

**SPECIFICATIONS**

FOR

**HISTORIC JARVISBURG COLORED SCHOOL  
SCHOOL IMPROVEMENTS & SITE WORK (PHASE2)**

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

1.3 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.2 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  - 1. Portland Cement: ASTM C 150, Type I/II. Supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
  - 2. Blended Hydraulic Cement: ASTM C 595, cement.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
  - 1. Maximum Coarse-Aggregate Size: 1-1/2 inches for footings, 3/4 inch for slabs nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.3 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.

2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

- C. Water: Potable.

## 2.5 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059, Type II, for bonding fresh concrete to previously poured concrete surfaces.

## 2.6 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
- D. Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: 3000 psi at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
  - 3. Slump Limit: 4 inches for slabs and 5 inches for footings, plus or minus 1 inch.
  - 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

## 2.7 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.



PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Do not chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use instructions furnished with items to be embedded.

3.3 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer. If a section cannot be placed continuously, provide construction joints and bonding agent. Deposit concrete to avoid segregation.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.5 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.6 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when required by Architect or Owner. Remove and replace concrete that cannot be repaired and patched to Architect's or Owner's approval.

END OF SECTION 033000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking and nailers.
3. Wood sleepers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content as specified. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood sills and similar concealed members in contact with masonry or concrete.
  - 2. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

- A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.
  - 1. Application: All interior partitions.
  - 2. Species:
    - a. Mixed southern pine; SPIB.
- B. Framing Other Than Non-Load-Bearing Interior Partitions: No. 2 grade.
  - 1. Application: Ramp substructure.
  - 2. Species:
    - a. Mixed southern pine; SPIB.

2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Power-Driven Fasteners: NES NER-272.

- C. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

## 2.5 METAL FRAMING ANCHORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated on Drawings by one of the following:
  - 1. Cleveland Steel Specialty Co.
  - 2. KC Metals Products, Inc.
  - 3. Phoenix Metal Products, Inc.
  - 4. Simpson Strong-Tie Co., Inc.
  - 5. USP Structural Connectors.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those required to resist the anticipated loads and the applicable building codes. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
  - 1. Use for exterior locations unless otherwise indicated.
- D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch thick.
  - 1. Use for wood-preservative-treated lumber and where indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate blocking and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

- C. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- D. Do not splice structural members between supports unless otherwise indicated.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in the North Carolina Building Code – latest edition.

END OF SECTION 061000

SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior ramp decking and railings.

1.2 ACTION SUBMITTALS

- A. Samples: For each type of product involving selection of colors, profiles, or textures.

1.3 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:

1. For lumber that is not marked with grade stamp.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20.

1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
  - a. For exposed lumber, provide certificates of grade compliance issued by inspection agency.

2.2 EXTERIOR TRIM

A. Lumber Trim:

1. Species and Grade: Cypress, pressure-preservative treated; B & B; SPIB.
2. Maximum Moisture Content: 15 percent.
3. Face Surface: Surfaced (smooth).

2.3 EXTERIOR RAMP DECKING AND RAILINGS

- A. Ramps and Landings:
  - 1. Walking Surface: 1-1/4-inch thick, kiln-dried.
    - a. Species and Grade: Cypress, B & B; SPIB.
- B. Railings: Clear, kiln-dried, solid, Cypress; railing stock of pattern indicated.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
  - 1. For applications not otherwise indicated, provide stainless-steel, hot-dip galvanized-steel or aluminum fasteners.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prime lumber to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 099113 "Exterior Painting."

3.2 INSTALLATION, GENERAL

- A. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Install walking surface with no more than 1/16-inch variation between adjacent deck boards.

3.3 STANDING AND RUNNING TRIM INSTALLATION

- A. Install flat-grain lumber with bark side exposed to weather.
- B. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long except where necessary.
  - 1. Use scarf joints for end-to-end joints.



2. Stagger end joints in adjacent and related members.
- C. Fit exterior joints to exclude water. Cope at returns and miter at corners.

END OF SECTION 062013

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Softwood Plywood: DOC PS 1.

1. Marine grade for vanity tops and back splashes.

2.2 INTERIOR TRIM

A. Softwood Lumber Trim:

1. Maximum Moisture Content: 15 percent.

B. Moldings for Opaque Finish (Painted Finish): Made to patterns included in WMMPA WM 12.

1. Softwood Moldings: WMMPA WM 4, P grade.
  - a. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine or Southern Yellow Pine.
  - b. Maximum Moisture Content: 15 percent.

C. Molding Patterns: Match existing beaded wood panel boards.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Countersink fasteners, fill surface flush, and sand unless otherwise indicated.
  - 3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

3.3 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Cope at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

END OF SECTION 062023

SECTION 081433 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior stile and rail wood doors.
2. Fitting stile and rail wood doors to frames and machining for hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For stile and rail wood doors. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and other pertinent data.

C. Samples: Represent typical range of color and grain for each species of veneer and solid lumber required.

1.3 INFORMATIONAL SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Use only materials that comply with referenced standards and other requirements specified.

2.2 INTERIOR STILE AND RAIL WOOD DOORS

A. Interior Stile and Rail Wood Doors: Interior stock doors complying with the AWI's "Architectural Woodwork Standards and with other requirements specified.

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

- a. Algoma Hardwoods, Inc.

- b. Artistic Doors and Windows, Inc.
  - c. Belentry Doors LLC.
  - d. Dimension Millworks.
  - e. Eggers Industries.
  - f. Enjo Architectural Millwork.
  - g. Harring Doors.
  - h. Maiman Company (The).
  - i. Marshfield DoorSystems, Inc.
  - j. Pinecrest Inc.
  - k. Select Door.
  - l. Sun-Dor-Co.
  - m. Woodtech Trading Company.
- 2. Grade: Custom.
  - 3. Finish: Opaque.
  - 4. Door Construction for Opaque Finish: Either of the following:
    - a. Stile and Rail Construction: Clear softwood; may be edge glued for width and finger jointed.
    - b. Raised-Panel Construction: Clear softwood lumber; edge glued for width or shaped, medium-density fiberboard.
    - c. Flat-Panel Construction: Veneered, wood-based panel product.
  - 5. Raised-Panel Thickness: Manufacturer's standard, but not less than 1-1/8 inches.

### 2.3 STILE AND RAIL WOOD DOOR FABRICATION

- A. Fabricate stile and rail wood doors in sizes indicated for field fitting.
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:
  - 1. Clearances: Provide 1/8 inch at heads and jambs. Provide 1/2 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide not more than 3/8 inch from bottom of door to top of threshold.
  - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
- C. Factory machine doors for hardware that is not surface applied.
- D. Prehung Doors: Provide stile and rail doors complete with frames, weather stripping, and hardware.
  - 1. Provide hardware that complies with Section 087100 "Door Hardware."

2.4 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099123 "Interior Painting."

2.5 FINISHING

- A. For doors either factory or shop finished, comply with the AWT's, "Architectural Woodwork Standards," and with other requirements specified, including 099123 "Interior Painting."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  - 1. Clearances: Provide 1/8 inch at heads and jambs. Provide 1/4 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
  - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

END OF SECTION 081433

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:
  - a. Swinging doors.

1.2 ACTION SUBMITTALS

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

B. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
  - b. Content: Include the following information:
    - 1) Identification number, location, hand, size, and material of each door and frame.
    - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
    - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three (3) years from date of Substantial Completion, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products referenced.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
  - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements.

2.2 HINGES

- A. Hinges: BHMA A156.1.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
    - a. Baldwin Hardware Corporation.
    - b. Bommer Industries, Inc.
    - c. Hager Companies.
    - d. IVES Hardware; an Ingersoll-Rand company.
    - e. Lawrence Hardware Inc.
    - f. McKinney Products Company; an ASSA ABLOY Group company.
    - g. Stanley Commercial Hardware; Div. of The Stanley Works.



2.3 MECHANICAL LOCKS AND LATCHES

- A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - 1. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
- B. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
    - a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
    - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
    - c. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
    - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    - e. Schlage Commercial Lock Division; an Ingersoll-Rand company.
    - f. Yale Security Inc.; an ASSA ABLOY Group company.

2.4 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
  - 1. Manufacturer: Same manufacturer as for locking devices.

2.5 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
  - 1. No Master Key System: Only change keys operate cylinder.
- B. Keys: Nickel silver.
  - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
    - a. Notation: Historic Jarvisburg Colored School Museum.
  - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
    - a. Cylinder Change Keys: Three (3).

2.6 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; bronze, unless otherwise indicated.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
    - a. Hager Companies.
    - b. IVES Hardware; an Ingersoll-Rand company.
    - c. Rockwood Manufacturing Company.
    - d. Trimco.

2.7 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: BHMA A156.16.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
    - a. Baldwin Hardware Corporation.
    - b. Hager Companies.
    - c. Rockwood Manufacturing Company.
    - d. Stanley Commercial Hardware; Div. of The Stanley Works.
    - e. Trimco.

2.8 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware.
  - 2. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.9 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors".
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
  - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.2 DOOR HARDWARE SCHEDULE

Door Hardware  
Set No. HW-1  
Door: 100

<u>Quantity</u>	<u>Item</u>	<u>Manufacturer</u>	<u>Product</u>
6	Hinges	IVES	5-BB-1-SW - 4.5 × 4.5 – 613-NRP
1	Mortise Lockset	Yale	TX-E3-8800/F04/2153/613
1	Cylinder	Yale	Compatible with 8800 Series Lockset.
2	Flushbolts	Baldwin	0626.150 Satin Nickel (inactive leaf)

END OF SECTION 087100

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

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

1. CertainTeed Corp.
2. Georgia-Pacific Gypsum LLC.
3. National Gypsum Company.
4. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

2.2 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.

B. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.3 AUXILIARY MATERIALS

A. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

PART 3 - EXECUTION

3.1 APPLYING PANELS

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Backing for beaded wood trim boards.
- E. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Wood.

1.2 DEFINITIONS

- A. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523 for wood siding, trim, windows, doors and louvers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and each color and gloss of topcoat.
- C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: Not less than one (1) gallon of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- D. Colors: As selected by Architect from manufacturer's full range.
  - 1. Zero (0) percent of surface area will be painted with deep tones.

2.3 WOOD PRIMERS

- A. Primer, Latex for Exterior Wood: MPI #6.
  - 1. Benjamin Moore; SuperSpec.
  - 2. Sherwin Williams; A-100.
  - 3. Zinsser; BullsEye 1-2-3.

2.4 WATER-BASED PAINTS

- A. Latex, Exterior Semi-Gloss (Gloss Level 5): MPI #11.
  - 1. Duron; Ultra Deluxe.
  - 2. Kelly-Moore; Acry-Lustre.
  - 3. Sherwin Williams; A-100.

2.5 RAMP DECK COATINGS

- A. Stain for Exterior Wood Decks:
  - 1. Sikkens; Cetol; DEK.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Wood: 15 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.



- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE

- A. Wood Substrates: Including wood ramp structure.

- 1. Latex System:

- a. Prime Coat: Primer, latex for exterior wood, MPI #6.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.

- B. Wood Substrates, Traffic Surfaces: Including lumber ramp decking and railing.

- 1. Latex System:

- a. Prime Coat: Sikkens; Cetrol; DEK.
- b. Top Coat: Sikkens; Cetrol; DEK.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Wood doors, frame and beaded wood trim boards.

1.2 DEFINITIONS

- A. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523 for gypsum board.
- B. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523 for wood trim, doors and interior surfaces of exterior doors and windows.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.
- C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
- a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
- b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.

- a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

### 2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

- B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.

- D. Colors: As selected by Architect from manufacturer's full range.

1. Zero (0) percent of surface area will be painted with deep tones.

### 2.3 PRIMERS/SEALERS

- A. Primer Sealer, Latex, Interior: MPI #50.

1. Benjamin Moore; Regal.
2. Sherwin-Williams; Quali-Kote.
3. Zinsser; BullsEye.

- B. Primer, Latex, for Interior Wood: MPI #39.

1. Benjamin Moore; Fresh Start.
  2. Sherwin Williams; Preprita.
  3. Zinsser; BullsEye.
- C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.
- 2.4 WATER-BASED PAINTS
- A. Latex, Interior, (Gloss Level 3): MPI #52.
1. Benjamin Moore; Regal.
  2. Sherwin Williams; Sherwin Williams.
  3. PPG; Speedhide.
- B. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.
1. Benjamin Moore; Regal.
  2. Sherwin-Williams, Duration Home.
  3. PPG; Speedhide.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Wood: 15 percent.
  2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
1. Application of coating indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 INTERIOR PAINTING SCHEDULE

- A. Wood Substrates: Including beaded wood trim boards and doors.
  - 1. Latex System:
    - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.

END OF SECTION 099123

SECTION 20 05 00 - SPECIAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Drawings use and interpretation:
  - 1. Drawings are diagrammatic and indicate general arrangement of systems and equipment, except when specifically dimensioned or detailed.
  - 2. For exact locations of building elements, refer to dimensioned architectural/structural drawings.
  - 3. Field measurements take precedence over dimensioned drawings.
  - 4. Piping and ductwork plans are intended to indicate size, capacity, approximate location, direction and general relationship of one work phase to another, but not exact detail or arrangement.
  - 5. Field verify locations and arrangement of existing systems and equipment.
- B. Description of systems: Provide materials resulting, upon completion, in functioning systems in compliance with performance requirements specified, and modifications resulting from reviewed Shop and Field Coordination Drawings.

