified. Groups of non-addressable devices are identified by zones.
   3. An authorized person at the MFACP presses the acknowledge button which silences its audible alarm and causes a print-out and display of the assigned message for the point in alarm with date, time and an acknowledge prefix.

C. Life Safety Control-By-Event Functions: The MFACP and ICU's immediately performs life safety control-by-event functions upon system alarm condition:
   1. Building manager alarm annunciators are activated in supervisor's office, and mechanical equipment rooms, drawing attention to the alarm condition.
   2. Private mode audible signals have a sound level of not less than 45 dBA at 10 Feet, or more than 120 dBA at the minimum hearing distance from the audible appliance. Also, the audible signal has a sound level at least 10 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 feet above the floor in the occupiable area.
   3. Private mode audible signals in mechanical equipment rooms sound have a sound level of not less than 100 dBA at 10 feet, nor more than 120 dBA at the minimum hearing distance from the audible appliance. Also, the audible signal has a sound level at least 10 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds, whichever is greater, measured 5 feet above the floor.
   4. Public mode audible notification appliances sound an ANSI S3.41 evacuation signal throughout the building.
   5. Audible alarm notification appliances sound a public mode ANSI S3.41 evacuation signal in the alarm signal initiation zone and other zones in accordance with the buildings fire evacuation plan. Evacuation signal is synchronized within each notification zone.
   6. Public mode audible alarm signals have a sound level of not less than 75 dBA at 10 feet nor more than 120 dBA at the minimum hearing distance from the audible appliance. Also, the audible signal has a sound level at least 15 dBA above the average ambient sound level or 5 dBA above the maximum sound level having a duration of at least 60 seconds (whichever is greater) measured 5 feet above the floor in each occupiable area.
   7. The system allows an authorized person to:

a. Silence any alarm signal in progress through a silence command, but subsequent actuation of initiating devices on other initiating device circuits or subsequent actuation of addressable initiating devices on signaling line circuits causes the system to resound the alarm.
    1) Silencing of an audible alarm does not cancel any visible zone alarm indicators.
    2) A silencing means that it is left in the "off" position when there is no alarm operates an audible trouble signal until the means is restored to normal.
b. Activate the alarm notification appliances on selected floors, and all floors.
    1) Visible indicators in the RA/CC at the MFACP indicate on/off status of the alarm notification appliances.

8. Alarm signal does not sound in stairwells.
9. Actuation of smoke detecting devices in stairwells, do not sound the alarm signal, but activates all other system alarm functions.
10. Public and private mode visible alarm notification appliances illuminate and flash a fire warning signal.
    a. Public mode flash rate does not exceed 2 flashes per second, nor less than one flash every second throughout the listed voltage range of the appliance.
        1) The maximum pulse duration is 0.2 seconds with a maximum duty cycle of 40 percent. The pulse duration is defined as the time interval between initial and final points of 10 percent of maximum signal.
        2) The light source is clear or nominal white and does not exceed 1000 candela (effective intensity).
    b. All strobes are synchronized to flash simultaneously to reduce the probability of photo-sensitive reactions.
    c. Visible alarms continue to flash until the initiating devices are restored to normal condition and the system is manually reset.
11. Electromagnetic door hold-open devices de-energize, allowing the associated smoke doors to close.
12. Locked doors for re-entry from exit stairwells, exit doors, and emergency exits release their fail safe door lock mechanisms so that associated doors may be opened.
13. Smoke detectors listed for use in air distribution systems and located as indicated below, automatically stop their respective fan(s) on detecting the presence of smoke:
    a. Downstream of the air filters and ahead of any branch connections in air supply systems having a capacity greater than 2000 ft.$^3$/min.
    b. At each story prior to the connection to a common return and prior to any recirculation or fresh air inlet connection in air return systems having a capacity greater than 15,000 ft.$^3$/min. and serving more than one story.

14. Safety controls operate for every system using recirculated air and serving an area of public assembly, or more than one fire area, or more than one story of a building:
    a. When the air in the system contains smoke of predetermined intensity or has an abnormal rise in temperature, the fans causing normal circulation in such area stops and requires manual reset at the fire alarm control panel.
15. Automatic devices for systems ventilating high hazard spaces stop the fans when the air in the system contains smoke of a predetermined quantity or has an abnormal rise in temperature. Controls require manual reset.
16. Fire dampers and smoke dampers close.
    a. Actuation of air duct smoke detecting devices used solely for the closing of dampers sounds the alarm signal and activates all other MFACP alarm functions.
    b. Attendant at the MFACP may manually position the smoke dampers.
    c. Smoke dampers that isolate the air-handling system close automatically when the system is not in operation.
    d. Smoke dampers installed in smoke barriers may remain open during fan shutdown provided that their associated controlling damper actuators and smoke detecting devices remain operational. Dampers close automatically when the fan system they are serving is not in operation.
17. Emergency lighting energizes.

D. An authorized person manually resets the system at the MFACP at conclusion of alarm condition. When an alarm condition is corrected, a print-out and display occurs at the MFACP stating the assigned reset message for the point in alarm with the date, time and reset suffix.
    1. Manually resetting the system requires only one operation.
    2. Resetting the system does not disturb system control points or functions.

E. Primary and Secondary Power Supplies:
    1. Failure of primary power supplies automatically transfers the affected portions of the system to the secondary power supplies:
        a. Initiating, notification, print recording/printer, visible indication and supervisory functions of the system are transferred without loss to the secondary power supplies.
            1) Ground fault indication, and battery trouble conditions, are not required to transfer to the secondary power supplies.
        b. System power requirements are transferred to the secondary power supplies except door hold open devices, door lock releases, controls for selected HVAC equipment, fire dampers, and smoke dampers.
        c. Audible and visible indication of alarm condition when operating system on secondary power supply is:
            1) Sounding of the MFACP's audible alarm.

2) Illumination of the MFACP's system alarm lamp or flashing display.
3) Display assigned message on the MFACP.

2. Utilizing the secondary battery power supplies, the system operates under maximum normal load conditions for 24 hours and then is capable of operating all alarm notification appliances used for evacuation for 5 minutes.
   a. At the end of the time period the secondary battery power supplies also have capacity to operate the rolling fire shutter, fire door and heat and smoke roof vent emergency electric release devices.
      1) The maximum power required to operate each heat and smoke roof vent emergency electric release device is 2.5 amperes at 24Vdc for 1 minute.
   b. The secondary supply, in addition to the battery standby power supplies, also includes connection to an automatic starting diesel-alternator system that will operate the system for 24 hours.
3. Upon restoration of primary power supply, the system reverts to normal operation without loss, attendant intervention, or manual re-start procedures.

F. Monitoring Integrity of Installation Conductors and Other Signaling Channels:
1. Performance of Signaling Line Circuits:
   a. Circuits from MFACP to ICU's: NFPA 72, Class A, Style 7. A display occurs to identify trouble conditions.
   b. Circuits from MFACP and ICU's to Addressable Devices: NFPA 72, Class B, Style 4. A display occurs to identify trouble conditions.
   c. Modem Unit Signaling Line Circuits from MFACP to ICU's: NFPA 72, Class B, Style 1. A display occurs to identify trouble conditions.
2. Performance of Initiating Device Circuits:
   a. Circuits from MFACP and ICU's to Initiating Devices (Fire Alarm, Sprinkler): NFPA 72, Class B, Style C. A display occurs to identify trouble conditions.
3. Performance of Notification Appliance Circuits:
   a. Circuits from MFACP and ICU's to Notification Appliances: NFPA 72, Class B, Style Y. A print-out and display occurs to identify trouble conditions.
4. Monitoring Integrity of Power Supplies:
   a. Primary and secondary power supplies are monitored for presence of voltage at the point of connection to the system. Failure of either supply results in a system trouble condition.
   b. An audible and visible alarm, display and print-out indicates failure of the primary (main) power supplies, within the system, at the MFACP.
   c. The system also monitors the secondary (battery) power supplies for battery trouble conditions (low voltage/no batteries, high current and charging current).

G. Interconnection of Fire Safety Control Functions:
   1. A listed relay or other listed appliance connected to the fire alarm system is used to initiate control of protected premises fire safety functions and is located within 3 feet of the controlled circuit or appliance.
      a. The installation wiring between the fire alarm control unit and the relay or other appliance is monitored for integrity.
      b. Relays and appliances that operate on loss of power are considered self-monitoring for integrity.
   2. The method(s) of interconnection between the fire alarm system and controlled electrical and mechanical systems is monitored for integrity and is achieved by one of the following recognized means:
      a. Electrical contacts listed for the connected load.
      b. Listed digital data interfaces such as serial communication parts and gateways.
      c. Other listed methods.
   3. Fire safety functions do not interfere with other operations of the fire alarm system.
      a. Fire safety function control devices and gateways are listed as compatible with the fire alarm control unit so as to prevent interference with control unit operation caused by controlled devices and to ensure transmission of data to operate the controlled devices.
   4. Controls provided specifically for the purpose of manually overriding automatic fire safety functions provide visible indication of the status of the associated control circuits.
      a. Status indicators for emergency equipment and fire safety functions are arranged to reflect the actual status of the associated equipment or function.
   5. Where the fire alarm system is a component of a life safety network, and it communicates data to other systems providing life safety functions:
      a. The path for communicating data is monitored for integrity, including the physical communication media and the ability to maintain intelligible communications.
      b. Data received from the network does not affect the operation of the fire alarm system in any way other than to display the status of life safety network components.
      c. Where non-fire alarm systems are interconnected to the fire alarm system using a network or other digital communication techniques; a signal (for example, heartbeat, poll, ping, query) is generated between the fire alarm system and the non-fire alarm system. Failure of proper receipt by the fire alarm system of confirmation of the transmission indicates a trouble condition.