1.02 QUALITY ASSURANCE

- A. Perform work in accordance with following codes:
  - 1. State and County building, plumbing and mechanical codes.
  - 2. American Gas Association.
  - 3. National Electrical Code.
  - 4. National Fire Protection Association.
  - 5. Authorities having jurisdiction.

1.03 PROTECTION

- A. Provide covering and shielding for equipment provided to protect from damage.
- B. Repair, restore and replace damaged items.
- C. Protect nameplates on motors, pumps and similar equipment.
- D. Protect plumbing fixtures and brass or chromium plated trim, valves and piping from damage.
- E. Keep dirt and debris out of pipes and ducts by capping or plugging open ends.
  - 1. Keep plug or cap in place until final connections are made.

1.04 JOB CONDITIONS

- A. Cause as little interference or interruption of existing utilities and services as possible.
  - 1. Schedule work which will cause interference or interruption in advance with Owner, Construction Manager, Architect, authorities having jurisdiction, and affected contractors.
- B. Examine Contract Documents to determine how other work will affect execution of mechanical work.

- C. Make arrangements for and pay for necessary permits, licenses, and inspections.
- D. Air Quality Permits: Contractor shall be responsible for obtaining EPA air quality permits. Coordinate permitting process with Owner.
- E. Record drawings:
  - 1. Keep a complete set of mechanical drawings in job site office for indicating actual installation of mechanical systems and equipment.
  - 2. Use this set of drawings for no other purpose.
  - 3. Where material, equipment, or system components are installed differently from that indicated, indicate such differences clearly and neatly.
  - 4. At project completion, submit record set of drawings in accordance with Division 01.

#### 1.05 DEFINITIONS

- A. Shop Drawings.
  - 1. Fabricated items in this Division in accordance with the requirements of the Contract Documents. Includes data on specially constructed equipment and items normally not referred to as stock items.
- B. Product Data.
  - 1. Data for stock items of equipment and materials may be technical catalog information or other engineering data.
- C. Samples
  - 1. Submit samples in accordance with the provisions of the Contract Documents.
  - 2. Although indicated as not required in the specification section, a sample will be required if submittal compliance with specification is not clear.
  - 3. All samples requested by the Engineer shall be promptly submitted upon request, in accordance with applicable provisions of the Contract Documents.
- D. Specification Comparison
  - 1. Specification comparison is to be submitted with shop drawings, product data, or samples where indicated for each section. Provide the number of copies required by shop drawings or product data.
  - 2. Specification comparison shall be a typewritten document listing each specification paragraph by number, and stating if the product or system complies with the specification. If product or system does not comply state how the product or system satisfies the specification intent to justify its approval.
  - 3. Shop drawings, product data, or samples will not be reviewed if specification comparison is not included where requested.
  - 4. Specification comparison shall be signed by the manufacturer or suppliers authorized representative.
  - 5. Although indicated as not required in the specification section, a specification comparison will be required if submittal compliance with specification is not clear.
- E. Test Reports
  - 1. Submit test report where required by the individual sections.
  - 2. Records of all tests and inspections, with complete data on all readings taken, shall be made and incorporated into a legible report. Contractor shall submit 4 copies of the test report in accordance with contract documents.

3. Test report shall be conducted by an independent testing agency where indicated or by the person responsible for the test as indicated in the individual section. If not specifically indicated otherwise, the contractor may conduct tests.
  4. Test report shall list date tested, test instruments, personnel who conducted test, and test results.
  5. All items that fail test shall be repaired or replaced and retested. Include all information listed above on retest.
  6. The person responsible for the test shall sign report.
  7. Submit test report after all items have passed tests.
  8. Test reports shall be submitted and approved, before final completion, and before inspection by AHJ.
- F. Qualifications of installer
1. Where required, submit Qualifications of installer where required by the individual sections. Refer to individual sections for additional requirements.
  2. Installer will supervise the installation and components of the system. Installer shall have a minimum 2 years experience successfully installing the same type and design as indicated.
  3. Where required, submit the names, locations, point of contact, and telephone number of at least 2 installations of the same type and design that the installer has installed.
- G. Operation and Maintenance Data
1. Where required, furnish operation and maintenance data on all equipment installed under this Division of the Specifications. Data shall conform to the requirements set forth under Division 01.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Use only prime quality, new materials, apparatus and equipment.

### 2.02 ACCESS DOORS, PANELS, AND FRAMES

- A. Access doors, panels and frames: See Section 08 31 16.
1. Where not indicated on Drawings, provide access panels and/or doors at walls, and inaccessible ceilings as required to permit access to equipment, devices and piping requiring service, adjustment, or inspection.
  2. Size:
    - a. As required to allow access, inspection, service, and removal of items served.
    - b. Minimum 18 x 18 IN.

### 2.03 MOTORS AND CONTROLS

- A. Motors:
1. Provide motors indicated in Mechanical Specification Divisions.
  2. Motors shall be ball or roller bearing type, premium efficiency type, and have starting and running characteristics consistent with torque and speed requirements of driven machine.
  3. Motor efficiency:
    - a. NEMA Standard MG-1, part 31.



- b. Indicate full load efficiency on each nameplate.
- 4. Use motors rated in accordance with NEMA performance standards to carry full nameplate load continuously at maximum temperature rise of 40 deg C above ambient with service factor of 1.15.
- 5. Motor powers as scheduled.
- 6. Do not allow power requirements of driven machine to exceed nominal nameplate rating of motor furnished.
- 7. Do not include service factor when selecting motor power.
- B. Motors for use with adjustable frequency drives (AFD's):
  - 1. Each motor shall be provided with the following to prevent bearing current damage:
    - a. Shaft grounding ring:
      - i. General: Discharges shaft currents to ground through use of frictionless conductive microfibers surrounding motor shaft.
      - ii. Maintenance required: none.
      - iii. Service life: Designed to last for service life of motor.
      - iv. RPM limitation: none.
- C. Motor controls and wiring for controls:
  - 1. Provide complete installation of controls and wiring for controls for Mechanical Specification Divisions packaged/pre-wired equipment.
    - a. Include line voltage controls, low voltage controls, control switches, starters, disconnects, conduit, and wiring.
    - b. Locate disconnects on outside of equipment enclosures or guards.
  - 2. Starters, disconnects, conduit, and wiring furnished under Mechanical Specification Divisions shall comply with applicable Electrical Specification Divisions.
  - 3. Where equipment is specified with packaged/pre-wired controls, but is furnished instead with loosely shipped components that require field wiring, coordinate complete installation and assume costs.

#### 2.04 RAIN HOODS AND COUNTER FLASHINGS

- A. Rain hoods and counter flashings not exposed to view:
  - 1. Stainless steel: Minimum 20 GA.
  - 2. Sheet copper: Minimum 7.3 kg/m<sup>2</sup> 24 OZ/SF.
- B. Rain hoods and counterflashings exposed to view:
  - 1. Material specified in Section 07 62 00.

#### 2.05 STRUCTURAL STEEL FOR SUPPORTS

- A. Structural steel for supports: ASTM-A36.
  - 1. Galvanize members installed in fan plenums or areas of high humidity or condensation, and outside.
  - 2. Shop fabricate for field assembly using bolts.
  - 3. Minimize field welding.
- B. Unless support is otherwise indicated where weight of equipment exceeds 180 kg 400 LBS, submit engineering design and calculations signed and seal by an engineer licensed in the state in which the project is located.

**PART 3 - EXECUTION**

**3.01 GENERAL**

- A. When changes in location of work are required, obtain approval of Architect before making change.
  - 1. Make changes at no extra cost.
- B. Provide necessary offsets and crossovers in piping and ductwork, whether indicated or not.
- C. Install piping and ductwork parallel to walls and vertically plumb.
- D. Do not change indicated sizes without approval of Architect.
- E. Roof penetrations:
  - 1. Make penetrations through roofs prior to installation of roofing.
  - 2. For penetrations required after installation of roofing:
    - a. In built up roofing (BUR), provide curbs, cants and counter flashings.
    - b. In elastic sheet roofing (ESR), arrange and pay for flashing work by authorized roofer; provide counter flashings.
  - 3. Repair and replace roof construction which is damaged by this work in manner which will not nullify roof warranty.

**3.02 CUTTING AND PATCHING**

- A. Where it is necessary to disturb work of other sections, perform or pay for cutting, fitting, repairing, patching and finishing of work to permit installation of mechanical work.
- B. Avoid cutting, where possible, by setting sleeves or frames, and by requesting openings in advance.
  - 1. Coordinate locations with work of other sections.
- C. Before cutting of structural elements, obtain written approval of Structural Engineer.
  - 1. Use only approved methods.
  - 2. Neatly cut holes as approved by structural engineer to admit work.
  - 3. Do not weaken walls or floors; locate holes in concrete to avoid structural members.
- D. Locate openings and sleeves to permit neat installation of piping, ductwork and equipment.
- E. Do not remove or damage fireproofing materials.
  - 1. Install hangers, inserts, supports, and anchors prior to installation of fireproofing.
  - 2. Repair or replace fireproofing removed or damaged, at no extra cost.
- F. In existing areas remove and replace existing ceilings for mechanical work if not indicated to be removed on architectural drawings.
- G. See Section 01 73 29.

**3.03 EXCAVATING AND BACKFILLING**

- A. See Section 31 23 33.

**3.04 INSTALLATION OF EQUIPMENT**

- A. Install equipment in accordance with manufacturer's recommendations and as specified.
- B. Provide necessary anchoring devices and supports.
  - 1. Use structural supports suitable for equipment, or as indicated.

2. Check loadings and dimensions of equipment with shop drawings.
  3. Do not cut building structural members.
  4. Provide equipment supports even though not detailed on architectural and structural drawings.
- C. Verify that equipment will fit support layouts indicated.
1. Where substitute equipment is used, revise indicated supports to fit.
- D. Arrange for necessary openings to allow entry of equipment.
1. Where equipment cannot be installed as structure is being erected, provide and arrange for building in of boxes, sleeves or other devices to allow later installation.
- E. Install rain hoods and metal counter flashings as indicated, and to make penetrations of mechanical work through walls and roofs water and weathertight.
1. Furnish clamps, waterproofing material and labor.
- F. Provide concrete foundations (isolation pads) or housekeeping pads for mechanical equipment as follows unless indicated otherwise:
1. Install 4 IN high concrete housekeeping pads. Outside dimension of pad shall be 4 IN larger in all directions than base of equipment or 9 IN from center of anchor, which ever is greater.
  2. Use 3,000 PSI concrete.
  3. Reinforce with No. 4 bars, 12 IN OC each way, with short No.4 dowels into floor at 24 IN OC each way.
  4. Chamfer top edges 3/4 IN.
  5. Make faces smooth.
  6. Set anchor bolts for equipment.

### 3.05 PAINTING

- A. See Section 09 91 13 and Section 09 91 23.

### 3.06 WORK IN EXISTING BUILDING

- A. Maintain existing services and equipment unless indicated to be removed.
- B. Salvage items in accordance with Section 02 41 00.

### 3.07 FIELD QUALITY CONTROL

- A. Perform indicated tests to demonstrate workmanship, operation, and performance.
1. Conduct tests in presence of Architect and, if required, inspectors of agencies having jurisdiction.
  2. Arrange date of tests in advance with Architect, manufacturer and installer.
  3. Give inspectors minimum of 24 hours notice.
  4. Furnish or arrange for use of electrical energy, steam, water or gas required for tests.
  5. Furnish materials required for test.
- B. Repair or replace equipment and systems found inoperative or defective and retest.
1. If equipment or system fails retest, replace it with products conforming to Contract Documents.
  2. Continue remedial measures and retests until satisfactory results are obtained.
- C. Test equipment and systems for each item, unless otherwise recommended by manufacturer.

1. Tests specified in Section 20 08 00, Testing and Balancing need not be duplicated under other sections.

**3.08 ADJUST AND CLEAN**

- A. Inspect equipment and put in satisfactory working order.
- B. Clean exposed and concealed items: See Cleaning (Section 01 74 23).
  1. Clean air surfaces of coils, fans (including fan wheels and motors), air handler plenums and air filter frames.
  2. Clean floor drains, cleanouts, and plumbing fixtures.
  3. Clean specialties such as traps and strainers and equipment surfaces such as pumps, motors, etc.
  4. Clean piping of tags, debris and other construction materials before insulating or painting.
  5. Clean debris including dirt and sand out of ductwork.

**3.09 PUTTING SYSTEMS IN OPERATION - START UP**

- A. Prior to substantial completion and building occupancy, at time agreed to by Owner and Architect, put systems into satisfactory operation.
  1. At first heating or cooling season following substantial completion, put systems not yet operated under their seasonal loads into satisfactory operation.
- B. Operate systems in satisfactory working order for period of 10 working days.
- C. After the 10 days, clean debris including dirt and sand out of ductwork.

END OF SECTION 20 05 00

SECTION 20 05 23 - MANUAL VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Definitions:
  - 1. Class: ANSI Class.
  - 2. SWP: Steam Working Pressure.
  - 3. WOG: Water/Oil/Gas non-shock working pressure.
  - 4. WWP: Cold water non-shock working pressure.

1.02 QUALITY ASSURANCE

- A. This specification lists a variety of valves that may be applicable to the project. Not all valves listed are applicable to the project, refer to appropriate specs sections for project applicability.
- B. Fire protection valves: UL listed, NFPA and FM approved.
- C. Valve bodies, shells and seats: Designed, manufactured, and tested in accordance with the following:
  - 1. Pressure testing of steel valves: MSS SP-61.
  - 2. Butterfly valves: MSS SP-67.
  - 3. Cast iron gate valves, flanged and threaded ends: MSS SP-70.
  - 4. Cast iron swing check valves, flanged and threaded ends: MSS SP-71.
  - 5. Cast iron plug valves, flanged and threaded ends: MSS SP-78.
  - 6. Bronze gate, globe, angle and check valves: MSS SP-80.
  - 7. Valve pressure testing methods: MSS SP-82.
  - 8. Cast iron globe and angle valves, flanged and threaded ends: MSS SP-85.
  - 9. Diaphragm type valves: MSS SP-88.
  - 10. Resilient seated eccentric cast iron plug valves: MSS SP-108.
  - 11. Ball valves--threaded, socket-welding, solder joint, grooved, and flared ends: MSS SP-110.
- D. Standard Specification for Composition of Bronze or Ounce Metal Castings: ASTM-B62.
- E. Iron body valves:
  - 1. Pressure containing parts: ASTM-A126, Grade-B.
    - a. Standard Specification for Gray Iron Castings for valves, flanges and pipe fittings: ASTM-A126, Grade B.
  - 2. Face to face and end to end dimensions: ANSI/ASME-B16.10.
- F. Valve stems: ASTM-B371, Alloy C69400; ASTM-B371, Alloy C65100H04 (rolled silicon brass); or other material equally resistant to dezincification.
- G. Indicate following information on valves:
  - 1. Stamped or cast into body:
    - a. Manufacturer's name or trademark.
    - b. Pressure rating as Class, SWP, WOG, or WWP.
    - c. "UL-FM" for UL-FM valves.

1.03 SUBMITTALS

- A. Product data:
  - 1. Valves.
    - a. In addition to submittal requirements of 01340, submittal shall include the following:
      - i. For submittals with model numbers not listed in this section, include published cross reference sheet. Indicate association between submitted model number and the listed model number on the cross reference sheet.
      - ii. For each valve submitted indicate in which specification section(s) and in which system(s) the valve will be used.
    - b. When valve assembly includes components other than the base valve body and handle (e.g., operator, valve box), include data on entire valve assembly.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. Acceptable manufacturers:
  - 1. Angle valves:
    - a. Base:
      - i. Nibco.
      - ii. Stockham .
    - b. Optional:
      - i. Crane Valves.
      - ii. Hammond Valve.
      - iii. Jenkins Valves.
      - iv. Lunken.
      - v. Milwaukee Valve.
      - vi. Powell.
      - vii. Walworth.
  - 2. Ball valves:
    - a. Base:
      - i. Milwaukee Valve.
      - ii. Nibco.
    - b. Optional:
      - i. Apollo.
      - ii. Crane Valves.
      - iii. Hammond Valve.
      - iv. Jamesbury.
      - v. Jenkins Valves.
      - vi. Stockham.
  - 3. Butterfly valves:
    - a. Base:
      - i. DeZurik.
      - ii. Milwaukee Valve.
      - iii. Stockham.
      - iv. Victaulic of America.
    - b. Optional:
      - i. CenterLine Inds.
      - ii. Crane Valves.

- iii. Jamesbury.
  - iv. Hammond Valve.
  - v. Keystone Valve.
  - vi. Lunken.
  - vii. Mueller Steam Specialty.
  - viii. Nibco.
  - ix. Powell.
  - x. Walworth.
4. High Performance Butterfly Valves:
- a. Base:
    - i. Dezurik.
  - b. Optioinal:
    - i. Bray Controls.
    - ii. Neles (Jamesbury).
5. Check valves:
- a. Base:
    - i. Apco Valve & Primer.
    - ii. Nibco.
    - iii. Stockham Valves & Fittings.
  - b. Optional:
    - i. Crane Valves.
    - ii. Hammond Valve.
    - iii. Kennedy Valve.
    - iv. Milwaukee Valve.
    - v. Mueller Steam Specialty.
    - vi. Powell.
    - vii. Victaulic of America.
    - viii. Viking.
    - ix. Walworth.
    - x. Waterous.
6. Gate Valves:
- a. Base:
    - i. Mueller Steam Specialty.
    - ii. Nibco.
    - iii. Stockham.
  - b. Optional:
    - i. Crane Valves.
    - ii. Hammond Valve.
    - iii. Jenkins Valves.
    - iv. Kennedy Valve.
    - v. Milwaukee Valve.
    - vi. Mueller Steam Specialty.
    - vii. Powell.
    - viii. Walworth.
7. Globe valves:
- a. Base:
    - i. Stockham.
  - b. Optional:
    - i. Crane Valves.

- ii. Hammond Valve.
  - iii. Jenkins Valves.
  - iv. Lunken.
  - v. Milwaukee Valve.
  - vi. Nibco.
  - vii. Powell.
  - viii. Walworth.
8. Plug valves:
- a. Base:
    - i. DeZurik.
    - ii. Resun Valves.
  - b. Optional:
    - i. Milliken.
    - ii. Mueller Steam Specialty.
    - iii. Rockwell International.
    - iv. Victaulic of America.
9. Valve boxes and stop boxes:
- a. Base:
    - i. Tyler Pipe.
    - ii. Western.
  - b. Optional:
    - i. Neenah Foundry.
    - ii. Vulcan.
    - iii. Local foundry.
10. Balancing valves (globe style):
- a. Base:
    - i. Tour and Andersson.
  - b. Optional:
    - i. Armstrong.
    - ii. Wheatley.
    - iii. Mepco.
11. Other manufacturers desiring approval comply with Section 00 26 00.
- B. Ball valves:
- 1. Port size: Standard.
  - 2. Ball and stem material: 316 Stainless Steel unless noted otherwise in specific valve description.
  - 3. Blow-out proof stems.
  - 4. Reinforced Teflon (PTFE) (PTFE) seats.
  - 5. Teflon (PTFE) (PTFE) seals.
  - 6. Adjustable packing.
  - 7. 3-piece valves:
    - a. May be standard port.
    - b. Repairable in line.
- C. Butterfly valves:
- 1. Ninety degree operation.
  - 2. Bi-directional, bubble-tight shut off at full pressure rating (at full differential pressure).
  - 3. 2 IN extended neck.
  - 4. Lugs, where specified, shall be drilled and tapped.



5. Operators:
  - a. DN65 to DN100 2-1/2 to 4 IN: Position lock handle.
  - b. DN125 5 IN and larger: gear operator with 4-arm or wheel handle.
6. Iron body:
  - a. Seals shall be replaceable without removing valve from line or removing parts other than operator.
7. Bronze:
  - a. Blow-out proof stem.
  - b. Viton seals.
  - c. Pressure rating: 175 PSI WWP, 350 PSI WOG.
- D. High performance butterfly valves:
  1. Ninety degree operation.
  2. Bi-directional, drip-tight shut off at full pressure rating.
  3. 2 IN extended neck.
  4. Lugs shall be drilled and tapped.
  5. Operator: gear type with 4-arm or wheel handle.
  6. Body: carbon steel.
  7. Disc: stainless steel.
  8. Seat: RTFE.
  9. Stem: stainless steel; blow-out proof.
  10. Taper pins: compression type; stainless steel.
  11. ANSI Class: 150.
  12. Applicable fire test standard: API-607.
- E. End styles, general:
  1. Compatible with piping systems served.
  2. Flanged valves:
    - a. Class 125 cast iron: Flat flanges.
    - b. Class 250 cast iron: Raised flanges.
    - c. Ductile iron: Raised flanges.
  3. Valves with solder ends for use in brazed piping systems shall be constructed for brazing.
- F. Extended necks and stems:
  1. For valves specified with extended necks or stems, provide design that isolates moving valve parts from insulation.
  2. For valves specified with extended necks or stems and memory stops, provide design that allows access to memory stop without disturbing insulation.
- G. Packing shall not contain asbestos.
- H. Plug valves:
  1. Eccentric plugs:
    - a. Non-lubricated valves with resilient seats shall be suitable for 250 degF service.
- I. Rubber seated eccentric plugs: Bolted stem seals shall permit replacement of packing without removing valve from line or removing parts other than operator.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Refer to individual sections for specific valve installation requirements.
- B. Keep valves clear of pull spaces.
- C. Install valves in accessible locations for operation, removal, inspection, and repair of valves and equipment.
- D. Install gate and globe valves with stem in vertical upright to horizontal position.
- E. Install butterfly valves with stem in horizontal position.
- F. Install diaphragm valves to be self draining.
- G. Support valves individually to relieve pipe stress and allow equipment removal.
- H. Follow manufacturer's recommendation for disassembly of valves for end joining method employed.
- I. Provide globe valve in bypass around control valves. Coordinate with Controls Contractor.
- J. Provide shut off valve on each side of control valve. Coordinate with Controls Contractor.

END OF SECTION 20 05 23

SECTION 20 05 53 - MECHANICAL IDENTIFICATION SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Description of work:
  - 1. Piping, valve, duct and equipment identification.

1.02 QUALITY ASSURANCE

- A. Piping system identification:
  - 1. ANSI-A13.1, "Scheme for the Identification of Piping Systems".

1.03 SUBMITTALS

- A. Product data:
  - 1. Pipe markers.
  - 2. Valve tags.
  - 3. HVAC duct markers.
  - 4. Equipment name plates.
  - 5. Access panel markers.
    - a. Underground marking tape.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Acceptable manufacturers:
  - 1. Pipe, valve and equipment markers:
    - a. Base:
      - i. Seton Name Plate.
    - b. Optional:
      - i. Brady, WH.
      - ii. EMED.
      - iii. Kolbi Industries.
      - iv. 3M.
      - v. Craftmark Identification Systems.
      - vi. Marking Services, Inc.
      - vii. Carlton Industries.
      - viii. Brimar.
  - 2. Underground marking tape:
    - a. Base:
      - i. Reef Industries.
    - b. Optional:
      - i. Seton Name Plate.
      - ii. EMED.

2.02 PIPE MARKERS

- A. Pipe markers: Conform to ANSI-A13.1.

1. Pressure sensitive vinyl (self-adhesive) material.
2. Mechanically fastened type: Snap on or strap on.
  - a. For dirty greasy, oily pipe where pressure sensitive markers may not perform satisfactorily.
3. Provide with arrows indicating direction of flow.
4. Letter sizes: In accordance with table in Part 3.

### 2.03 VALVE TAGS

- A. Valve tags: Brass or anodized aluminum type.
  1. Brass: Minimum 19 gauge, polished, 1-1/2 IN diameter with following lettering:
    - a. Service: 1/4 IN stamped black filled letters.
    - b. Valve numbers: 1/2 IN stamped black filled letters.
  2. Aluminum: 2 IN diameter, 0.032 IN thick, with following lettering:
    - a. Service: 1/4 IN engraved letters.
    - b. Valve numbers: 1/2 IN engraved letters.
- B. Valve tag fasteners:
  1. 4 ply 0.018 IN copper or monel wire meter seals, brass "S" hooks or No.16 brass jack chain.

### 2.04 EQUIPMENT NAME PLATES

- A. Equipment name plates:
  1. 1/16 IN rigid plastic, "Setonply", "Emedolite" or bakelite with 4 edges beveled; or engraved aluminum with black enamel background and natural aluminum border and letters.
    - a. Two 3/8 IN mounting holes.
    - b. Lettering size: Minimum 1/2 IN high.

### 2.05 UNDERGROUND MARKING TAPE

- A. Underground detectable marking tape:
  1. Lamination bond of 1 layer of aluminum foil between 2 layers of inert plastic film.
    - a. Aluminum foil: Minimum 0.35 mils thick.
    - b. Inert plastic film: Minimum 4.3 mils thick.
  2. Resistant to alkalis, acids and other destructive agents found in soil.
  3. Minimum tensile strength: 63 LBS per 3 IN width.
  4. Minimum elongation: 500 percent.
  5. Provide continuous printed message repeated every 16 to 36 IN warning of pipe buried below (e.g.: "CAUTION WATER SYSTEMS BURIED BELOW").
  6. Tape to be inductively locatable and conductively traceable using a standard pipe and cable device for minimum of 8 years after burial.
  7. Color code:
    - a. Blue: Water systems, domestic and fire.
    - b. Green: Sanitary sewer system.
- B. Reef Industries, Detectable Terra Tape.

**PART 3 - EXECUTION**

**3.01 VALVE IDENTIFICATION**

- A. Identify all valves, with appropriate service designation and valve number designation on valve tags.
- B. Install tags on valves using valve tag fasteners in manner for easy reading.