H. Sprinkler System Alarm and Supervision:
   1. Flow of water through a waterflow fire alarm switch causes a system alarm.
   2. Supervision of sprinkler system signal attachments (sprinkler valve supervisory switches, pressure switches, etc.) are arranged to indicate

circuit trouble and supervisory signal conditions at the MFACP for each circuit.

a. Removal of covers from water flow alarm switches indicates trouble conditions at the MFACP.

3. Control valves in the sprinkler system are supervised to initiate 2 separate and distinct signals at the MFACP, indicating movement of the valve from its normal position.

a. The off-normal signal is initiated during the first 2 revolutions of a hand wheel or during 1/5 of the travel distance of the valve control apparatus from its normal position.

b. The second signal indicates restoration of the valve to its normal position. (The off-normal signal remains until the valve is restored to its normal position).

I. Supervision of Pressure Sources Associated with Fire Suppression Systems:

1. Pressure sources are supervised to initiate two separate and distinct signals, one indicating that the required pressure has been increased or decreased, and the other indicating restoration of the pressure to its required value.

a. A pressure supervisory signal initiating device for a pressurized limited water supply, such as a pressure tank, indicates both high and low pressure conditions. A signal is obtained where the required pressure is increased or decreased 10 psi from the required pressure value.

b. A pressure supervisory signal initiating device for dry-pipe sprinkler system indicates both high and low pressure conditions. A signal is obtained when the required pressure is increased or decreased 10 psi from the required pressure value.

c. A pressure supervisory switch for non-interlock or double interlock preaction sprinkler system initiates a signal when the pressure is not maintained at 7 psi.

d. A steam pressure supervisory initiating device indicates a low pressure condition. A signal is obtained where the pressure is reduced to a value that is 110 percent of the minimum operating pressure of the steam operated equipment supplied.

J. Supervision of Water Levels Associated with Fire Suppression Systems:

1. Water storage containers associated with fire suppression systems are supervised to obtain two separate and distinct signals, one indicating that the required water level has been lowered or raised and the other indicating restoration:

a. A pressure tank supervisory initiating device detects both high and low water level conditions. A signal is initiated when the water level falls 3 inches or rises 3 inches.

b. A supervisory signal initiating device for other than pressure tanks initiates low-water level when the level falls 12 inches.

2. Water storage containers are supervised to initiate 2 separate and distinctive signals, one indicating that the temperature of the water has decreased to 40 degrees F, and the other indicating restoration to a temperature above 40 degrees F.

K. Supervision of Electric Motor Driven Centrifugal Fire Pumps:
   1. Activation of contacts in the fire pump controller in Fire Pump Room are indicated by an audible signal at the MFACP and a visible indicator in the RA/CC. Separate indication for each of the following conditions:
      a. Main power source available visible indicator (visible indicator, constantly illuminated, demonstrating that operating voltage is available to the contactor coil).
      b. Controller connected to alternate source (controller has been transferred to the alternate source, alternate source supplying power to the controller).
      c. Disconnecting means is open.
      d. Loss of alarm power sources.
      e. Controller has operated into a motor running condition (fire pump running).
      f. Loss of line power on line side of fire pump controller, in any phase (all phases monitored).
      g. Phase reversal on line side of fire pump controller.
      h. Automatic transfer switch isolating switch open.
   2. Switch at MFACP allows attendant to start fire pump for non-automatic continuous operation independent of the pressure-actuated switch. Remote station switch cannot stop the fire pump.

L. Supervision of All Fire Suppression Systems for Tampering:
   1. In addition to the specific supervision functions of each fire suppression system, each system also indicates trouble condition at the MFACP whenever components of the system are tampered with, opened or removed, including:
      a. Removal of covers from junction boxes on the outside of buildings.
      b. Valves installed in the connection between a signal attachment and the fire suppression system to which it is attached.
      c. Operation of disconnect switches that are used to allow system testing without activating the fire suppression system.

## 1.05 SUBMITTALS

A. Waiver of Submittals: The "Waiver of Certain Submittal Requirements" in Section 013300 does not apply to this Section.

B. Preliminary Submittal: Existing system test report.

C. Submittals Package: Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.
   1. Company Field Advisor Letter: With the submittals package include a letter from the Company Field Advisor stating that he/she has reviewed the Submittals Package for accuracy and completeness, and approves all materials and installation methods included in the Submittals Package.

D. Shop Drawings:

1. Composite wiring and/or schematic diagrams of the complete system as proposed to be installed (standard diagrams will not be acceptable).
    a. Indicate circuits which are power-limited if power-limited wiring is proposed for use.
    b. For 2-hour fire rated cable assemblies show proposed routes and installation details (include UL classification data, listing and system number).
    c. Include transient surge and lightning protection grounding details for signaling line circuits, initiating device circuits, and ac power conductors entering and leaving each fire alarm control panel.

E. Product Data:
1. Catalog sheets, specifications and installation instructions.
2. Bill of materials.
3. Detailed description of system operation. Format similar to SYSTEM DESCRIPTION.
4. Sample procedure, programming and print-out for alarm, acknowledgment, and system reset.
5. Total electrical load of the complete system in supervisory and alarm conditions.
    a. Include for each system component that utilizes batteries the battery ampere-hour capacity recommended for each component by the Company producing the system, for the specified duration.
6. Statement from the Company producing the system, for each size and type of single conductor and multiconductor cable proposed for use, indicating that the electrical characteristics meet the requirements of the Company.
7. Data from the Company furnishing the products, proving that detection devices that receive their power from the initiating device circuit or a signaling line circuit of a fire alarm control unit are UL listed for use with the control unit.
    a. Submit copy of the control unit “Installation Manual Wiring Diagrams” that were a part of the UL “UOJZ” approval process showing that the proposed products, circuits, and wiring diagrams are UL listed “Control Units System (UOJZ)” for use with the control panel.
    b. Submit data proving that the software and firmware is listed for use with the control panel.
    c. Submit data proving that the initiating devices are listed for the intended application.
    d. Submit data proving that relays and appliances connected to the fire alarm system, which are used to initiate control of fire safety functions, are listed for the purpose.
    e. Submit data proving that the method(s) of monitoring the connection between the fire alarm system and controlled electrical and mechanical systems for integrity are listed for the purpose.
8. Detailed description of procedure proposed to test individual initiating devices.

a. Include product information pertaining to the test equipment that will be used to perform the tests.
b. Include certified statement that the proposed test method meets the test requirements of NFPA 72 and UL 268 (cite reference to the applicable NFPA and UL paragraphs).

9. Name, address and telephone number of nearest fully equipped service organization.
   a. Include list of service technicians who are NICET Level II or higher Fire Alarm Systems certified.
10. State grade and number of leased telephone lines required for use with modem units.

F. Quality Control Submittals:
1. Copy of license required by New York State General Business Law Article 6-D for installing Fire Alarm Systems.
   a. Also include copy of identification card issued by the Licensee for each person who will be performing the Work.
2. Company Field Advisor Data: Include:
   a. Name, business address and telephone number of Company Field Advisor secured for the required services.
   b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
   c. Copy of NICET Letter of Approval indicating Level III or higher Fire Alarm Systems certification.
   d. Services and each product for which authorization is given by the Company, listed specifically for this project.

G. Contract Closeout Submittals:
1. System acceptance test report.
2. Certificates:
   a. Affidavit, signed by the Company Field Advisor and notarized, certifying that the system meets the contract requirements and is operating properly.
   b. NFPA Record of Completion (NFPA 72 Figure 1-6.2.1).
3. Operation and Maintenance Data:
   a. Deliver 2 copies, covering the installed products, to the Director's Representative. Include:
      1) Operation and maintenance data for each product.
      2) Complete point to point wiring diagrams of entire system as installed. Identify all conductors and show all terminations and splices. (Identification shall correspond to markers installed on each conductor.)
      3) Name, address, and telephone number of nearest fully equipped service organization.
      4) A suggested maintenance and testing program that will insure operational integrity of the smoke control functions of the system.

## 1.06 QUALITY ASSURANCE

A. Equipment Qualifications For Products Other Than Those Specified:
   1. At the time of submission provide written notice to the Director of the intent to propose an “or equal” for products other than those specified. Make the “or equal” submission in a timely manner to allow the Director sufficient time to review the proposed product, perform inspections and witness test demonstrations.
   2. If products other than those specified are proposed for use furnish the name, address, and telephone numbers of at least 5 comparable installations that can prove the proposed products have performed satisfactorily for 3 years. Certify in writing that the owners of the 5 comparable installations will allow inspection of their installation by the Director's Representative and the Company Field Advisor.
      a. Make arrangements with the owners of 2 installations (selected by the Director) for inspection of the installations by the Director's Representative. Also obtain the services of the Company Field Advisor for the proposed products to be present. Notify the Director a minimum of 3 weeks prior to the availability of the installations for the inspection, and provide at least one alternative date for each inspection.
      b. Only references from the actual owner or owner’s representative (Security Supervisor, Maintenance Supervisor, etc.) will be accepted. References from dealers, system installers or others, who are not the actual owners of the proposed products, are not acceptable.
         1) Verify the accuracy of all references submitted prior to submission and certify in writing that the accuracy of the information has been confirmed.
   3. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.
      a. Make arrangements with the test facility for the Director's Representative to witness test demonstrations. Also obtain the services of the Company Field Advisor for the proposed product to be present at the test facility. Notify the Director a minimum of 3 weeks prior to the availability of the test facility, and provide at least one alternative date for the testing.
   4. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.

B. UL Listing: The system shall be listed in the UL Fire Protection Equipment Directory under product category “Control Units System (UOJZ)”.

C. Test Facility: The Company producing the system shall have test facilities available that can demonstrate that the proposed system meets contract requirements.

D. Company Field Advisor: Company Field Advisor shall be National Institute for Certification in Engineering Technologies (NICET) certified as Level III or higher Fire Alarm Protection/Fire Alarm Systems Engineering Technician.