**3.02 PIPE IDENTIFICATION**

- A. Fire-protection and sprinkler piping.
  - 1. Painting not required in non-finished areas.
- B. Identify piping systems with indicated lettering:

Drawing      Pipe Identification

Symbol      Lettering

CD            Condensate Drain

CW            Domestic Cold Water

F             Fire Protection

GWR          Glycol Water Return

GWS          Glycol Water Supply

S             Sprinklers

- C. Locate identification lettering as follows:
  - 1. Next to each valve and fitting, except on plumbing fixtures and equipment.
  - 2. At each branch or riser take off.
  - 3. At each passage through walls, floors and ceilings.
  - 4. At each pipe passage to underground.
  - 5. On horizontal pipe runs every 20 FT, at least once in each room and each story traversed by piping system.
  - 6. Identify piping contents, flow direction, supply and return.
  - 7. So it is readable from access panels and not obscured by other work.
- D. Size lettering, marker color fields, and arrows as follows:

Outside Diameter of Pipe or Pipe Covering IN	Length of Color Field (Markers) IN	Size of Letters and Arrows IN
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4

- E. Pipe markers:

1. Install markers with tape color bands over each end of marker, extending around pipe and overlapping a minimum of 30 degrees.

### 3.03 EQUIPMENT IDENTIFICATION

- A. Attach equipment nameplates in conspicuous location, directly on item of equipment or apparatus such as starters, pumps, fans, HVAC units and control panels.
  1. Secure nameplates with self-tapping screws, or nuts and bolts.
- B. For unsuitable surfaces, such as high temperature or lack of space, use copper or brass rings or chains to attach tags.

### 3.04 CONTROL DIAGRAMS AND INSTRUCTIONS

- A. Provide HVAC control and systems instructions and diagrams in wall mounted frames.
  1. Mount framed diagrams in conspicuous, in equipment rooms housing appropriate HVAC system.
- B. Diagrams and instructions may be reduced in size provided they are easily readable and lettering is not smaller than 0.1 IN.

END OF SECTION 20 05 53

SECTION 20 07 00 - PIPE, DUCT AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Description of systems:
  - 1. Pipe insulation.
  - 2. Duct insulation.
  - 3. Equipment insulation.
  - 4. Insulation jacketing and prefabricated fitting covers.
  - 5. Insulation fasteners: Adhesives, mastics, and caulking.
- B. Definitions:
  - 1. Concealed: Outside surfaces are isolated from room ambient air conditions by physical barrier(s).
    - a. Concealed items are typically accessed through suspended ceilings, through access doors, or by cutting and patching.
    - b. Listed below are examples of spaces that typically contain concealed items:
      - i. Walls.
      - ii. Partitions.
      - iii. Chases.
      - iv. Shafts.
      - v. Ceiling spaces.
  - 2. Exposed to weather: Outside surfaces are not isolated by physical barrier(s) from weather or outside ambient air conditions.
  - 3. Runouts: Piping not more than 12 FT in length.
  - 4. Thermal conductivity (k): Btu/(h-ft-degF).
  - 5. Serviceable: strainers, cleanouts.
  - 6. Non-Serviceable: fittings, valves.

1.02 QUALITY ASSURANCE

- A. Comply with the following fire and smoke hazard ratings:
  - 1. Test products by procedure ASTM-E84, NFPA-255 and ANSI/UL-723.
  - 2. Rating requirements:
    - a. Maximum Flame Spread: 25.
    - b. Maximum Smoke Developed: 50.
  - 3. Properly identify products for flame and smoke ratings.
    - a. Shipping cartons may be labeled instead of product.
- B. Comply with requirements of the following:
  - 1. ASTM-C547: "Standard Specification for Mineral Fiber Preformed Pipe Insulation."
  - 2. ASTM-C533: "Standard Specification for Calcium Silicate Pipe and Block Insulation."
  - 3. ASTM-C534: "Standard Specification for Preformed Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form."
    - a. Products are allowed to deviate from this standard with regard to insulation density.
  - 4. ASTM-C552-00: "Standard Specification for Cellular Glass Thermal Insulation."
  - 5. ASTM-C553: "Standard Specification for Mineral Fiber Blanket and Felt Insulation."

6. ASTM-C585: "Recommended Practice for Inner and Outer Diameters of Rigid Pipe 'Insulation for Nominal Sizes of Pipe and Tubing (NPS System)."
7. ASTM-C612: "Standard Specification for Mineral Fiber Block and Board Thermal Insulation."
8. ASTM-C1136: "Standard Specification for Flexible Low Permeance Vapor Retarders for Thermal Insulation."
9. Federal Specification HH-I-558B: "Mineral Fiber Boards, Blankets, Pipe Covering."
10. ASTM E 84, Surface Burning Characteristics: Omega Point Laboratories Applied Fireproofing Listing Nos. 11660-2, 11660-4.
11. ASTM C 518 Aging Test, Steady State Heat Flux Measurements and Thermal Transmission Properties.
12. ASTM E 162, Surface Flammability of Materials.
13. ASTM E 136, Combustion Characteristics of Building Materials in a Vertical Tube Furnace.
14. National Commercial and Industrial Insulation Standards (1999 fifth edition).
  - a. Published by Midwest Insulation Contractors Association (MICA).
  - b. Endorsed by National Insulation Association (NIA).
  - c. MICA plate numbers listed in this specification reference this document.

### 1.03 SUBMITTALS

- A. Product data:
  1. Pipe insulation.
  2. Precut insulation inserts.
  3. Ductwork insulation.
  4. Insulation for hot equipment.
  5. Insulation for high-temperature equipment.
  6. Insulation for cold equipment.
  7. Jacketing and prefabricated fitting covers.
  8. Insulation fasteners.
    - a. Schedule of services and insulation thicknesses.

## PART 2 - PRODUCTS

### 2.01 INSULATION MATERIALS

- A. Acceptable manufacturers:
  1. Insulation materials:
    - a. Base: As indicated.
    - b. Optional:
      - i. Owens-Corning Fiberglass.
      - ii. Armacell.
      - iii. Nomaco K-Flex.
      - iv. CertainTeed Insulations.
      - v. Knauf Fiber Glass.
      - vi. Johns Manville.
      - vii. Pittsburgh Corning.
  2. Air Ventilation Duct Wrap Fire Protection Systems:
    - a. Base:



- i. Thermal Ceramics.
    - b. Optional:
      - i. Unifrax Corporation.
      - ii. 3M.
  - 3. Jacketing:
    - a. Base: As indicated.
    - b. Optional:
      - i. Ceel-Co.
      - ii. Childers Products.
      - iii. Johns Manville.
      - iv. Proto PVC Corporation.
      - v. RPR Metals.
      - vi. Pabco Metals Corporation.
  - 4. Prefabricated fitting covers:
    - a. Base: As indicated.
    - b. Optional:
      - i. Ceel-Co.
      - ii. CertainTeed Insulations.
      - iii. Childers Products.
      - iv. Proto PVC Corporation.
      - v. Johns Manville.
      - vi. RPR Metals.
      - vii. Pabco Metals Corporation.
  - 5. Adhesives, mastics, caulking, and finishes:
    - a. Base: As indicated.
    - b. Optional:
      - i. Foster Products, Division of HB Fuller.
      - ii. Armacell.
      - iii. Childers Products.
      - iv. Dow Corning.
      - v. Johns Manville.
- B. Insulation - General:
- 1. Do not use material that exceeds specified flame and smoke ratings.
  - 2. Use permanent treatments to jacketings and facings to impart specified fire ratings.
  - 3. Use of water soluble treatments is prohibited.

## 2.02 PIPE INSULATION, NON-FLEXIBLE

- A. Pipe insulation, non-flexible; fiberglass:
- 1. Material: Preformed commercial-grade fiberglass.
  - 2. Temperature range: - 0 degF to 850 degF.
  - 3. Thermal conductivity at mean temperature:
    - a.  $k \leq 0.23$ , 75 degF.
  - 4. Facing: All service jacket.
  - 5. Temperature range: -20 to 150 degF.
  - 6. Integral vapor retarder: Provide where indicated in Part Three.
  - 7. Seams, longitudinal: 2 IN self-sealing facing tabs.
    - a. Provide adhesive on both contacting surfaces.
    - b. Designed to perform without stapling.

**2.03 PIPE INSULATION, FLEXIBLE**

- A. Pipe insulation, flexible:
  - 1. Material: Commercial-grade closed-cell elastomeric or unicellular polyolefin thermal insulation.
  - 2. Temperature range: 40 to 200 degF.
  - 3. Thermal conductivity at mean temperature:
    - a.  $k \leq 0.276$ , 90 degF.
  - 4. Seams, longitudinal: Factory-cut and self-sealing.
  - 5. Base product: AP Armaflex SS.

**2.04 DUCTWORK INSULATION, NON-FLEXIBLE**

- A. Ductwork insulation, non-flexible:
  - 1. Material: Commercial-grade fiberglass thermal insulation formed with a thermosetting resin into semi-rigid or rigid boards.
  - 2. Temperature range: 0 to 450 degF.
  - 3. Minimum density:
    - a. Semi-rigid: 3.0 PCF.
    - b. Rigid: 6.0 PCF.
  - 4. Thermal conductivity at mean temperature:
    - a. Semi-rigid:
      - i.  $k \leq 0.27$ , 150 degF.
    - b. Rigid:
      - i.  $k \leq 0.27$ , 150 degF.
  - 5. Facing: All-Service-Jacket (ASJ).
  - 6. Temperature range: -20 to 150 degF.
  - 7. Base product:
    - a. Semi-Rigid: Owens-Corning Fiberglas Type 703.
    - b. Rigid: Owens-Corning Fiberglas Type 705.

**2.05 DUCTWORK INSULATION, FLEXIBLE**

- A. Ductwork insulation, flexible for interior use:
  - 1. Material: Commercial-grade fiberglass thermal insulation.
  - 2. Temperature range: 40 to 250 degF.
  - 3. Thermal conductivity at mean temperature:  $k \leq 0.27$ , 75 degF.
  - 4. Installed R-value: . 5.6 hr-ft<sup>2</sup>-degF/Btu (based on 2 IN nominal thickness).
  - 5. Density: 0.75 pcf.
  - 6. Facing: Foil-Reinforced-Kraft (FRK) vapor-retarding.
  - 7. Seams: 2 IN facing tab.
  - 8. Base product: Owens-Corning Fiberglas commercial-grade all-service duct wrap.
- B. Ductwork insulation, flexible for exterior use:
  - 1. Material: Commercial-grade closed-cell elastomeric or unicellular polyolefin thermal insulation.
  - 2. Temperature range: -40 to 180 degF.
  - 3. Thermal conductivity at mean temperature:  $k \leq 0.27$ , 90 degF.
  - 4. Water vapor permeability: 0.08 perm-in.
  - 5. Base Product: AP Armaflex Sheet and Roll.

## 2.06 VENTILATION DUCT WRAP FIRE PROTECTION SYSTEMS

- A. Material:
  - 1. High temperature inorganic foil encapsulated flexible fireproofing wrap.
  - 2. Performance:
    - a. Fire rating: 1 or 2 hour, as indicated.
  - 3. Clearance to combustibles rating: zero clearance.
  - 4. Thickness: 1-1/2 IN.
  - 5. Density: 6 pcf.
  - 6. Encapsulated maximum flame spread rating: 25.
  - 7. Encapsulated maximum smoke developed rating: 50.
  - 8. Standards compliance:
    - a. ASTM E2336.
      - i. ASTM E2336 sections 16.4 (Internal Fire Test) and 16.5 (Fire Engulfment) must both appear on grease duct enclosure design listing.
    - b. ASTM E-814 Firestop Test F-Rating: 2 hours.
    - c. ASTM E-814 Firestop Test T-Rating: 2 hours.
    - d. ASTM E-119 Full Scale Engulfment test fire rating: 2 hour.
- B. Tapes: as directed by and approved by manufacturer installation requirements.
- C. Insulation pins/washers: as directed and approved by manufacturer installation requirements.
- D. Through penetration fire stop materials: as directed by and approved by the manufacturer installation requirements.
- E. Access door (either of the following access door assemblies is acceptable):
  - 1. Field assembled:
    - a. Steel angle, same material and gauge as duct, welded to duct.
    - b. Access cover material: minimum 16 gauge steel.
    - c. Accessory devices (threaded rod, insulation pins, wing nuts, washers, etc.): per manufacturers instructions to provide a complete rated and tested assembly.
  - 2. Pre-fabricated system supplied by insulation manufacturer with following main components:
    - a. Inner door: compression seal door (Basis of Design: Ductmate F2-HT).
    - b. Outer door: pre-fabricated insulated access door.

## 2.07 INSULATION FASTENERS

- A. Insulation adhesive:
  - 1. Flexible pipe insulation: Manufacturers standard adhesive as approved for application.
  - 2. Foster 30-36.
  - 3. Foster Spark-Fas 85-70.
- B. Insulation mastic:
  - 1. Childers CP-30.
  - 2. Foster 35-00-GPM.
- C. Insulation caulking:
- D. Dow No.11.

**PART 3 - EXECUTION**

**3.01 APPLICATION - GENERAL**

- A. Apply products per manufacturer's recommendations and as specified.
  - 1. Allow for thermal expansion and contraction.
- B. Do not insulate piping until satisfactory completion of required pressure tests.
- C. Do not insulate piping until heat tracing cable has been installed. Coordinate with cable installer.
- D. In general, do not insulate piping below ground.
  - 1. Specific exceptions may exist under "Pipe insulation, flexible."
- E. Apply insulation to clean, dry surfaces and within manufacturers recommended temperature range.
- F. Butt edges of insulation firmly together, and seal joints with compatible jackets, facings and adhesives as specified.
- G. To prevent condensation on cold systems and equipment, apply insulation with a continuous, unbroken vapor retarder including, but not limited to, insulation of the following.
  - 1. Vapor seals on hangers, supports, and anchors that are secured directly to cold surfaces.
- H. Continue insulation through sleeves and wall and ceiling openings.
- I. Insulate fittings, unions, valve bodies, flanges and other pipeline accessories.
- J. Rectangular and flat-oval ductwork exposed to weather:
  - 1. Apply insulation and jacketing so that top of ductwork has crown that effectively prevents pooling of water.
    - a. Minimum crown slope: 1/4 IN/FT.
- K. Insulation installed in multiple layers: Stagger joints between layers.

**3.02 PIPE INSULATION, FLEXIBLE**

- A. General:
  - 1. Install by slipping insulation over piping.
  - 2. Do not make longitudinal field cuts.
  - 3. Seal joints with manufacturer approved adhesive.
  - 4. Do not use flexible pipe insulation on systems with heat tracing cable or temperature maintenance cable.
- B. Fittings:
  - 1. Insulate fittings and valve bodies with segments cut from pipe insulation.
- C. Provide flexible insulation on following piping systems in wall thickness indicated:
  - 1. Refrigerant systems:
    - a. Refrigerant piping:
      - i. Runouts to DN50 2 IN: 1 IN.
      - ii. DN25 1 IN and smaller: 1 IN.
      - iii. DN32 1-1/4 IN and larger: 1-1/2 IN.
  - 2. Plumbing systems:
    - a. Domestic cold water piping:
      - i. DN40 1-1/2 IN and smaller: 1/2 IN.

- ii. DN50 2 IN and larger: 1 IN.
- b. Domestic water piping below ground within 5 FT of outside walls:
  - i. All sizes: 13 mm 1/2 IN.
- c. Horizontal condensate drain leaders (serving condensate drain discharge from cooling coil condensate drains):
  - i. All sizes: 1 IN.
  - ii. Condensate drain leaders are cold systems.

### 3.03 DUCTWORK INSULATION, NON-FLEXIBLE

#### A. General:

1. Secure insulation to ductwork by impaling over welded-pin or adhesive-pin mechanical fasteners.
  - a. Secure insulation on mechanical fasteners with speed clips.
  - b. Space mechanical fasteners to hold insulation securely in place.
    - i. Maximum spacing: 12 IN centers.
2. Where access is not possible for pin attachment, use adhesive or caulk.
  - a. Cover entire surface with brush applied adhesive.
  - b. Apply caulk in continuous bead on 6 IN centers.
3. Seal joints and speed clips with 3 IN wide pressure-sensitive joint-sealing tape that matches facing.
  - a. Staple corners of tape with outward clinching staples.
4. Cold systems only: Coat staples with mastic.
5. Reinforce edges with metal corner angles.
6. Apply insulation to ductwork from unit housing to ends of duct runs including diffuser necks and register ducts.
7. Do not apply insulation over coil and damper access panels.
8. Do not apply insulation over internally lined ductwork: Coordinate with Section 23 31 13.
9. Use FRK facing on concealed ductwork.
10. Use ASJ facing on exposed ductwork.

#### B. Provide non-flexible insulation on following ductwork in thickness indicated:

1. Outside-air ductwork (rectangular):
  - a. All sizes: 2 IN.
2. Supply-air ductwork exposed in occupied spaces (except equipment rooms):
  - a. All sizes: 1-1/2 IN.
3. Factory-packaged air handling units, , component housings to fan unit inlet including transition sections and prefilter:
  - a. All sizes: 2 IN.
4. Fan discharge transition to and including final filter housing:
  - a. All sizes: 2 IN.
5. Relief-air/exhaust-air plenums behind louvers or below roof ventilators (gravity and powered):
  - a. All sizes: 2 IN.

### 3.04 DUCTWORK INSULATION, FLEXIBLE

#### A. General:

1. On ductwork 24 IN wide and less, secure insulation to bottom of ductwork with 4 IN wide bands of brush-applied adhesive on 12 IN centers.

2. Provide either type of lap seal at joints:
    - a. Seal facing tab over adjoining facing with lap adhesive.
      - i. Secure lap with outward clinching staples on 6 IN centers.
    - b. Use 3 IN wide pressure-sensitive joint-sealing tape that matches facing.
      - i. Secure both sides of tape with outward clinching staples on 6 IN centers.
    - c. Cold systems only: Seal staples with mastic.
  3. Apply insulation to ductwork from unit housing to ends of duct runs, including diffuser necks and register ducts.
  4. Do not apply insulation over coil and damper access panels.
  5. Do not apply over internally lined ductwork: Coordinate with Section 23 31 13.
- B. Provide flexible insulation on following ductwork in thickness indicated:
1. Outside-air ductwork (round):
    - a. All sizes: 3 IN; minimum installed R-value of 8.0.
  2. Supply-air ductwork (including downstream of terminal units), including sound attenuators, reheat coil casings and tube ends, except where specified to be internally lined or where specified to be covered by non-flexible insulation:
    - a. All sizes: 2 IN; minimum installed R-value of 5.0.
  3. Return-air ductwork in non air conditioned areas (including utility shafts):
    - a. All sizes: 2 IN; minimum installed R-value of 5.0.
  4. Return-air, relief-air, and exhaust air ductwork from relief plenum at louver (or other outside opening) back to relief-air damper plus 36 IN or a minimum of 10 FT upstream of plenum, louver or other outside air opening:
    - a. All sizes: 2 IN; minimum installed R-value of 5.0.
  5. Insulation of standing seams: insulation manufactures field-cut pipe insulation with weather barrier.
  6. Apply insulation and jacketing so that top of ductwork has crown that effectively prevents pooling of water.
    - a. Minimum crown slope: 1/4 IN/FT.

### 3.05 VENTILATION DUCT WRAP FIRE PROTECTION SYSTEMS

- A. General installation methods:
1. Acceptable application methods:
    - a. Telescoping overlap.
    - b. Butt joint with collar wrap.
  2. Utilize stainless steel banding to attach the material to the duct; space banding per manufacturers guidelines.
  3. Duct spans 24 IN or larger:
    - a. Weld insulation pins, and apply insulation, to the duct along the bottom horizontal and outside vertical runs per manufacturers instructions.
- B. Access door installation:
1. Install pre-fabricated or field fabricated access door and associated duct wrap, fire stopping, weld pins, etc., according to manufacturer instructions to provide required assembly rating.
- C. Provide air ventilation duct wrap on following ductwork in thickness indicated:
1. Air systems: 1 layer, 1 ½ IN.

### 3.06 JACKETING AND PREFABRICATED FITTING COVERS

- A. General:
  - 1. Stagger jacketing and insulation joints.
- B. Systems exposed to weather:
  - 1. Material:
    - a. 0.016 IN smooth aluminum.
  - 2. Attach as recommended by manufacturer.
  - 3. Joints:
    - a. Orient joint laps to prevent entry of water.
- C. Seal joints weather tight.

END OF SECTION 20 07 00

SECTION 20 08 00 - TESTING AND BALANCING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Test, balance and adjust following mechanical systems:
  - 1. Air distribution systems.
  - 2. Air handling units and air moving equipment.
  - 3. Temperature Controls.

1.02 QUALITY ASSURANCE

- A. Agency qualifications: Member of Associated Air Balance Council (AABC), or National Environmental Balancing Bureau (NEBB).
  - 1. Work supervised by a certified Testing and Balancing Engineer.
  - 2. Indicate at least 5 successfully completed projects of similar size and scope.
- B. Testing and balancing standards: AABC or NEBB standards and procedures.

1.03 RESPONSIBILITIES OF TESTING AND BALANCING (TAB) AGENCY

- A. Review contract document ductwork drawings before bid and advise contractor as to the number and size of additional branch main volume dampers required to facilitate balancing.
- B. Review contractor ductwork installation drawings before fabrication and advise where additional volume dampers are required to facilitate balancing.
- C. Schedule work with trades involved.
- D. Check, adjust, and balance system components to obtain optimum conditions for function and operation of system.
- E. Evaluate operation of systems and advise installer of necessary adjustments and corrective measures.
- F. Prepare and submit test reports.

1.04 RESPONSIBILITIES OF MECHANICAL INSTALLER

- A. Start up system and keep in correct operation during balancing operations.
- B. Provide necessary adjustments and corrections to systems as directed by Testing and Balancing Agent.
- C. Maintain accessibility to test locations and devices requiring adjustment.
- D. Provide a complete set of approved mechanical-equipment shop drawings to Testing and Balancing Agency.
- E. Provide a complete set of "As-built" drawings to Testing and Balancing Agency.

1.05 JOB CONDITIONS

- A. Balance at time directed by Architect.
  - 1. If balancing is not done during peak cooling season demonstrate satisfactory balancing during next peak cooling season.



- B. Keep dust, dirt and debris to an absolute minimum and reinstall removed ceiling tiles to their original positions at end of each day.

#### 1.06 CORRECTIVE WORK

- A. Provide extended warranty of 90 days, after completion of test and balance work, during which time Architect may, at Architect's discretion, request recheck or resetting of equipment or system which is not performing satisfactorily. Provide technicians to assist as required in making such tests.

#### 1.07 SUBMITTALS

- A. Project information:
  - 1. Within 60 days of award of contract submit a complete Submission Report including:
    - a. A company resume listing its personnel and project experience in air and hydronic balancing.
    - b. An inventory and calibration data of instruments and devices in possession of balancing agency whether or not they will be used on this project.
    - c. Test and Balance Report Forms and Field Data Sheets that will appear in final report, with design data already filled in.
    - d. A written, system-by-system description of measurements, test locations and procedures that will be employed during test and balance.
- B. Contract closeout information:
  - 1. Final test and balance report(s):
    - a. Use forms similar to AABC or NEBB latest editions.
      - a. Report(s) signed by TAB Engineer.

### PART 2 - PRODUCTS

#### 2.01 JOB SITE INSPECTIONS

- A. Job site inspections:
  - 1. During construction inspect installation of piping, sheet metal work, temperature controls, and other components of HVAC system as specified in contract documents.
  - 2. Note any deficiencies and submit them, in writing, to Architect.
    - a. Include these inspection reports in final TAB report.

#### 2.02 FINAL TEST AND BALANCE REPORT

- A. Using field data, test forms and procedures outlined in Submission Report, perform and record measurements, and complete final TAB report including:
  - 1. Preface:
    - a. A general discussion of system including any abnormalities and problems encountered.
  - 2. Instrumentation list:
    - a. List of instruments including type, model, manufacturer, serial number and calibration date.
  - 3. System identification:

- a. On each Test and Balance Report Form, number and/ or letter air terminal units, zones, supply, return and exhaust openings and traverse points to correspond to numbers and letters on Field Data Sheets.
  4. Air handling equipment:
    - a. Manufacturer, model number, and serial number.
    - b. Design and manufacturer related data.
    - c. Total actual air flow rate by traverse if practical; if not practical, sum of outlets may be used, or a combination of each of these procedures.
      - i. For specific systems, such as ones with diversity, see AABC National Standards.
    - d. Suction and discharge static pressure of each fan, as applicable.
    - e. Outside air and return air total air flow rate.
    - f. Actual operating current, voltage, and brake power of each fan motor.
    - g. Final RPM of each fan.
    - h. Fan and motor sheave manufacturer, model, size, number of grooves and center distance.
    - i. Belt size and quantity.
    - j. Static pressure controls final operation set points.
  5. Pumps:
    - a. Manufacturer, size, and serial number.
    - b. Design and manufacturer's related data.
    - c. Pump operating suction and discharge pressures, and final total dynamic head.
    - d. No-flow (pump discharge valve closed) suction and discharge pressures, and corresponding total dynamic head. (This procedure is to determine actual impeller size.)
    - e. Rated and actual operating current, voltage and brake power of each pump motor.
    - f. Submit pump curve indicating design, operating, and no-flow points of operation.
  6. Heating and cooling coils:
    - a. Manufacturer.
    - b. Design and manufacturer's related data.
    - c. Rated and actual water pressure drops through each coil and related water flow rate.
    - d. Rated and actual static air pressure drops across each coil.
    - e. Entering and leaving water temperatures.
    - f. Wet bulb and dry bulb temperatures entering and leaving each cooling coil.
    - g. Dry bulb temperatures entering and leaving each heating coil.
    - h. Water flow rate from flow stations or steam pressure.
  7. Air terminal units, diffusers, registers and grilles:
    - a. Adjust air terminal units to deliver design maximum and minimum air-flow conditions.
    - b. Flow rate at each air outlet (diffuser).
    - c. Flow rate at each return and exhaust air inlet (register or grille).
  8. Room Pressure relationships.
    - a. Maintain pressure relationships in rooms that are either positive (supply greater than return/ exhaust) or negative (supply less than return/exhaust).
- B. In the final test and balance report, indicate that these pressure relationships were maintained.