1. Secure the services of a Company Field Advisor for a minimum of 40 working hours at the contract site for the following:
    a. Render advice regarding installation and final adjustment of the system.
    b. Assist in initial programming of the system.
    c. Render advice on the suitability of each signal initiating device for its particular application.
    d. Witness final system test and then certify with an affidavit that the system is installed in accordance with the contract documents and is operating properly.
    e. Train facility personnel on the operation, programming and maintenance of the system (minimum of two 3-hour sessions).
    f. Explain available service programs to facility supervisory personnel for their consideration.

E. Company Field Advisor (Existing Sub-Systems): Secure the services of a Company Field Advisor from the Company of each existing sub-system for a minimum of 8 working hours at the contract site for the following:
1. Render advice and witness test of existing sub-systems.
2. Render advice on the interconnection of existing sub-systems with the new system.
3. Witness the final test of the combined new system and existing sub-systems.

## 1.07 MAINTENANCE

A. Service Availability: A fully equipped service organization capable of guaranteeing response time within 8 hours to service calls shall be available 24 hours a day, 7 days a week to service the completed Work.
1. Service organization personnel shall include service technicians who are National Institute for Certification in Engineering Technologies (NICET) certified as Level II or higher Fire Alarm Protection/Fire Alarm System Engineering Technician.

B. Spare Parts:
1. 50 percent spare of each type fuse.
2. 30 percent spare of each type lamp (except LED type).
3. 10 percent spare of each type initiating device.
4. 10 percent spare of each type notification appliance.
5. 10 percent spare of each type protective device.

# PART 2 PRODUCTS

## 2.01 PEER-TO-PEER NETWORK

A. Network: Edwards' Systems Technology's (Unit of GS Building Systems Corp.) EST-2, EST-3, Notifier Fire Systems Noti(Fire(Net, or Simplex Time Recorder Co. 4120:

1. Equip the fire alarm control panels and other network devices with network interface modules able to function with the type of wiring specified for the network communication bus signaling line circuit.

B. Fire Alarm Control Panels: Edwards EST-2, EST-3, Notifier's AFP-200, AFP-300, AFP-400, AFP-1010, AM2020, Simplex's 4120, 4100, 4020, 4010:
   1. Base selection of each fire alarm control panel upon its capacity and capabilities to the specific requirements of the system at the panels' location.
   2. Permanently record the installed software and firmware version number within each fire alarm control panel.
   3. 14 gage metal cabinet. Size as recommended by the Company producing the system.
      a. Control switches, inaccessible behind hinged and locked door.
      b. Alarm display and lamps visible when door is closed.
   4. Annunciator (or display) that individually identifies addressable devices and identifies groups of non-addressable devices by zones.
   5. Do not load visible alarm appliance circuit outputs to more than 70 percent of the FACP's power limited rating.
   6. Input circuits suitable for operation on 120Vac primary (main) power supply and 24 Vdc secondary (battery) power supply.
   7. 24 Vdc Secondary (Battery) Power Supplies: Sealed, lead-acid gelled electrolyte or maintenance free lead-calcium batteries:
      a. Ampere-hour capacity to operate under load conditions specified in SYSTEM DESCRIPTION.
      b. Battery charger with charging characteristics as recommended by battery manufacturer.
      c. Meters for battery voltage and charging current.
      d. Batteries and charger integrally mounted or separate cabinet mounted as recommended by the company producing the system.
   8. Transient surge and lightning protection for signaling line circuits, initiating device circuits, and ac power conductors entering and leaving each fire alarm control panel:
      a. City Connection Circuit Wiring (reverse polarity type): UL listed to Standard 497A; Edwards' _____, Notifier's _____, or Simplex's 2081-9045.
      b. Signaling Line Circuits and Initiating Device Circuits: UL listed to Standard 497B; Edwards' LTP, Notifier's T11325-2M, or Simplex's 2081-9027, 2081-9028, 2081-9034, 2081-9043.
      c. AC Power Conductors: Edwards' TSP, Notifier's _____, or Simplex's 2081-9033, 2081-9042.
   9. Two position key switch, keyed with fire department standard Key No. _____, and trouble indicating lamp for fire department disconnect mode.

C. Remote Auxiliary Power Supplies: Edwards' BPS, Notifier's FCPS-24, Simplex's 2080 Series:
   1. 14 gage surface mounted metal cabinet. Size as recommended by the Company producing the system.

2. Control switches inaccessible behind hinged and locked door.
3. Input circuit suitable for operation on 120Vac primary (main) power supply.
4. Regulated and filtered 24 Vdc output.
5. 24 Vdc Secondary (Standby) Power Supply: Sealed, lead-acid gelled electrolyte or maintenance free lead-calcium batteries:
    a. Ampere-hour capacity to operate under load conditions specified in SYSTEM DESCRIPTION.
    b. Battery charger with charging characteristics as recommended by battery manufacturer.
    c. Meters for battery voltage and charging current.
    d. Batteries and charger integrally mounted or separate cabinet mounted as recommended by the Company producing the system.
6. Activated by host FACP via signaling line circuit loop thru addressable modules:
    a. Addressable control monitor activates the power supply outputs.
    b. Addressable monitor module senses power supply trouble conditions.
7. Supervised power supply, battery, and notification appliance circuits.

F. Building Manager Alarm Annunciators: Edward's 2-3 ANND, 3-ANN, Notifer's INA/ACS, or Simplex's 4603, having:
1. Surface mounted enclosure.
2. LCD that is capable of displaying all system points.
3. System alarm indication (audible and visible). Silence at MFACP.
4. System supervision alarm indication (audible and visible). Silence at MFACP.
5. System trouble indication (audible and visible). Silence at MFACP.
6. Lamp test switch or supervised lamps.

**2.02 INITIATING DEVICES**

A. General:
1. Fire detection devices that receive their power from the initiating device circuit or a signaling line circuit of a fire alarm control unit shall be listed for use with the control unit.
2. Where individually identifiable (addressable) devices are required, but not available from the Company producing the system, either:
    a. Use non-addressable devices and individually wire each device to the FACP's as separate monitor points, making each non-addressable device individually identifiable, or:
    b. Employ remote addressable network modules to make each non-addressable device individually addressable.

B. Ceiling Mounted Detecting devices (Non-Addressable, Non-Intelligent):
1. General:
    a. Heat detectors, ionization type smoke detectors, and photoelectric type smoke detectors shall have common mounting base that accommodates interchanging of the different type detectors.

2. Smoke Detectors:
    a. Ionization Type with LED: Edwards' 6250B, Notifier's 1451, or Simplex's 2098-9576.
    b. Photoelectric Type.
        1) With 135 degrees F Thermal Device and LED: Edwards' 6270B-003, Notifier's 2451 TH, or Simplex's 2098-9202.
        2) With LED: Edwards' 6270B, Notifier's 2451, or Simplex's 2098-9201.
    c. Remote Alarm Indicator For Use with Smoke Detectors: LED type indicator mounted on single gang stainless steel faceplate.
3. Heat Detectors:
    a. Fixed Temperature:
        1) 135 degrees F: Edwards' 293B, Notifier's 5451, or Simplex's 4098 Series.
        2) 190/200 degrees F: Edwards' 294B, Notifier's 4451 HT, or Simplex's 4098 Series.
    b. Combination Rate-of-Rise/Fixed Temperature:
        1) 135 degrees F: Edwards' 291B, Notifier's 5451 TH, or Simplex's 4098 Series.
        2) 190/200 degrees F: Edwards' 292B, or Simplex's 4098 Series.

C. Ceiling Mounted Sensors (Intelligent, Addressable, Analog):
1. General:
    a. Heat sensors, ionization smoke sensors, and photoelectric smoke sensors shall have common mounting base that accommodates interchanging of the different type sensors.
2. Smoke Sensors:
    a. Ionization Type: Edwards' SIGA-IS, Notifier's FSI-751, or Simplex's 4098-9716/9798.
    b. Photoelectric Type: Edwards' SIGA-PS, Notifier's FSP-751, or Simplex's 4098-9714/9798.
    c. Multi-Sensor Type:
        1) Photoelectric/Heat: Edwards' SIGA-PHS 3D or Notifier's FSP-751T
        2) Photoelectric/Ionization/Heat: Edwards' SIGA-IPHS 4D or Notifier's IPX-751.
    d. Remote Alarm Indicator For Use With Smoke Sensors: Edwards' SIGA-LED, Notifier's RA-400, or Simplex's 4098-9782.
3. Heat Sensors:
    a. 135 degrees F (fixed temperature): Edwards' SIGA-HFS, Notifier's FST-751, or Simplex's 4098-9733/9789.
    b. 135 degrees F (fixed temperature/R.O.R.): Edwards' SIGA-HRS, Notifier's FST-751R, or Simplex's _____.

F. Flame Detecting Devices (Non-Addressable):

G. Explosion Proof Rate-of-Rise/Fixed Temperature Heat Detectors (Non-Addressable):
1. 135 degrees F: Edwards' EPB501, Notifier's 302-EPM-135, or Simplex's 2098-9430.

I. Manual Fire Alarm Boxes:
1. Non-Addressable:
a. Single Action Pull Type: Edwards' 276B Series, Notifier's BNG-1R, or Simplex's 2099-9754 Series.
2. Addressable:
a. Single Action Pull Type: Edwards' SIGA-270, Notifier's, NBG-12LX, or Simplex's 2099-9795.

## 2.03 NOTIFICATION APPLIANCES

A. General:
1. Provide UL 464 listed audible signal appliances:
a. Classified "Public" or "Private Mode Only" to suit application.
b. Marked "F. A. Service" or "F. A. Service - Private Mode Only" to suit application.
2. Provide UL listed visible signal devices:
a. For private mode applications, UL 1638 "Fire Protective Visible Signaling Appliance".
b. For public mode applications, UL 1971 "Signaling Devices for the Hearing Impaired".
c. For wall mounting or ceiling mounting to suit application.