**PART 3 - EXECUTION**

**3.01 GENERAL**

- A. Accurately calibrate and maintain test instruments in good working order.
- B. Do not begin balancing until system(s) have been completed and are in good working order to permit measurements of total air volumes and system pressures.
- C. Record inspections, tests and adjustments.

**3.02 AIR BALANCING METHODS**

- A. Balance each air system that is served by air filters, using artificial static loading of system, to demonstrate, test and obtain system design pressure drop data.
  - 1. Provide dirty filter pressure drop conditions on system.
  - 2. Do not use high efficiency filters (75 percent and above) in testing and balancing.
  - 3. Static pressure losses may be simulated by using wood or sheet steel blanking plates in high efficiency filter racks and housings.
  - 4. Do not install blanking plates within 2 FT of low efficiency filter unit or rack.

**3.03 AIR BALANCE TESTING PROCEDURE**

- A. Perform tests and balance system in accordance with approved Submission Report.
- B. Take readings of airflow stations if installed or make pitot tube traverse of main supply, return and exhaust air ducts.
  - 1. Obtain flow rates at fans at both maximum and minimum outside air operation.
- C. Test and adjust each diffuser, grille, and register served by an air terminal unit to within 10 percent of design requirements.
- D. In cooperation with HVAC Controls installer, set automatically operated dampers to operate as indicated.
  - 1. Check controls for proper calibration and list controls requiring adjustment.

**3.04 OPERATING TEST**

- A. After systems are balanced, conduct operating test of not less than 8 hours duration to demonstrate to satisfaction of Architect that system(s) comply with requirements of plans and specifications, and that equipment and controls are functioning properly.

END OF SECTION 20 08 00

SECTION 20 10 10 - OUTSIDE UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Description of system:
  - 1. Domestic water piping.
  - 2. Fire protection piping.
  - 3. Sanitary sewer piping.
- B. Definition:
  - 1. Outside utility work: Work for following systems from a point 5 FT outside building wall:
    - a. Domestic water system.
    - b. Fire protection system.
    - c. Sanitary sewer system.
  - 2. Engineer: Soils Engineer employed by Owner and empowered to undertake necessary inspections and approvals.

1.02 QUALITY ASSURANCE

- A. Owner will hire an independent soils laboratory to conduct in place moisture-density tests to ensure that work complies with this specification.
  - 1. Notify Construction Manager or Owner's representative at least 2 weeks prior to anticipated date of testing.
  - 2. Contractor will pay additional cost if work is delayed due to Contractor's failure to notify Owner's agent as specified above.
- B. Comply with aspects of "Safety Rules & Regulations for Excavation" as promulgated by State law for state in which excavation will occur.
- C. Piping and Fittings: Section 20 11 00.

1.03 SUBMITTALS

- A. Shop drawings:
  - 1. Fire protection drawings approved by authorities having jurisdiction.
- B. Contract closeout information:
  - 1. Pressure test reports.
  - 2. Disinfection test report.
  - 3. Infiltration test report.

1.04 JOB CONDITIONS

- A. Protect existing utilities and structures as indicated in Section 20 05 00.

- B. Avoid overloading. Keep surcharge sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such a manner to be as little inconvenience as possible to public and adjoining property owners.
  - a. Provide full access to public and private premises, to fire hydrants, at street crossings, sidewalks and other points as designated by Engineer to prevent serious interruption of travel.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Acceptable manufacturers:
  - 1. Coal tar coating:
    - a. Base:
      - i. Koppers Industries.
  - 2. Cleanouts:
    - a. Base:
      - i. Wade.
  - 3. Coating and sealants:
    - a. Base:
    - b. Optional:
      - i. Koppers Industries.
      - ii. Sonneborn Building Products.

### 2.02 PIPE AND FITTINGS

- A. Pipe and fittings – General:
  - 1. Meet or exceed applicable standards and Section 20 11 00.
- B. Domestic water piping, above grade: Section 22 10 16.
- C. Domestic water piping, below grade:
  - 1. DN100 4 IN and smaller: Copper (type L), with soldered joints and wrought copper or cast brass fittings.
- D. Fire protection piping, below grade: Cast iron pressure pipe or ductile iron pipe, lined with restrained Class D mechanical joints or push-on joints and cast iron fittings.
- E. Sanitary sewer piping except pressure drains:
  - 1. Extra strength vitrified clay pipe and fittings with compression joints.
- F. Pressure drains: Cast iron, with mechanical joints and cast iron fittings.

### 2.03 VALVES AND VALVE BOXES

- A. Water valves, service: Complying with AWWA standards.
  - 1. Gate valves: V-47.
  - 2. Butterfly valves: V-48.

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3. Curb stop gate valves: V-45 or V-46.
- B. Fire protection valves:
  1. Gate valves:
    - a. DN50 2 IN and smaller: V-49.
    - b. DN65 2-1/2 IN and larger: V-50.
  2. Butterfly valves (DN65 2-1/2 IN and larger): V-51.
  3. Check valves (DN65 2-1/2 IN and larger): V-53 or V-54.
  4. Post indicator valve (DN65 2-1/2 IN and larger): V-52.
- C. Valve boxes: Adjustable, cast iron (minimum 3/16 IN thick).
  1. Provide for each valve.
  2. Cover with type of service cast-in: "Water", etc.
- D. Cleanouts: Wade W-6000 cast iron floor clean out, Heavy Duty Top-X.

#### 2.04 BACKFILL MATERIAL

- A. Backfill material: As approved by Engineer.
  1. Free of rock cobbles, roots, sod or other organic matter, and frozen material.
  2. Moisture content at time of placement: 3 percent plus/minus of optimum moisture content.
- B. As tested in accordance with ASTM-D698.

### PART 3 - EXECUTION

#### 3.01 EXCAVATING AND TRENCHING - GENERAL

- A. Remove and dispose of materials determined by Engineer to be unsuitable.
- B. Trench, backfill and compact for underground utilities.

#### 3.02 TRENCH EXCAVATION

- A. Excavate trenches by open cut method to depth indicated and necessary to accommodate work.
  1. Permission may be granted for tunnel work for crossing under crosswalks, driveways or existing utility lines.
  2. Such tunnels are limited to 10 FT in length.
- B. Avoid over-excavating below indicated grades unless required to remove unsuitable material.
- C. Back-fill over-excavations in firmly compacted 6 IN lifts.
- D. Trench size: Excavate only sufficient width to accommodate free working space.
  1. Cut trench walls vertically from bottom of trench to top of pipe, conduit, or utility service.

- 2. Trench width at top of pipe or conduit may not exceed outside diameter of utility service by more than following dimensions:

Overall Diameter of Utility Service	Excess Dimension
33 IN and less	16 IN

- E. Keep trenches free of water.
- F. Brace and sheet trenches as soil conditions dictate. Do not remove until backfilling has progressed to a stage that no damage to piping, utility service, or conduit will result due to removal.
- G. Bedding: Lay pipe directly on shaped subgrade.
  - 1. No blocking permitted.
  - 2. Form a continuous bearing with a minimum width of bearing equal to six-tenths (0.6) of outside diameter of pipe, for full length of pipe, except for portion at hole excavated for joint.
- H. Form bell holes in trenches such that only barrel of pipe is firmly supported by bedding material.

### 3.03 PIPE INSTALLATION - GENERAL

- A. Pitch piping to drain:
  - 1. Sanitary sewer: Flow of 2 FPS or 1 percent, where possible.
  - 2. Other piping: 1 percent, minimum.
- B. Install piping in accordance with Section 20 11 00.
- C. Protect pipe from lateral displacement by using pipe embedment indicated.
- D. Lay no pipe in water or in unsuitable weather or trench conditions.
- E. Keep pipe and fittings clean inside; plug open end when laying is stopped.
- F. Paint exposed metal surfaces in structures as indicated in Section 20 05 53.
- G. Set valves in trenches as indicated or as directed by Engineer.
  - 1. Set valves and valve boxes plumb.
  - 2. Place valve boxes directly over valves with top at surface.
  - 3. Immediately after installing boxes, backfill for 4 FT on each side of box.
  - 4. Pour concrete ring around box at grade.
- H. Paint exposed metal surfaces in structures as indicated in Section 20 05 53.

### 3.04 REACTION ANCHORAGE

- A. Reaction anchorage:
  - 1. Use concrete thrust blocking where solid undisturbed ground of adequate bearing capacity is available.

2. Use joint harness in other cases.
  3. If lack of solid undisturbed ground is due to careless or improper trench excavation, provide joint harness at no extra cost.
- B. Coat underground metal surfaces not encased in concrete with coal tar coating.
1. Apply to clean, dry surface.
  2. Allow first coat to dry hard; apply second coat.

### 3.05 FIELD QUALITY CONTROL

- A. Test domestic water piping hydrostatically at pressure not less than 50 percent in excess of maximum pressure to which pipe will ordinarily be subjected, but not less than 150 PSI, indicating no leakage.
- B. Test fire protection piping hydrostatically at 200 PSI for 2 hours, indicating no leakage in excess of NFPA-24 limits.
1. Provide 3 day notice to Fire Marshal prior to testing.
- C. Test sanitary sewer piping in sections as directed by Engineer prior to backfilling.
1. Maximum allowable infiltration: 15 GAL/IN diameter/100 FT/day; or 100 GAL/100FT/ day.
  2. Workmanship: Each line shall indicate a good light circle through its length.
  3. When infiltration test is not practical, low pressure test method as designated in ASTM-C828 is permitted.
- D. Perform backfill density tests as directed by Engineer.
1. Allow for one test per 100 FT of trench.

### 3.06 BACKFILLING

- A. Do not backfill until tests are performed on system, and system complies with specified requirements.
- B. Tamp backfill under and around pipe up to 24 IN above top of pipe in lifts not exceeding 8 IN loose thickness.
- C. Backfill and compact remainder of trench in 8 IN lifts to density specified.
- D. Tamp evenly on both sides of pipe to top of excavation or to a depth such that pipe will not be injured by subsequent compaction used to achieve required density.
- E. Exercise care in backfilling operations to avoid displacing pipe joints either horizontally or vertically and to avoid breaking pipe.
- F. Do not water flush for consolidation.

### 3.07 COMPACTION

- A. Compact trench backfill in areas under paved roads, parking areas, sidewalks and other structures, to minimum of 95 percent.

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- B. In locations where trench will not be under paved areas or structures, compact backfill to minimum 90 percent.

**3.08 STERILIZATION OF DOMESTIC WATER PIPING**

- A. Sterilize system as indicated, or in accordance with AWWA-C601.
- B. Thoroughly flush potable water systems.
- C. After flushing, introduce chlorine or chlorine compound into system with dosage sufficient to give an initial residual chlorine content of 50 ppm.
  - 1. Liquid chlorine: F.S.BB-C-120B.
  - 2. Hypochloride: F.S.O-C-114B2, type II, grade B, or 0-5-602E.
- D. Collect samples from various taps and fixtures throughout buildings during introduction of chlorine to assure uniform distribution. Open and close valves 3 times.
- E. After a 24 hour contact period, flush traces of heavily chlorinated water from systems.
- F. After flushing is complete, submit evidence of effectiveness of disinfection.
  - 1. Laboratory reports of bacteriological tests on samples taken from system.
  - 2. Number and locations of taking samples as specified by Architect.
- G. If unsatisfactory results are obtained, repeat disinfection process until satisfactory.
- H. Do not put system into service until satisfactory tests are reviewed by Engineer.

**3.09 INSTALLATION OF UNDERGROUND MARKING TAPE**

- A. Install underground marking tape above metallic outside utility lines as indicated on Drawings in accordance with manufacturer's instructions.
- B. Install underground detectable marking tape above non-metallic outside utility lines in accordance with manufacturer's instructions.
- C. Allow 12 IN between tape and line, and install as close to grade level as feasible.
- D. When lines are buried at indicated depths, install indicated width of tape.
  - 1. 10 IN depth: 2 IN tape.
  - 2. 20 IN depth: 3 IN tape.
- E. 30 IN depth: 6 IN tape.

END OF SECTION 20 10 10

SECTION 20 11 00 - PIPE AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Description of system:
  - 1. Pressurized piping.
  - 2. Nonpressurized piping.
  - 3. Accessories:
    - a. Dielectric fittings.
    - b. Unions.
- B. This specification lists a variety of piping that may be applicable to the project. Not all piping and fittings listed are applicable to the project, refer to appropriate specs sections for project applicability.

1.02 QUALITY ASSURANCE

- A. Pipe and fittings to be ASTM labeled for rating specified.
- B. Welder qualifications: Certified under requirements of ANSI/ASME-B31.1 Power Piping.

1.03 SUBMITTALS

- A. Project information:
  - a. Manufacturer of listed products.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Acceptable manufacturers:
  - 1. PVC plastic pipe:
    - a. Base:
      - i. Plastiline.
    - b. Optional:
      - i. Cresline.
      - ii. DuPont.
      - iii. Eslon Thermoplastics.
      - iv. R & G Sloane Manufacturing.
      - v. Schuller International.
      - vi. Nibco.
      - vii. CertainTeed Pipe & Plastics.
      - viii. Clow Water Systems.
      - ix. Tyler Pipe.
  - 2. Fittings, mechanical groove-end and plain-end pipe:
    - a. Base:
      - i. Victaulic Company of America.
    - b. Optional:

- i. Anvil International, Inc.
- 3. Fittings, ring seal crimped; copper:
  - a. Base:
    - i. Viega.
  - b. Optional:
    - i. Nibco.
- 4. Dielectric waterway fittings:
  - a. Base:
    - i. Perfection Corp. Victaulic Company of America.
    - ii. Wilkins (a Zurn Company).
    - iii. Epcos Sales Inc.

## 2.02 PIPE

- A. Copper pipe:
  - 1. Seamless copper tubing, ASTM-B88, Type-K, Type-L, or Type-M as indicated.
  - 2. Joints:
    - a. Soldered: Use ASTM-B32, 95 percent tin, 5 percent antimony solder, or Silvabrite 100.
    - b. High temperature soldered: Use 1,000 degF solder.
    - c. Roll grooved.
    - d. Ring seal crimped, where specified and permitted by authority having jurisdiction.
  - 3. 400 PSI fittings: Heavy wall type, Mueller "Steamline".
- B. Polyvinyl chloride (PVC) plastic sewer pipe:
  - 1. ASTM-D3034, SDR35.
  - 2. Joints: Integral bell and spigot type, ASTM-D3212.
  - 3. Gaskets: ASTM-F477, rubber.
  - 4. Fittings: Push-on joint compatible with pipe and conforms to ASTM-D3034.
  - 5. Workmanship:
    - a. Pipe and fittings: Homogeneous throughout and free from cracks, holes, foreign inclusions, or other injurious defects.

## 2.03 FITTINGS AND COUPLINGS

- A. Copper pipe fittings:
  - 1. Wrought copper fittings: ANSI/ASME-B16.22.
  - 2. Cast brass fittings: ANSI-B16.18.
  - 3. Mechanical groove-end fittings: Factory roll grooved.
  - 4. Flared tubing fittings: Use only on annealed pipe.
  - 5. Cast flanged fittings: ANSI/ASME-B16.24, Class 150.
  - 6. 400 PSI fittings: Heavy wall type, Mueller "Steamline".
- B. PVC plastic pipe fittings:
  - 1. Socket type: ASTM-D2466 or ASTM-D2467, Schedule-40 and Schedule-80, long radius patterns.
  - 2. Threaded type: ASTM-D2464, Schedule-80, long radius patterns.
  - 3. Same pressure and temperature rating as pipe.

- C. Unions.
  - 1. Same type, pressure rating and material as piping.
  - 2. Flanges: Raised face type of same type, pressure rating and material as piping.
  - 3. Unions in copper pipe:
    - a. 2 IN and smaller: Use wrought copper solder joint copper to copper unions.
    - b. 2-1/2 IN and larger: Use brass flange unions.
- D. Dielectric unions: See Dielectric fittings:

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Comply with ANSI/ASME-B31.9 for pressure piping installations.
  - 1. Install piping without "bull-head" fittings.
- B. Flush out water piping systems with clean water prior to adding treatment.
- C. In general, make connections to components in piping systems with 3-elbow swing joints to allow for movement.
  - 1. Movement includes but not limited to expansion, contraction, seismic, and equipment vibration isolation.

#### 3.02 PIPING

- A. Install piping parallel to building walls at such heights as not to obstruct portion of window, doorway, stairway, or passageway.
  - 1. Where interference develops in field, offset or reroute piping as required to clear such interferences.
  - 2. Consult Drawings for exact location of pipe spaces, ceiling heights, door and window openings or other architectural details and report discrepancies to Architect, before installing piping.
- B. Pitch piping to drain:
  - 1. Minimum pitch of 1 IN in 100 FT(except drainage piping).
  - 2. Make piping and equipment drainable.
  - 3. Accomplish pipe drainage using drain valves located on equipment and fixtures or separate drains.
- C. Factory cut and thread nipples from seamless stock.
  - 1. Use nipples of same material as pipe with which they are used.
  - 2. Do not use close nipples except where such use is unavoidable.
  - 3. Use Schedule-80 seamless pipe for close nipples and nipples of pipes 3/8 IN or smaller.
- D. Provide backing and sleeves required in walls or floors for setting of fixtures or equipment.
- E. Where transition occurs from sweated fittings (as at connection to fixture supplies, etc.), provide rigid anchorage so that no strain will be placed upon tubing.

#### 3.03 UNIONS

- A. Provide a union between valves, at connection to each fixture, device or item of equipment, and elsewhere as required to facilitate installing, servicing, making up and disconnecting piping.
  - 1. Install each union to facilitate removal of parts, equipment or fixtures for inspection or cleaning.
  - 2. Install in a position which will permit device, fixture or part to be removed without disconnecting piping except unions.
- B. Install unions as directed by Fluid Controls Institute, (FCI).
  - 1. Grooved piping systems:
    - a. Grooved type couplings may serve as unions.
  - 2. Make connections between couplings and flanged equipment with slip-on flanges and a grooved nipple, or groove-to-flange adapter.
- C. Install dielectric fitting at each piping joint and equipment connection between ferrous and non-ferrous materials.

#### 3.04 PIPING EXPANSION

- A. Install piping to allow thermal expansion and contraction without injury to piping, equipment or structure.
  - 1. Use loops or expansion joints where necessary and where detailed.
  - 2. Provide pipe guides at loops as indicated.

#### 3.05 COPPER PIPING

- A. Brazed (high temperature soldered) joints:
  - 1. Take care to avoid annealing of pipe material.
  - 2. For pipe sizes 2 IN and larger: Use a circular torch such as Circa Torch by Cedarberg Industries, for soldering joints.
- B. Use lead-free solder.
- C. T-drilling:
  - 1. Tapped pipe shall be least 1 IN diameter and branch shall be at least 2 pipe sizes smaller.
  - 2. Braze (high-temperature solder) joints.
  - 3. Branch pipe shall not protrude into main.

#### 3.06 PVC PIPING

- A. Make pipe cuts only with miter box.
  - 1. Make cuts square and straight with pipe centerline.
  - 2. Use fine toothed hand wood saw with 14 or more points per inch.
  - 3. After cutting, slightly ream pipe inside and remove external burrs.
- B. Pipe threading:
  - 1. Form standard tapered pipe thread using sharp dies with a negative rake angle of 5 degrees.
  - 2. Perform threading over inserted tapered wooden plugs to assure uniform deep threads.
  - 3. Dies must be sharp and clean.
  - 4. Assemble threaded joint using either graphite base compound or compound recommended by pipe manufacturer.

5. Apply to male threads only and seat joint at slightly more than hand tightness.
  6. Wrench marks will not be allowed on either fitting or pipe.
- C. Chemical welding:
1. Perform in strict accordance with manufacturer's recommendations.
  2. Comply with ASTM-D2855.
  3. Clean both pipe and fitting contact areas with recommended cleaner.
  4. Apply cement lightly to both pipe and fitting and slide fitting on to pipe with one continuous motion and at proper time.
  5. Rotate fitting lightly to distribute cement.
  6. Wipe off excess cement.
  7. Deliver cement for chemical welding to job site in sealed pint containers and keep covered at all times when not in use.
  8. Do not dilute, thin or alter cement.
- D. Use only cement recommended by pipe manufacturers.

END OF SECTION 20 11 00

SECTION 23 23 00 - REFRIGERANT PIPING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Refrigeration piping system includes:
  - 1. Refrigeration piping.
  - 2. Refrigeration valves.
  - 3. Refrigeration specialties.

1.02 QUALITY ASSURANCE

- A. Piping standards: See Section 20 11 00.
- B. Valve standards: See Section 20 05 23.

1.03 SUBMITTALS

- A. Contract closeout information:
  - a. Test reports.

PART 2 - PRODUCTS

2.01 MATERIALS - GENERAL

- A. Furnish material and equipment from an established and reputable manufacturer.

2.02 PIPE AND FITTINGS

- A. Refrigerant piping: Copper, dehydrated, with high-temperature soldered joints and wrought copper ( 400 PSIG) fittings.
  - 1. For underground use: Type K.
  - 2. For above ground use: Type L.
- B. For field assembled units, size refrigeration lines in accordance with manufacturer's published tables using pressure or temperature drops as follows:
  - 1. Suction lines: 2 degF.
  - 2. Liquid lines: 1 degF or 2 PSI.
  - 3. Hot gas lines: 1 degF or 3.6 PSI.
  - 4. Size discharge and hot gas risers for positive oil return to compressors.

2.03 SPECIALTIES

- A. Acceptable manufacturers:
  - 1. Refrigerant piping specialties:
    - a. Base:
      - i. Sporlan Valve.
  - 2. Expansion valves:
    - a. Base:
      - i. Sporlan Valve.
      - ii. Alcoa Building Products.

- B. Moisture indicator: indicate presence of moisture in system by change of color.
  - 1. Install adjacent to filter.
  - 2. In bypass line use Sporlan SA-12S.
- C. Strainers: Design to permit removing screen without removing strainer from piping system.
  - 1. Provide with screens of not larger than 80 mesh.
  - 2. Provide strainers on liquid line serving each thermostatic expansion valve and in suction line serving each refrigerant compressor not equipped with integral strainer.
- D. Oil traps:
  - 1. Provide in lines as indicated.

#### 2.04 VALVES

- A. Valves: Bronze.
  - 1. In lines 2 IN and smaller: Solder ends.
  - 2. In lines 3 IN and over: Four bolt union ends.
- B. Shut off valves: Packed type with gas tight cap seal and hard metal seats and shoulders which permit packing stuffing boxes wide open under pressure; or sealed diaphragm type.
  - 1. Wheel, globe, angle or "T" handle.
- C. Check valves:
  - 1. In liquid lines 5/8 IN and smaller: Lift check type.
  - 2. In lines 3/4 - 2 IN: Swing check type.
  - 3. In lines 3 IN and over: Wafer type swing check with bronze disc.
- D. Expansion valves: Sized by manufacturer for refrigerant used.
  - 1. Provide one in each circuit with liquid distributor connection immediately after.
- E. Vent and test valves: Angle cap type with seal and outlet caps.

### PART 3 - EXECUTION

#### 3.01 REFRIGERANT PIPING ASSEMBLY

- A. Install in accordance with Section 20 11 00.
- B. Thoroughly clean piping of dirt and grease on inside with a suitable cleaning solution just before soldering.
- C. Polish end of tube and inside of fitting.
- D. Purge refrigerant piping of air while connections of refrigerant piping are being made.
  - 1. Shut off valves.
  - 2. Connect tank of dry nitrogen to line on back side of valve.
  - 3. Introduce dry nitrogen into line as refrigerant piping joints are successively made up from valve to each condenser.

#### 3.02 TESTING

- A. Test refrigerant piping to hold pressure of twice normal working pressure for period of 72 hours before refrigerant is added.



- B. Testing pressure shall not exceed maximum rating of weakest component of system.
  - 1. Place an initial charge of Freon in system for detection purposes.
  - 2. Use dry nitrogen gas for pressure testing.
  - 3. Low side to be valved off and tested to 200 PSI.
- C. Check joints with an electronic leak detector.
- D. Cut out joints found to be leaky and replace with new material.

### 3.03 CLEANING

- A. After complete system is tested, disconnect suction and discharge lines from compressor for cleanup.
- B. Valve or blank off system into three separate systems for purpose of cleanup.
  - 1. Suction side including cooling coils.
  - 2. Discharge side including air cooled condenser.
  - 3. Hot gas reheat side including heating DX coils.
- C. Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant or any foreign matter shall be considered contaminated systems.
- D. Restore contaminated system(s) to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging using current refrigerant and refrigeration manufacturer's procedures. Restoring contaminated systems shall be at no additional cost to the Owner.

### 3.04 EVACUATION AND DRYING

- A. After tests and cleaning have been completed and system proved tight, charge each circuit with dry clean Freon to approximately 350 kPa 50 PSI of gas pressure.
- B. Evacuate to 0.4 Pa absolute 100 micron Hg and hold for 48 hours.
  - 1. Use laboratory type vacuum pump capable of holding absolute pressure of 0.2 Pa absolute 50 micron Hg.
- C. Admit another drying charge of Freon and allow 4 to 6 hours to absorb moisture and install dryer cores.
- D. Use second evacuation to remove Freon and moisture.
- E. After second evacuation, charge system with Freon.
- F. Add refrigerant to system as required after final evacuation.

END OF SECTION 23 23 00

## SECTION 23 31 13 - AIR DISTRIBUTION SYSTEM

### PART 1 - GENERAL

#### 1.01 DESCRIPTION

##### A. Description of system:

1. High and low pressure ductwork, fittings and accessories.
2. Dampers.
3. Diffusers, registers and grilles.
4. Sound attenuators.
5. Air blenders.
6. Louver blank-off plates.
7. Duct access doors.
8. Control dampers less actuators.