B. Combination Audible/Visible Appliances - Wall Mounted:

1. Type AV: Edwards' Genesis Series, Notifier's SpectrAlert Series, or Simplex's TrueAlert Series:
a. Xenon flashtube strobe:
1) AV-15: 15 candela.
2) AV-75: 75 candela.
3) AV-110: 110 candela.
b. Clear lens having FIRE imprinted thereon in red letters, or clear lens with red base having FIRE imprinted thereon in white letters.
c. Audible alarm notification appliance as indicated on the drawing.
1) Horn.
2) Speaker.
3) Bell.
4) Chime (Electro/Mechanical).
5) Chime (Electronic).
d. Surface or flush wall mounted as indicated on the Drawings.

C. Visible Appliances - Wall Mounted:
1. Type V: Edwards' Genesis Series, Notifier's SpectrAlert Series, or Simplex's TrueAlert Series:

a. Xenon flashtube strobe:
   1) V-15: 15 candela.
   2) V-75: 75 candela.
   3) V110: 110 candela.
b. Clear lens having FIRE imprinted thereon in red letters, or clear lens with red base having FIRE imprinted thereon in white letters.
c. Surface or flush wall mounted as indicated on the Drawings.

D. Audible Appliances - Wall Mounted:
1. Horns:
   a. Type H: Edwards' Genesis Series, Notifier's SpectrAlert Series, or Simplex's TrueAlert Series:
      1) Surface or flush wall mounted as indicated on the Drawings.
   b. Type H-1: Edward's 5530D-AW Adaptatone, Notifier's _____, or Simplex's 4901-9813:
      1) Surface wall mounted.
      2) Selectable multiple tone signals.
      3) Suitable for damp and wet locations.

**2.04 MASTER TRANSMITTER FOR MUNICIPAL CONNECTION**

A. The Owner will secure an agreement with a central station operating company. Contractor shall:
1. Install transmitters furnished by the central station operating company.
2. Provide conduit and wiring between transmitters and MFACP.
3. Provide relays and equipment in MFACP as required to operate in conjunction with central station operating company system.

B. Comply with Elmira Fire Department requirements:
1. Master Fire Alarm Box: Gamewell Corp.'s Three Fold Master Fire Alarm Box Data Sheet 3130, shunt type, flush mounted, wheel code #22.
   a. Contact:

**2.05 DIGITAL ALARM COMMUNICATOR SYSTEMS**

A. Digital Alarm Communicator Transmitter (DACT): Edwards' FACP module, Notifier's FACP module, or Simplex's Model 2080-9024:
1. Input circuit suitable for operation on 24 Vdc primary and secondary power supplies.
   a. DACT may be separately wall mounted or an integral module in a fire alarm control panel.
2. UL-864 listing.
3. NFPA 72 compliance, operation with two telephone lines.
4. Compatible with central supervising station DACR and regulations.

B. Digital Alarm Communicator Receiver (DACR).

1. The central supervising station DACR is an Ademco Model 685, located at _____.
2. The contact person is _____.

## 2.06 MODEM UNITS

A. Modems: Edwards' SHM-M/SHM-F, Notifier's TP1-232, or Simplex's 4100-0131 FSK Series:
   1. Input circuit suitable for operation on 120 V ac primary (main) power supply and 24 V dc secondary (standby) power supply.
   2. Full duplex operation.
   3. UL-864 listing.
   4. Dedicated leased line operation.
   5. RS232C to DC converter.
   6. DC to RS232C converter.
   7. Surface mounted cabinets, housing components of each unit.
   8. Recessed mounted cabinets, housing components of each unit.

## 2.08 AUTOMATIC FIRE SUPPRESSION SYSTEM SIGNAL ATTACHMENTS

A. General:
   1. Use non-addressable devices and individually wire each device to the FACP's as separate monitor points, making each non-addressable device individually identifiable, or:
   2. Employ remote addressable network modules to make each non-addressable device individually addressable.

B. Sprinkler Valve Supervisory Switches:
   1. For Outside Screw and Yoke Gate Valves: Grinnell's Model F640, Notifier's OSY2, Potter Electric Signal Co.'s OSYSU Series, or Simplex's 2097 Series.
   2. For Post Indicator Valves: Potter Electric Signal Co.'s PCVS Series, Notifier's P1BV2, or Simplex's 2097 Series.
   3. For Gate Valves (Non-Rising Stem) and Special Applications: Potter Electric Signal Co.'s PTS, Notifier's _____, or Simplex's 2097 Series.

C. Tamper Switches: By Micro Switch or Square D Company to suit installation conditions.

D. Waterflow Switch, Vane Type: Autocall Div., Federal Signal Corp.'s 4160, Notifier's WFD Series, Potter Electric Signal Co.'s VSR, Reliable's Model A, or Simplex's 2097 Series having:
   1. Corrosion-resistant vane.
   2. Splash/dust resistant enclosure with anti-tamper switch.
   3. Adjustable pneumatic retard.
   4. Screw type wiring terminals.
   5. Switch rated minimum 7.0 amps at 125 Vac and 0.25 amps at 125 Vdc.

## 2.09 PROTECTIVE DEVICES

A. Pull Station Protective Shield: Clear Lexan shield and red frame covering manual pull station. When shield is lifted a battery powered warning horn is activated. The horn is silenced by lowering and realigning the shield.
   1. Edwards' STI Series Stopper II, Notifier's STI Stopper II, Safety Technology International Inc.'s STI Stopper II, or Simplex's 2099 Series (STI) including:
      a. Batteries.
      b. Weatherproof shield for damp and wet locations.
      c. Mounting accessories.

B. Protective Grid for Bells: Edwards' Full Cast Grid, Notifier's _____, or Simplex's _____.

## 2.10 TERMINAL STRIP CABINETS

A. Lockable, vandal resistant, surface mounted cabinets constructed of 14 gage steel, size as recommended by the Company producing the system. Equip cabinets with barrier type double screw terminals rated 300 V minimum, meeting UL 94 requirements for materials classed 94 V-0. Use identification strips, tags or labels to identify each conductor. Paint cabinets fire department red and stencil on front in 1/2 inch high white letters, the purpose of each terminal strip cabinet.

## 2.11 POWER-LIMITED FIRE ALARM CIRCUIT CONDUCTORS

A. All electrical characteristics shall meet the requirements of the Company producing the system (conductor to conductor capacitance, dc resistance, velocity of propagation etc.).

B. Multiconductor Cables NFPA 70 type FPLP, FPLR, FPL:
   1. Insulated copper conductors.
   2. Conductors twisted, shielded and jacketed as recommended by the Company producing the system.
   3. Voltage rating of not less than 300 volts (Voltage rating not marked on cable except where cable has multiple listings and voltage marking is required for one or more of the listings).

C. Other types of cables may be used in accordance with NFPA 70 Table 760-61 "Cable Uses and Permitted Substitutions", as approved, if listed as being suitable for the purpose.

## 2.12 NONPOWER-LIMITED FIRE ALARM CIRCUIT CONDUCTORS

A. All electrical characteristics shall meet the requirements of the Company producing the system (conductor to conductor capacitance, dc resistance, velocity of propagation, etc.).

B. Conductors twisted, shielded and jacketed as recommended by the Company producing the system.

C. Single Conductors:
   1. No. 18 and No. 16 AWG: Insulated copper conductors suitable for 600 volts, N.E.C. types KF-2, KFF-2, PAFF, PTFF, PF, PFF, PGF, PGFF, RFH-2, RFHH-2, RFHH-3, SF-2, SFF-2, TF, TFF, TFN, TFFN, ZF, ZFF.
   2. Larger Than No. 16 AWG: Insulated copper conductors suitable for 600 volts, in compliance with NFPA 70 Article 310.
   3. Conductors with other types and thickness of insulation may be used if listed for nonpower-limited fire alarm circuit use.

D. Multiconductor Cables NFPA 70 Types NPLFP, NPLFR, NPLF:
   1. Conductors:
      a. Conductor Sizes No. 18 and No. 16 AWG: Insulated copper conductors rated 600 volts, NFPA 70 types KF-2, KFF-2, PAFF, PTFF, PF, PFF, PGF, PGFF, RFH-2, RFHH-2, RFHH-3, SF-2, SFF-2, TF, TFF, TFN, TFFN, ZF, ZFF.
      b. No. 14 AWG and Larger: Insulated copper conductors suitable for 600 volts, one of the types listed in NFPA 70 Table 310-13 or one that is identified for nonpower-limited fire alarm circuit use.
   2. Cable Listing and Marking: NPLFP, NPLFR, and NPLF marked to suit listings and may be marked with a maximum usage voltage rating of 150 volts.

## 2.13 MC CABLE

A. Metal-Clad Cable, NFPA 70 Type MC:
   1. All electrical characteristics shall meet the requirements of the Company producing the system (conductor to conductor capacitance, dc resistance, velocity of propagation, etc.).
   2. Conductors twisted, shielded and jacketed as recommended by the Company producing the system.
   3. Interlocked flexible galvanized steel armor sheath conforming to UL requirements for Type MC metal clad cable.
   4. Insulated copper conductors suitable for 600 volts:
      a. No. 18 and No. 16 AWG: A type listed in NFPA 70 Table 402-3 with a maximum operating temperature not less than 90°C, or types KF-2, KFF-2, PAF, PAFF, PTFF, PF, PFF, PGF, PGFF, PTF, PTFF, SF-2, SFF-2, ZF, ZFF.
      b. No. 14 AWG and Larger: One of the types listed in NFPA 70 Table 310-13 or of a type identified for use in Type MC cable.
   5. Acceptable Companies: AFC Cable System, Inc., Coleman Cable Co.
   6. Connectors for MC cable: AFC Fitting Inc.'s AFC Series, Arlington Industries Inc.'s Saddle Grip, or Thomas and Betts Co.'s Tite-Bite with anti-short Bushings.

## 2.14 2-HOUR FIRE RATED CABLE ASSEMBLIES

A. Fire Alarm Circuit Integrity (CI) Cable: Cables identified as meeting the requirements for circuit integrity shall have the additional classification using the suffix "CI". Examples: FPLP-CI, FPLR-CI, FPL-CI, NPLFP-CI, NPLFR-CI, NPLP-CI.
   1. Cables shall have a minimum 2-hour fire resistance rating for the cable when tested in accordance with the Standard for Tests of Fire Resistive Cables-UL 2196.

B. MI Cable: AFC Cable Systems' MI cable, or BICC/Pyrotenax Mineral Insulated System 1850 Pyrotenax Cable:
   1. All electrical characteristics shall meet the requirements of the Company producing the system (conductor to conductor capacitance, dc resistance, velocity of propagation, etc.).
   2. Solid copper conductors, twisted, shielded as recommended by the Company producing the system.
   3. Seamless copper sheath.
   4. Two hour fire resistive rating UL system classified, listed in the UL Fire Resistance Directory product category Electrical Circuit Protective Systems (FHIT) and Fire Resistive Cables (FHJR).
   5. Accessories as required for a complete system to suit installation conditions.

C. Other 2-hour Fire Resistive Cables: Listed in UL Buildings Materials Directory, product category Electrical Circuit Protective Systems (FHIT), and Fire Resistive Cables (FHJR):
   1. Type MC/CI: Rockbestos – Surprenant Cable Corp.'s VITALink MC Circuit Integrity Cable (FHIT System No. 17).
      a. PVC jacketing (where shown on drawings).
   2. Type FPL/EMT: Rockbestos – Surprenant Cable Corp.'s VITALink FA UL Listed Type FPL installed within ¾" EMT steel conduit (FHIT System No. 22).

## 2.15 SIGNS, LABELS, MARKERS, AND NAMEPLATES

A. Procedure Sign: Card holder with aluminum or stainless steel frame, plexiglass front and sheet aluminum card backing plate. Minimum size card 8 x 10 inches. For each procedure sign furnish l blank card in holder and 5 spare blank cards suitable for typing future procedures thereon.

B. Code Locator: Card holder with aluminum or stainless steel frame, plexiglass front and sheet aluminum card backing plate. Minimum size card 8 x 10 inches. Type all codes on the card and the area associated with each coded alarm signal.

D. Floor Locator: Flip type bound file, indexed with tabs and equipped with 8-l/2 x 11 inch (minimum) plan of each floor in building. Show location of all major equipment associated with the system. Also show location of each manual fire alarm box. Enclose each floor plan in clear plastic envelope so that floor plans can be removed and updated.

E. Wiring Diagram: One line diagram showing interconnection of all major components associated with the system. Encase with aluminum or stainless steel frame, and plexiglass front.

F. Nameplates: Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inch high.
1. Phenolic: Two color laminated engraver's stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (white).
2. Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.
3. Materials for Outdoor Applications: As recommended by nameplate manufacturer to suit environmental conditions.

G. Fire Alarm Signs: 9 x 12 inches, metal, with the words "FIRE ALARM" imprinted thereon in white letters upon a red background. Include a white arrow pointing down, left or right showing the route to, or actual location of the fire alarm stations. Frame the outside edges of the signs in red and white diagonal stripes.
1. Sign Mounting Styles:
a. Single face for mounting flat against the wall.
b. Double faced for mounting extended from wall.

H. Manual Fire Alarm Box Signs: Precision engrave letters with uniform margins, character size minimum 1/8 inch high, stating "LOCAL ALARM ONLY - NOT CONNECTED TO FIRE DEPARTMENT-CALL FIRE DEPARTMENT BY TELEPHONE".
1. Phenolic: Two color (red surface, white core) laminated engraver's stock, 1/16 inch minimum thickness, machine engraved to expose inner core color.

I. Markers:
a. Premarked self-adhesive; W.H. Brady Co.'s B292, B708, Ideal Industries' Mylar/Cloth wire markers, or Markwick Corp.'s permanent wire markers, Plastic Extruded Parts Inc.'s Flexible Sleeve or ID Band Markers, or Thomas and Betts Co.'s E-Z Code WSL self-laminating.
b. Other Styles: To suit application by W.H. Brady Co., Ideal Industries, Marwick Corp., Plastic Extruded Parts, Inc., or Thomas and Betts Co.

## 2.16 SYSTEM KEYING

A. All system locks, key switches, etc., shall operate with the same key.

## 2.17 ACCESSORIES

A. Include accessories required to perform the functions summarized in SYSTEM DESCRIPTION and indicated on the drawings.

## 2.18 FIRE EXTINGUISHER

A. CO2 type fire extinguisher, minimum 20 pound unit by Amerex Corp., Ansul Inc., Fire-End and Croker Corp., or Walter Kidde Portable Equipment, Inc.

## PART 3 EXECUTION

### 3.01 INSTALLATION

A. Install system in accordance with the Company's printed instructions unless otherwise indicated.

B. Do not install smoke detecting devices until the Work (including cleaning) of all trades in the area has been completed. Protect installed smoke detecting devices from airborne dust and debris.

C. Mount smoke detecting devices, and seal air holes in the back of the devices (including interior of raceways and holes associated with installation of boxes and raceways) so that air flow from inside of housing or from the periphery of the housing will not prevent entry of smoke during a fire or test condition. Seal air holes with gaskets, expanding silicone foam, or other sealants as approved.

E. Wiring For Survivability:

1. Signals from manual fire alarm boxes and other fire alarm initiating devices within a building transmitted over the same signaling line circuit shall not interfere with the manual fire alarm box signals when both types of initiating devices are operated at the same time.
2. Failure of equipment or a fault on one or more installation wiring conductors of one notification appliance circuit shall not result in functional loss of any other notification appliance circuit.
3. Connect MFACP, ICU's and other system components requiring a primary power supply to dedicated branch circuits.
   a. Do not connect MFACP and ICU's to a 2 pole device that can trip both poles at once, such as a 2 pole circuit breaker with handle tie (omit the tie).
4. Splices in wiring in vertical risers is prohibited.
5. Avoid splices in horizontal runs. When splices are necessary, use junction boxes. Exception: For 2-hour fire rated cable assembly, use UL listed methods to maintain 2-hour rating.
   a. Make splices with mechanical or hydraulic type pressure connectors. The use of wire nuts is prohibited.
   b. Paint cover of junction boxes fire department red.
6. Protect notification appliance circuits and other circuits necessary for the operation of the notification appliance circuits from the point at which they exit the fire alarm panel until the point that they enter the notification zone that they serve using one or more of the following methods:
   a. A 2-hour rated cable assembly.
   b. A 2-hour rated shaft or enclosure.
   c. A 2-hour rated stairwell in a building fully sprinklered.
7. Wiring Class A, Style 6, 7, D, E, or Z Signaling Line Circuits, Initiating Device Circuits and Notification Appliance Circuits: Do not install both

legs of Class A, Style 6, 7, D, E, or Z circuits in same cable assembly, enclosure, or raceway back to MFACP or ICU's.

a. Run return legs along another route to obtain maximum benefit of these alternate path circuits.

F. Identification, Labeling, Marking:

1. Procedure Sign: Install adjacent to MFACP and remote annunciator.
2. Code Locator: Install adjacent to MFACP and remote annunciator.
3. Alarm Notification Appliance Locator: Install adjacent to each RA/CC.
4. Floor Locator:
   a. Install adjacent to MFACP.
5. Nameplates:
   a. Install on each manual fire alarm box a nameplate stating: Floor number, and location (1st Fl, east, etc.).

   c. Label the device used as the circuit disconnecting means for the dedicated branch circuits serving the system "FIRE ALARM CIRCUIT CONTROL" with white letters on a red background.
      1) Install on each system component requiring a primary power supply a label stating the location of its circuit disconnecting means.
   d. Install nameplate on each remote alarm indicator stating the location of its smoke detecting device and the area protected by the smoke detecting device and its function (IN DUCT SMOKE DETECTOR ALARM FOR _____).
6. Power-Limited Circuits: Mark circuits at terminations, indicating that circuit is a power-limited fire protective signaling circuit.
7. Fire Alarm Signs: Where directed, install _____ single face signs mounted flat against the wall and _____ double faced signs mounted extended from the wall at conspicuous locations, drawing attention to the manual fire alarm boxes. Fasten signs to walls with vandal resistant fasteners.
8. Identification of Manual Stations Which Do Not Transmit Alarm to Fire Department: Install manual fire alarm box sign above each manual fire alarm box.
9. Identification of Circuits: Identify wires and cables by system and function in interconnection cabinets, and FACP's to which they connect with premarked, self-adhesive, wraparound type markers. Designations shall correspond with point to point wiring diagrams.
10. Battery Data: Insert a copy of the battery warranty in each battery compartment and mark on batteries the date placed in service.
11. Alarm Verification Warning Marking: Affix to the inside of each FACP, a list indicating:
    a. Affected circuits.
    b. Delay (seconds).
    c. The smoke detector model numbers used.

G. Fire Suppression Systems Signal Attachments:

1. Install tamper switches.
2. Install sprinkler system signal attachments.

H. Protective Devices: Install where indicated on the drawings.
   1. Where devices are installed on wood or masonry surfaces, attach protective devices directly to the surface with vandal resistant fasteners.
   2. Where devices are installed on suspended ceiling provide additional supports in the ceiling, such as channel support system, angle iron or additional runner bars. Fasten the additional supports rigidly to the ceiling runner bar system. Attach frame or brackets of protective device to the supports with vandal resistant fasteners. Install metal spacers between the protective device frame and the supports so that the ceiling tiles will not be a part of the support system.
   3. Use finishing collar between surface and protective device where protective device cannot be mounted tight against surface due to job conditions.

I. Locate fire extinguisher proximate to MFACP.

## 3.04 FIELD QUALITY CONTROL

A. Preliminary System Test:
   1. Preparation: Have the Company Field Advisor adjust the completed system and then operate it long enough to assure that it is performing properly.
   2. Run a preliminary test for the purpose of:
      a. Determining whether the system is in a suitable condition to conduct an acceptance test.
      b. Checking and adjusting equipment.
      c. Training facility personnel.

B. System Acceptance Test:
   1. Preparation: Notify the Director's Representative at least 3 working days prior to the test so arrangements can be made to have a Facility Representative witness the test.
   2. Supply all equipment necessary for system adjustment and testing.
   3. Make the following tests:
      a. Test the system in accordance with NFPA 72, Chapter 7.
         1) Follow test methods stated in Table 7-2.2.
         2) Record results on NFPA 72 Figure 1-6.2.1 Record of Completion.
      b. Test system operation step by step as summarized in SYSTEM DESCRIPTION.
   4. Submit written report of test results signed by Company Field Advisor and the Director's Representative. Also complete an NFPA Record of Completion.
      a. Mount a copy of the written report of test results, and the NFPA 72 Record of Completion in plexiglass enclosed frame assemblies adjacent to the MFACP (one framed assembly for each report).

## 3.05 INSULATED CONDUCTOR SCHEDULE - TYPES AND USE

A. Signaling Line Circuits, Initiating Device Circuits and Notification Appliance Circuits:
   1. Power-Limited Circuits: For interior wiring (in raceways) use power-limited fire alarm circuit multiconductor cable types specified in PART 2 except where a 2-hour fire rated cable assembly is required.
      a. Number of conductors and conductor size as recommended by the Company producing the system, except that conductor size shall not be less than No. 18 AWG for signaling line circuits and not less than No. 16 AWG for initiating device circuits and notification appliance circuits.
      b. Using Nonpower-Limited Wiring On Power-Limited Circuits: Wiring size and types specified for nonpower-limited circuits may be used for power-limited circuits if power-limited circuits are reclassified and the power-limited markings are eliminated. Refer to NFPA 70 Article 760-52(a) Exception No. 3.
   2. Nonpower-Limited Circuits: For interior wiring (in raceways) use nonpower-limited fire alarm circuit single conductors or multiconductor cable types specified in PART 2 except where a 2-hour fire rated cable assembly is required.
      a. Number of conductors and conductor size as recommended by the Company producing the system, except that conductor size shall not be less than No. 18 AWG for signaling line circuits, not less than No. 16 AWG for initiating device circuits, and not less than No. 14 AWG for notification appliance circuits.
   3. Where wiring is specifically indicated on drawings not to be run in raceway, use metal-clad cable type MC (concealed, unless otherwise indicated), except where a 2-hour fire rated cable assembly is required.

D. Other Circuits for Which 2-Hour Fire Rated Cable Assembly is Specified or Indicated:
   1. Use CI cable in rigid steel conduit, MI cable, MC/CI cable or FPL/EMT.
      a. Where MI or MC/CI cable is used and run in areas subjecting cable to corrosion, use PVC or HDPR jacketed cable (nonmetallic jacketed cable is not suitable for use in ducts, plenums or other spaces used for environmental air). Use nonmetallic jacketed cable in the following areas:

E. Control Circuits: Associated with the Fire Alarm System: Use Class 1, 2, and 3 wiring specified in Section 260519.

F. Primary Supply Circuits and Secondary Supply Wiring:
   1. Use electric light and power wiring specified in Section 260519.

**END OF SECTION**

31 04 00

Site Clearing

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

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

### 1.02 SUMMARY

A. This section includes, but is not limited to, the following:

1. The entire site within contract limit lines shown will be available to the Contractor for his use from beginning of the Project until final acceptance.
2. Removal of trees and other vegetation.
3. Topsoil stripping.
4. Clearing and grubbing.
5. Removal of above grade improvements indicated on drawings.
6. Soil and siltation protection.

### 1.03 PROJECT CONDITIONS

A. Conduct site clearing operations to ensure minimum interference with roads, streets, walks and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.

B. Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
   1. Protect improvements on Owner's property.
   2. Restore damaged improvements to their original condition, as acceptable to Owner.

C. Carefully remove items indicated to be salvaged and store on Owner's premises where indicated or directed.

D. Soil erosion and sediment control:
   1. All soil erosion and sediment control practices will be installed in accordance with the standards specified in the New York guidelines for urban erosion and sediment control and will be installed in proper sequence and maintained until permanent protection is established.
   2. Any disturbed area that will be left exposed for more than fourteen days and not subject to construction traffic shall immediately receive a temporary seeding. If the season prohibits temporary

seeding, the disturbed area will be mulched with salt hay or the equivalent and bound in accordance with the NY Standards.

3. Immediately following initial disturbance or rough grading, all critical areas subject to erosion will receive a temporary seeding in combination with straw mulch or a suitable equivalent according to the NY Standards.

### 1.04 EXISTING SERVICES

A. Indicated locations are approximate; determine exact locations before commencing work.
B. Arrange and pay for disconnecting, removing, capping and plugging utility services.
C. Place markers to indicate location of disconnected services. Identify service lines and capping locations on project record documents.

## PART 2 PRODUCTS

### 2.01 PRODUCTS

A. Straw bales.
B. Filtered fabric.

## PART 3 EXECUTION

### 3.01 SITE CLEARING

A. Remove trees, shrubs, grass and other vegetation, improvements or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots, including stumps left by previous tree cuttings.

B. Topsoil is defined as friable clay loam surface soil. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones and other objects over 2" diameter, and without weeds, roots and other objectionable material.

1. Strip topsoil to whatever depths encountered in manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to free drainage of surface water. Cover storage piles, if required, to prevent wind erosion.

C. Clear site of trees, shrubs, and other vegetation.
   1. Completely remove trunks, branches, stumps, roots, and all debris.
   2. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
   3. Place fill material in horizontal layers not exceeding 6" loose depth, and thoroughly compact each layer to density equal to adjacent, original ground.

D. Remove existing above grade improvements as indicated and as necessary to facilitate new construction.
   1. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings and is included under work of related Division 15 and 16 sections. Removal of abandoned underground piping or conduit interfering with construction is included under this section.

## 3.02 DISPOSAL OF WASTE MATERIALS

A. Burning is not permitted on owner's property.
B. Remove waste materials and unsuitable and excess topsoil from Owner's property and dispose of off site in legal manner.

## 3.03 SOIL SILTRATION PROTECTION

A. The site shall at all times be maintained such that all storm water run-off is diverted to soil erosion and sediment control facilities.
B. The base of all stockpiles should be protected by a silt dam or straw bale dike in accordance with NY Standards.
C. Paved roadways must be kept clean at all times.
D. Soil siltation of areas adjacent to work areas and drainage ways shall be prevented by lining the down hill sides of the site with securely anchored bales of straw in single and double offset wythes.

04/26/21: PDA

*** END OF SECTION ***

31 05 00

Earth Work

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

### 1.02 SCOPE

A. Furnish all labor, materials, and equipment to complete earthwork as shown and/or herein specified.
   1. Topsoil stripping
   2. Excavation.
   3. Filling and backfilling.
   4. Rough grading.
   5. Finish grading.
   6. Excavation and backfill of trenches for HVAC, Plumbing, and Electric Contractors.

### 1.03 RELATED WORK

A. Refer to Divisions 22, 23, and 26 for excavation and backfill required in conjunction with underground mechanical and electrical utilities.
B. Concrete – Section 03 10 00.
C. Interlocking Concrete pavement – Section 32 14 13.

### 1.04 REFERENCES

A. American Society for Testing and Materials
   1. ASTM D1557-91, "Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort".
   2. ASTM D2216-90, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock".
   3. ASTM D2922-91, "Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)."
   4. ASTM D3017-88, "Standard Test Method for Water Content of Soil and Rock in place by Nuclear Methods "Shallow Depth".

B. New York State Department of Transportation
   1. Standard Specifications of 1990 with Addenda.

## PART 2 PRODUCTS

### 2.01 PRODUCTS

A. All material subject to architect/engineer approval.
B. Topsoil: Stripped from site and stockpiled where directed.
C. General Fill
   1. Approved excavated material free from frost, stumps, trees, roots, sod, muck, etc.
   2. Bank run gravel.
      a. Bank run gravel shall be tested to assure the following minimum requirements to meet acceptance by Architect for compacted fill.
      b. Contractor to pay for and submit test results.

| Sieve Size | Percentage Passing by Weight |
|---|---|
| 3" | 100 |
| 3/4" | 50 - 85 |
| 1/4" | 30 - 60 |
| #40 | 0 - 20 |
| #200 | 0 - 10 |

D. Control Fill
   1. Select Granular Fill
      a. Crushed/screened gravel or rock conforming to NYSDOT Item Type 4 Subbase as follows:

| Sieve Size | Percentage Passing by Weight |
|---|---|
| 2" | 100 |
| 1/4" | 30 - 65 |
| #40 | 5 - 40 |
| #200 | 0 - 10 |

      b. And has a Uniformity Coefficient of at least 4 and a Coefficient of Curvature between 1 and 3.

E. Subbase:
   1. Naturally or artificially graded crushed stone conforming to NYSDOT Item 304-2.02, Type 2 as follows:

| Sieve Size | Percentage Passing by Weight |
|---|---|
| 2" | 100 |
| 1/4" | 25 - 60 |
| #40 | 5 - 40 |
| #200 | 0 - 10 |

F. #2 Crushed Stone meeting NYSDOT standards, clean, durable, angular, and uniform quality throughout.

| Sieve Size | Percentage Passing by Weight |
|---|---|
| 1 ½"" | 100 |
| 1" | 90 - 100 |
| ½" | 0 - 15 |

G. Drainage Fill
1. Clean, sound, durable sharp angled fragments of rock of uniform quality and conforming to NYSDOT designation 703-0201 size designation no 2.

H. Geofabric
1. Non Woven Material
a. Typar 3401
b. Mirafi 140 N
c. Amoco 4547

## PART 3 EXECUTION

### 3.01 WORKMANSHIP

A. Topsoil: See section 32 92 19
B. Earth Excavation
1. General
a. Includes all earth and miscellaneous material encountered that can be excavated with a single D-8 track type tractor with a single-shanked hydraulic ripper, and all boulders measuring one cubic yard or less in volume for a single unit.
b. Cut to exact elevations and grade. Transport to fill areas.
c. Excess excavated material shall be hauled away.

2. Excavation for Structure
a. All soils within building and minimum 1'-0" beyond footings each side of building.
**i.** Clearance: Sufficient for formwork to be performed. The excavation which is required for the execution of the work includes the removal of all materials of every kind.
**ii.** Banks and Sides: Angle of recline or sheathing, shoring, and bracing as required for safety and conforming to all applicable laws, rules, regulations and codes. Remove all bracing materials before backfilling.

b. Unauthorized Excess Depth: Backfill with compacted controlled fill at Contractor's expense.
c. Keep excavation clear of water by ditching or pumping.
d. Keep loose material and debris out of excavation.
e. Where excavation for foundations extends into water or water enters the excavation, remove water during excavation so that no water stands. Take special care to insure that movement of heavy equipment in the excavation does not cause working and pumping of the underlying soil which is not to be excavated. Should the equipment used cause excessive subsoil disturbance, other methods of excavation shall be used in order to maintain the design bearing capacity of the soil.
f. Depth of Excavation: Allow for below slabs on grade and concrete pavers base and setting courses.

C. Trench Excavation
1. Includes all earth and miscellaneous material encountered that is possible to excavate with a one-yard backhoe.
2. Excavate to 6" below utility piping and 2" below drainage piping. Transport to fill areas or haul away excess.
3. Within controlled fill area after all controlled fill has been placed, excavate to exact depth and grade.
4. Smooth grading of trench bottom shall be by trade responsible for installing utility and drainage piping.
5. Should trench bottom be found to be wet or unstable when excavation is completed, report same to owner's representative. Should condition deem unsuitable, excavate to depth as directed and backfill with approved bedding material to trench bottom or as otherwise directed.
6. Excavate not over 12" wider than outside diameter of pipe below spring line or as indicated on drawings.
7. Banks and Sides: Angle of repose or sheathing, shore and bracing as required for safety and conforming to all applicable laws, rules, regulations, and codes. Remove as backfill is placed unless otherwise directed by Architect.

D. General Fill
1. Begin after area inspected and approved by Architect.
2. Method: Do not place on frozen ground. Use least desirable material on bottom of fill, best on top. Place in 6" to 8" layers, compacting with tamping roller or smooth wheel roller. At places inaccessible to roller, use mechanical or hand tamps. Distribute stones in fill, none over 4" diameter within 12" of subgrade. Layers of fill shall be free of ruts and compacted before next layer applied.

Slope to provide drainage and prevent ponding of water.

3. Compaction: Uniformly spread, moisten, or dry each layer as required and then compact so that the unit dry weight of the compacted material meets or exceeds 90% of the maximum unit dry weight of the material compacted in the laboratory per ASTM D1557, latest edition. Vibratory equipment not to be used.
4. Tests: Not required for general exterior fill. If required by Architect, Owner will pay for test.

E. Controlled Fill

1. Controlled fill material shall be select granular fill.
2. Complete before concrete slab work has begun.
3. Do not place on frozen ground.
4. All material must be free from frost, organic, and foreign matter.
5. Surface Preparation: All vegetation, organic materials, debris, etc., to be removed as specified before beginning work.
6. Placement: Place in 6" to 8" lifts, each to required density. Minimum thickness of gravel below slab to be 6" and allow for 2" cushion sand below slab, otherwise depth to be as necessary to establish finish top of slab.
7. Backfill and maintain compaction against both sides of foundation wall simultaneously.
8. Compaction: Control soil compaction during construction. Maintain at optimum moisture content. Provide necessary equipment to reach 95% density in all areas of fill. Uniformly spread, moisten, or dry each layer as required and then compact so that the unit dry weight of the compacted material meets or exceeds 90% of the maximum unit dry weight of the material compacted in the laboratory per ASTM D1557, latest edition. Vibratory equipment not to be used.
9. Avoid use of any vibratory equipment which will disturb the subgrade.
10. Moisture Control: Where the subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to the surface of subgrade, or layer of soil material. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing, or pulverizing, until the moisture content is reduced to a satisfactory value, as determined by moisture density relation tests.
11. Moisture-density relation tests of soils ASTM D1557 Method D* one test for approval, additional tests as required by changes in materials by approved commercial testing laboratory at Contractor's expense.

F. Trench Backfill
   1. See also Divisions 22, 23, 26 and 31 for backfill requirements of mechanical trades.
   2. After completion of their work and their backfill to level stated above their line, backfill the remainder of the trench in 6" to 8" lifts. Tamp with mechanical tamper. Fill to required subgrade.
   3. Fill and compaction as noted above for Controlled Fill in Controlled Fill areas.
   4. Fill and compaction as noted for General Fill in General Fill areas.
   5. Testing for compaction as described for backfill.

G. Controlled Backfill Materials Testing
   1. At Contractor's expense.
   2. Submit results of tests performed by approved commercial testing laboratory to owner's representative for material gradation and required densities after compaction as specified for each material proposed for use. Separate tests must be performed on materials used from different sources.
   3. No backfill will be approved until required initial material tests are acceptable to the Architect.

H. Continuous Testing Controlled Backfill - Owner
   1. Continuous in-place testing of density of soil in place at Owner's expense.
   2. Continuous on-site compaction tests for each separate lift of each backfill material. Tests to be performed by use of non-destructive moisture density meter to give immediate on-site test of compaction. Submit results of compaction tests for review by Architect.
   3. Notify Architect at least one week in advance of all backfill.
   4. If tests verify compaction below that specified above, remove, replace, and retest materials until specified compaction is achieved at Contractor's expense.
   5. No slab concrete is to be placed prior to report of test results confirming specified compaction.

I. Settlement
   1. General: Repair to proper grade any settlement of slab, pavement, utility, or structure adversely affected by settlement within one year after final acceptance at no expense to the Owner.

04/24/21 PDA ***END OF SECTION***

32 12 17

Granite Curb

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

### 1.02 SCOPE

A. Furnish and install granite curb.
B. Remove and reuse existing granite curb.

### 1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Society for Testing and Materials (ASTM):

| | |
|---|---|
| C 131 | Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine |
| C 615 | Structural Granite |

2. New York State Department of Transportation (NYSDOT):

| | |
|---|---|
| Specification | Standard Specifications - Construction and Materials. |

### 1.04 DELIVERY, STORAGE, AND HANDLING

A. Granite curb units shall be delivered to the job adequately protected from damage during transit.
B. Curb shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the work.

## PART 2 PRODUCTS

## 2.01 GRANITE CURB

A. Granite shall be a structural granite conforming to ASTM C 615, Class 1 Engineering Grade, suitable for curbstone use, and NYSDOT Specification Section 609, “Curbing, Gutters and Concrete Mall”.

1. Curb shall be light grey, free from seams which impair structural integrity, and with percentage of wear less than 32%, as determined by ASTM C 131.
2. Granite curb shall be furnished in two types: vertical and transition curb, of size, shape, and dimensions indicated on the Drawings. Finish shall be sawn top, split face, and jointed. Sawn face for where adjacent to unit pavers, provide sawn face for top 4" of face.

## 2.02 CEMENT MORTAR

A. Mortar for pointing joints between curbstones shall be a cement mortar composed of one-part Portland cement and two parts sand, be volume with sufficient water to form a workable, stiff mixture.

## 2.03 CONCRETE

A. Concrete for foundation at granite curb shall conform to NYSDOT Specifications Section 500, Class A.

# PART 3 EXECUTION

## 3.01 SETTING CURB

A. Curb shall be set in an 18 in. wide trench bottom at 6 in. Below bottom of curb. Excavation shall be filled to required level with concrete foundation and base course material conforming to the requirements of Section 31 05 00, Site Earth Work, and as indicated on the Drawings.

B. Vertical face of vertical curb shall be plumb, with curb top parallel to adjacent surface.

C. Curb shall be accurately to line and grade. Curb units shall be fitted together as closely as possible. Curb shall not be field cut.

D. Joints, between curb units shall be carefully filled with a cement mortar, and neatly pointed on the top and front exposed portions. After pointing excess mortar shall be cleaned from curb surface.

E. Backfill material on each side of curb shall be as specified for adjacent surface and shall be thoroughly compacted by means of power tampers. Extreme care shall be taken not to destroy alignment. Curb sections disturbed during backfilling or otherwise shall be reset to line and grade, and properly backfilled.

04/24/21: PDA

*** END OF SECTION ***

SECTION 32 14 13

Interlocking Concrete Pavement

## PART 1 GENERAL

### 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 specification sections apply to work of this section.

### 1.02 SCOPE

A. Concrete Pavement System
B. Installation work includes:
   a. Verifying Subgrade is to the lines, grades and density shown on the construction drawings;
   b. Furnishing and installing Geotextile, Base Course, Bedding Course, Edge Restraint, Concrete Pavers and Joint Filling Sand to the lines and grades shown on the construction drawings.

### 1.03 ENVIRONMENTAL REQUIREMENTS

A. Adhere to cold weather requirements of IMIAC, "Recommended Practice and Guide Specifications for Cold Weather Masonry Construction".

### 1.04 SUBMITTALS

A. Submit manufactures color and texture charts for selection.
B. Submit four full size samples of each Paver type/size/thickness/color/finish specified; the samples shall represent the range of shape, texture and color permitted for the respective type. Color(s) will be selected by Owner from Manufacturer’s standard colors.
C. Prior to delivery of the associated material to the site, the Contractor shall submit the following product specific documentation for approval:
   1. Concrete Pavers:
      a. Warranty documentation
      b. Close out Operations and Maintenance program.

## 1.06 Mock-Ups

A. Install the entry area north of the building to the planting area, following the installation practices described in Article 3.02.
B. This area will be used to verify surcharge of the Bedding Course; joint sizes; lines; laying pattern(s); color(s); and, texture of the job.
C. This area shall be the standard from which the work will be judged.
D. Subject to approval by the Owner, the mock-up may be retained as part of the finished work.

## 1.07 Delivery, Storage and Handling

A. Coordinate delivery and paving schedule to minimize interference with normal use of buildings adjacent to paving.
B. Contractor shall check all materials upon delivery to assure that the proper materials have been received and are in good condition before signing off on the manufacturer's packing slip.
C. Contractor shall protect all materials from damage or contamination due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged or contaminated materials shall not be incorporated into the work.
D. Deliver Concrete Pavers to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. Unload and store Concrete Pavers at job site in such a manner that no damage occurs to the product.
E. Handle and transport aggregates to avoid segregation, contamination and degradation. Keep different materials sufficiently separated as to prevent mixing. Do not dump or store one material on top of another unless it is part of the installation process. Cover material with waterproof covering to prevent exposure to rainfall or removal by wind – secure the covering in place.

## 1.08 Environmental Conditions

A. Do not install during heavy rain, freezing conditions or snowfall.
B. Do not install on frozen soil subgrade.
C. Do not install frozen Bedding Coarse sand, Joint Filling Sand or Base Course material.

## 1.09 Maintenance Materials

A. Provide 50 square feet additional paver material for use by Owner for maintenance and repair as attic stock.
B. Pavers to be from the same production run as installed materials.
C. Store paver materials in Owner designated location.

## PART 2 PRODUCTS

### 2.01 ACCEPTABLE CONCRETE PAVER MANUFACTURERS

A. Belgard.
B. Hanover.
C. UniLock

### 2.02 CONCRETE PAVING UNITS

A. 4x8 and 8x8 Holland Stone
B. Concrete Pavers shall conform to the following requirements set forth in ASTM C-936:
   1. Measured length or width of test specimens shall not differ by more than +/- 0.063 in, while measured thickness shall not differ by more than +/- 0.125 in.
   2. Average compressive strength of 8,000 psi with no individual unit under 7,200 psi when tested in accordance with ASTM C-140.
C. Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C-140.
D. Pigment in Concrete Pavers shall conform to ASTM C-979.

### 2.03 BEDDING COURSE

A. Clean, non-plastic sand, free from deleterious or foreign matter, natural or manufactured from crushed rock.
B. Verify gradation conforms to ASTM C-33 requirements for concrete sand (listed in Table 1) as tested in accordance to ASTM C-136.

**Table 1**
**Grading Requirements for Bedding Sand**

| Sieve Size | Percent Passing |
|---|---|
| 3/8 in.(9.5 mm) | 100 |
| No. 4 (4.75 mm) | 95 to 100 |
| No. 8 (2.36 mm) | 85 to 100 |
| No. 16 (1.18 mm) | 50 to 85 |
| No. 30 (0.600 mm) | 25 to 60 |
| No. 50 (0.300 mm) | 5 to 30 |
| No. 100 (0.150 mm) | 0 to 10 |
| No. 200 (0.075 mm) | 0 to 1 |

## 2.04 Joint Filling Sand

A. Clean, non-plastic, free from deleterious or foreign matter, natural or manufactured from crushed rock.
B. Verify gradation conforms to ASTM C-144 requirements for mortar sand (listed in Table 2) as tested in accordance to ASTM C-136.

**Table 2**
**Grading Requirements for Joint Filling Sand**

| Sieve Size | Percent Passing |
|---|---|
| No. 4 (4.75 mm) | 100 |
| No. 8 (2.36 mm) | 95 to 100 |
| No. 16 (1.18 mm) | 70 to 100 |
| No. 30 (0.600 mm) | 40 to 100 |
| No. 50 (0.300 mm) | 10 to 35 |
| No. 100 (0.150 mm) | 2 to 15 |
| No. 200 (0.075 mm) | 0 to 5 |

## 2.05 Base Course

A. Clean, non-plastic, free from deleterious or foreign matter, natural or manufactured from crushed rock.
B. Verify gradation conforms to ASTM D-2940 as presented in Table 3.

| Sieve Size | Percent Passing |
|---|---|
| 2 in (50 mm) | 100 |
| 1 ½ in (37.5 mm) | 95 to 100 |
| ¾ in (19 mm) | 70 to 92 |
| 3/8 in (9.5 mm) | 50 to 70 |
| No. 4 (4.75 mm) | 35 to 55 |
| No. 30 (0.600 mm) | 12 to 25 |
| No. 200 (0.075 mm) | 0 to 8 |

## 2.06 Edge Restraints

Edge restraints: .125” 6063 Aluminum 1.5” high with anchor flange. With aluminum anchor spikes

## 2.07 Geotextiles

A. See Section 31 05 00.

## PART 3 – EXECUTION

### 3.01 Pre-Construction Inspection

A. Beginning of Base Course installation means acceptance of Subgrade.

### 3.02 Installation Base Course

A. Install Geotextiles as required in accordance with the specifications and drawings. The Geotextile is applied to the bottom and sides of the excavation with overlapping joints a minimum of 12 inches. Overlaps to follow down slope.

B. Install the Base Course at the thickness, compaction, surface tolerances, and elevations outlined in the specifications.

1. The aggregate should be spread and compacted in uniform layers not exceeding 6 inch loose thickness.
2. Density testing shall be conducted to verify conformance.
3. Surface tolerance should be plus or minus 3 /8 in. over a 10 ft. straight edge laid in any direction.
4. Attention will be paid to providing proper compaction near curbs, grade beams, concrete collars around utility structures, lights standards, tree wells, building edges and other protrusions as applicable to the project. In areas not accessible to large compaction equipment, compact to specified density with mechanical tampers (jumping jacks).
5. The upper surface of the base shall be sufficiently well graded and compacted to prevent infiltration of the bedding sand into the base both during construction and throughout its service life. Segregated areas of the granular base shall be blended by the application of crushed fines that have been watered and compacted into the surface.

### 3.03 Installation Edge Restraints

**A.** Edge restraint shall be provided along the perimeter of all paving. The face of the edge restraint, where it abuts pavers, shall be vertical.

### 3.04 Installation Bedding Course, Concrete Pavers and Joint Filling Sand

A. Install Geotextiles as required in accordance with the specifications and drawings. 12” wide Geotextile is applied around the perimeter above the base course.

B. Spread the Bedding Course evenly over the Base Course and screed to a nominal 1 in. thickness. The screeded sand should not be disturbed. Place sufficient sand to stay ahead of the laid pavers. Do not use the bedding sand to fill depressions in the Base Course surface.

Note**:** The spread sand shall be carefully maintained in a loose condition, and protected against incidental compaction, both prior to and following screeding. Any incidentally compacted sand or screeded sand left overnight or impacted by rain, shall be loosened before further paving units are placed. Sand shall be lightly screeded in a loose condition to the predetermined depth, only slightly ahead of the paving units. Under no circumstances shall the sand be screeded in advance of the laying face to an extent to which paving will not be complete on that day.

C. The Contractor shall screed the Bedding Course using either an approved mechanical spreader or by the use of screed rails and boards

D. Ensure that Concrete Pavers are free of foreign material before installation. Concrete Pavers shall be inspected for color distribution and all chipped, damaged or discolored Concrete Pavers shall be replaced. Initiation of Concrete Paver placement shall be deemed to represent acceptance of the pavers.

E. Lay the Concrete Pavers in Basket Weave pattern. Maintain straight pattern lines.

F. Paving units shall be installed from a minimum of 3 bundles by hand, simultaneously to ensure color blending.

G. Joints between the individual Concrete Pavers, and between Concrete Pavers and the Edge Restraints, buildings, collars, or other protrusions/edging, on average shall be between 1 /16 in. and 3 /16 in. (2 mm to 5 mm) wide.

H. Fill gaps at the edges of the paved area with cut pavers or edge units. Do not install cut pavers smaller than one-third of a whole paver along edges subject to vehicular traffic – trim two pavers to fit.

I. Cut all pavers using a masonry saw. Upon completion of cutting, the area must be swept clean of all debris to facilitate inspection and to ensure the Concrete Pavers are not damaged during compaction.

J. Compact the Concrete Pavers into the Bedding Course.

K. The pavers shall be compacted to achieve consolidation of the sand bedding and brought to level and profile by not less than three passes. Initial compaction should proceed as closely as possible following the installation of the paving units and prior to the acceptance of any traffic or application of sweeping sand.

L. Any units that are structurally damaged during compaction shall be immediately removed and replaced.

M. Sweep dry Joint Filling Sand into the joints and vibrate until they are full. This will require at two or three passes with the compactor. Do not compact within 3 ft of the unrestrained edges of the paving units.

N. All work to within 3 ft of the laying face must be left fully compacted with sand-filled joints at the end of each day. Cover the laying face with plastic sheets overnight if not closed with cut and compacted pavers.

O. Sweep off excess sand when the job is complete.

P. The final surface elevations shall not deviate more than 3 /8 in. under a 10 ft long straightedge.

## 3.05 Quality Assurance/Quality Control

A. Quality Assurance - The Owner may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction quality control testing.

B. Quality assurance should include as a minimum verification with the Design Engineer that the Contractor's quality control plan and testing are adequate. Quality assurance shall also include observation of construction for general compliance with design drawings and project specifications.

C. Quality Control – The Contractor shall engage inspection and testing services to perform the minimum quality control testing described in the design plans and specifications. Only qualified and experienced technicians and engineers shall perform testing and inspection services.

D. Quality control testing shall include backfill testing to verify soil types and compaction, and verification that the system is being constructed in accordance with the design plans and project specifications.

## 3.06 As-built Construction Tolerances

A. Final inspection shall be conducted to verify conformance to the drawings after removal of excess joint sand. All pavements shall be finished to lines and levels to ensure positive drainage.

B. The final surface elevations shall not deviate more than +/- 3/8 inch under a 10 ft long straight edge.

**END OF SECTION**

04/24/21:PDA ***END OF SECTION***