##### B. Definitions:

1. Low and high pressure ductwork: See Article 2.2 of this section.
2. Gage:
  - a. Steel sheet and wire: U S Standard Gage.
  - b. Aluminum sheet: Browne & Sharpe Gage.
  - c. Steel wire: Washburn and Moen Gage.
3. Concealed insulated surfaces: Piping, ductwork and equipment in walls, partitions, floors, pipe chases, pipe shafts, duct shafts and above suspended ceilings.
4. Exposed insulated surfaces: Piping, ductwork and equipment located in mechanical rooms, tunnels and rooms without suspended ceilings.

#### 1.02 QUALITY ASSURANCE

##### A. Design and installation standards:

1. ASHRAE Handbook - HVAC Systems and Equipment: Current chapter on duct construction.
2. ADC Standard 1062: GRD-84, Test Code for Grilles, Registers and Diffusers.
3. ADC Test Code FD 72-R1, Flexible Air Duct Test Code.
4. AMCA Standard 210, Test Code for Air Moving Devices.
5. ASHRAE Standard 70-72, Method of Testing for Rating the air flow performance of outlets and inlets.
6. NFPA-90A, Standard for the Installation of Air Conditioning and Ventilating Systems, current edition.
7. SMACNA HVAC Duct Construction Standard - Metal and Flexible, Current Edition.
8. SMACNA Duct Cleanliness for New Construction, Current Edition.
9. ASTM-A653/A653M: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanealed) by the Hot-Dip Process.

10. ASTM-A109: Standard Specification for Steel, Strip Carbon (0.25 Maximum Percent), Cold-Rolled.
  11. ASTM-B209: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. Fire and smoke rating test standards: ASTM-E84, NFPA-255 and ANSI/UL-723.
- C. Duct sizes indicated are internal sizes.

### 1.03 SUBMITTALS

- A. Product data:
1. Ductwork and fittings, high pressure.
  2. Dampers, nonrated.
  3. Diffusers, registers and grilles.
  4. Combination Louvers.
  5. Control dampers.
- B. Contract closeout information:
1. Operating and maintenance data for applicable devices such as: control dampers and combination louvers.
    - a. Test reports.

## PART 2 - PRODUCTS

### 2.01 MATERIALS - GENERAL

- A. Acceptable manufacturers:
1. Factory fabricated duct connection systems:
    - a. Base:
      - i. Ductmate Industries.
    - b. Optional:
      - i. Nexus.
      - ii. Ward Industries, Inc.
  2. Sealants, mastics and adhesives:
    - a. Base:
      - i. Hardcast.
    - b. Optional:
      - i. United McGill Airflow Corporation.
      - ii. Foster (Division of HB Fuller).
  3. Turning vanes:
    - a. Base:
      - i. Aerodyne Controls.
    - b. Optional:
      - i. Airsan.

- ii. Tuttle & Bailey.
  - iii. Titus.
  - iv. VentProducts.
- 4. Flexible fan connections:
  - a. Base:
    - i. Ventfabrics.
  - b. Optional:
    - i. Duro-Dyne.
    - ii. Elgin.
- 5. Flexible duct, preinsulated:
  - a. Base:
    - i. Atco.
  - b. Optional:
    - i. Flexible Technologies, Thermaflex.
    - ii. Hart and Cooley.
- 6. Access doors, low pressure:
  - a. Base:
    - i. Ruskin Manufacturing.
  - b. Optional:
    - i. Air Balance.
    - ii. Nailor-Hart Industries, Inc.
    - iii. Ventfabrics.
    - iv. CESCO products.
    - v. Safe-Air of Illinois.
- 7. Access Doors, low and high pressure:
  - a. Base:
    - i. Ductmate.
  - b. Optional:
    - i. Ward Industries.
    - ii. United McGill Airflow Corporation.
- 8. Dampers (manual, backdraft, and control):
  - a. Base:
    - i. Ruskin Manufacturing.
  - b. Optional:
    - i. Arrow Louvers and Dampers, Inc.
    - ii. American Warming & Ventilating.
    - iii. Air Balance.
    - iv. Cesco Products.
    - v. Greenheck.
- 9. Diffusers, registers and grilles (except laminar flow in ceiling systems and radial throw diffusers):
  - a. Base:
    - i. Titus.
  - b. Optional:

- i. Anemostat Air Products.
  - ii. Carnes.
  - iii. Tuttle & Bailey.
  - iv. Krueger.
  - v. Price.
- B. Sheet metal:
  1. Galvanized steel (G90): ASTM-A653/A653M.
- C. Duct sealer: NFPA rating of "Non-Combustible".
  1. Flame spread rating: 25 or lower, in dry condition.
  2. Smoke developed rating: 50 or lower, in dry condition.
  3. Resistant to water and water vapors.
  4. Pressure rupture rating: 16 IN WG, minimum.
- D. Solder: ASTM-B23, Grade-50B.
- E. Duct sealing tape: NFPA rating of "Non-Combustible".
  1. Flame spread rating: 25 or lower, in dry condition.
  2. Smoke developed rating: 50 or lower, in dry condition.
  3. Adhesive: Specifically compounded for maximum adhesion to galvanized and stainless steel.
  4. Listings/Labels: UL 181A or UL 181B.
- F. Duct liner adhesive and mastic: NFPA rating of "Non-Combustible".
  1. Flame spread rating: 25 or lower, in dry condition.
  2. Smoke developed rating: 50 or lower, in dry condition.
  3. Adhesive: Specifically compounded for maximum adhesion to galvanized and stainless steel ductwork.
  4. Listings/labels: UL 181A or UL 181B
- G. RTV foam: UL listed room temperature vulcanized silicone rubber foam.

## 2.02 DUCTWORK

- A. Ductwork - general:
  1. Maintain full areas and suitable shapes at every point.
  2. Shapes may be changed to fit unusual space conditions.
    - a. Cross sectional area to be maintained.
    - b. Modifications increasing system pressure drop require Architect approval.
    - c. Modifications increasing aspect ratio beyond 5:1 require architect approval.
  3. Provide necessary transitions and offsets to complete systems.
  4. All systems shall be constructed of G90 galvanized steel, except as follows:
- B. Ductwork, low pressure, sheet metal:

1. Construct in accordance with SMACNA HVAC Duct Construction Standard as follows:
    - a. Ductwork for systems operating between 2 IN WG 500 Pa and 3 IN WG 750 Pa static pressure, positive or negative:
      - i. Rectangular duct: Table 1-6, 3 IN WG static pressure, positive or negative.
    - b. Ductwork systems operating under 2 IN WG positive or negative:
      - i. Rectangular duct: Table 1-5, 2 IN WG a static pressure, positive or negative.
      - ii. Round duct: Tables 3-2A & 2B, 2 IN WG static pressure, positive or negative.
  2. Low pressure ductwork includes but is not limited to:
    - a. Supply ductwork on outlet side of single and dual duct air terminal units.
    - b. Return, relief air, and outside air ductwork.
    - c. Exhaust air ductwork from air inlets to air terminal units (e.g. isolation exhaust system).
    - d. Exhaust air for other exhaust systems operating less than 3 IN WG static pressure, positive or negative.
    - e. Supply ductwork for constant volume systems without air terminal units.
  3. Transverse joints, rectangular:
    - a. Ducts with longest side 36 IN 910 mm and longer:
      - i. Use factory fabricated flanged duct connection systems (e.g. Ductmate 35/25 slide on systems).
      - ii. Non-proprietary SMACNA defined T-22 or T-24 flanged connections
      - iii. Seal transverse flanged duct connections with pressure sensitive, high density, closed cell, neoprene or polyurethane tape gasket.
    - b. Ducts with longest side shorter than 35 IN:
      - i. Flanged duct connection systems as defined above are optional.
      - ii. Refer to SMACNA HVAC Duct Construction Standard for proper duct construction.
  4. Longitudinal seam: Use Pittsburgh lock seam only.
  5. Seal low pressure ducts to Seal Class A requirements.
  6. Runouts to diffusers, register and grilles: Flexible ducts may be used.
    - a. Exception: Flexible ducts may not pass through smoke or fire rated walls, floors or ceilings.
    - b. Maximum flexible duct length: 3 FT.
    - c. Minimum turning radius:
      - i. As recommended by manufacturer.
      - ii. Do not kink, bend or restrict free area of duct as to generate additional pressure drop or noise.
- C. Ductwork located outside, exposed to weather:
1. Construct using flanged duct connection systems.

2. Seal flanged ends with pressure sensitive, high density, closed cell, neoprene or polyurethane tape gasket.
  3. Use continuous cleat seals on top joints of ducts.
- D. Duct hangers and supports: In accordance with following:
1. High and low pressure ductwork (sheet metal): SMACNA HVAC Duct Construction Standard, Section-IV.
- E. Duct fittings and joints on low pressure systems:
1. Radius elbows without vanes: Radius ratio (R/W) of 1.5 and greater.
  2. Radius elbows with vanes: Radius ratio (R/W) less than 1.5; use where space limitations occur.
    - a. R/W = 0.75 to 1.0: Provide 3 vanes in elbow.
    - b. R/W = 1.0 to 1.25: Provide 2 vanes in elbow.
    - c. R/W = 1.25 to 1.5: Provide 1 vane in elbow.
    - d. Provide vane spacing per Figure 2-3, SMACNA HVAC Duct Construction Standards.
  3. Where square elbows are indicated or required, provide with turning vanes.
  4. Connections to diffusers, grilles and registers: Fitted securely to necks or collars provided behind diffuser, grille, or register face area.
  5. Branch connections:
    - a. Round: Factory built short cone or bellmouth type. Air scoops are not acceptable.
    - b. Rectangular: 45 degree entry type or radius elbow.
  6. Provide necessary transition pieces and duct collars to make connections to ductwork from neck sizes scheduled or indicated on drawings.
  7. Where building walls, floor and ceilings form portions of duct or plenum, provide gasketed angles or channels at junction points, securely bolted to building structure.
- F. Duct fittings and joints on high pressure systems:
1. Elbows 3-8 IN diameter: Die stamped, for minimum air friction loss, with continuous corrosion resistance welds.
  2. Elbows over 8 IN diameter: Welded segment type, not less than 5 pieces for 90 degree elbows, and not less than 3 pieces for 45 degree elbows, using corrosion resistant welds.
  3. Tees: "Low loss, short cone type", unless specifically detailed otherwise for space limitations.
  4. "Y's" 45 degree type. 60 degree type may be used if space conditions dictate.
  5. Install "Y's" as indicated.
  6. Where tees are indicated, "Y's" may be substituted if space is available.
  7. "Y's": Straight sided type (no cone).
  8. Takeoffs from air handling unit plenums: Standard Bellmouth fittings.

- a. Construct in accordance with SMACNA HVAC Duct Construction Standards.
  9. "Y" takeoffs from horizontal ceiling mounted ducts to serve boxes: May be straight sided, shop fabricated type by accurately cutting and welding "Y's" into spiral ducts without use of fittings.
- G. Flexible fan connections:
1. Material: Neoprene double coated closely woven glass fabric flexible connections.
  2. Fasten fabric to sheet metal duct work and to fan collar extension with 3/16 IN rivets spaced not more than 5 IN OC.
  3. Locate in inlet and outlet of fans, as close to fan as possible.
  4. Provide at ducts crossing building expansion joints and as indicated on drawings.
  5. Connections shall not be under tension.
  6. Provide minimum separation distance of 1 IN across the connection.
- H. Flexible ducts, preinsulated:
1. Low pressure construction:
    - a. Liner: Steel wire helix encapsulated within a double lamination of polyester.
    - b. Insulation: 1 IN x 3/4LB/CF fiberglass insulation, minimum resistance of R-4.2.
    - c. Insulation: 1 IN x 3/4 LB/CF fiberglass insulation, minimum resistance of R-6.
  2. Jacket: Bi-directional metalized polyester.
  2. Rated working pressure:
    - a. Low pressure duct: Positive 3 IN WG minimum; negative 1 IN WG minimum, for return or exhaust air connections.
  3. Fire resistant, self extinguishing, UL-181, Class 1, with flame spread of 25 or less and smoke development not to exceed 50.
  4. Thermal conductance(C): 0.23 BTU/ h-FT<sup>2</sup>-F.
  5. Low pressure connections:
    - a. Secure duct to collar or sleeve with screws, or metal or nylon clamps or bands.
    - b. Seal connection with 2 wraps of duct tape.
  6. Turn radius: Not less than R/D equal to 1.0.
  7. Provide flexible duct supports in accordance with Figure 3-9 and 3-10, SMACNA HVAC Duct Construction Standards.

## 2.03 DAMPERS

- A. Dampers - general:
1. Sizes and types: As indicated.
  2. Locate as indicated.
  3. Factory built and assembled dampers.



- B. Dampers, manual (rectangle and square):
  - 1. Opposed blade type, fitted with shank bolts, marked for direction (open/closed).
  - 2. Provide locking hand quadrant, with 2 IN standoff bracket.
  - 3. Construction:
    - a. Greater than 36 x 12 IN:
      - i. Frame: 16 GA galvanized steel formed into structural shape.
      - ii. Blades: 16 GA galvanized steel, equipped with brass pin running on stainless steel pivot for vertical axis.
      - iii. Axles: Continuous, steel 1/2 IN 13mm hex.
      - iv. Basis of design: Ruskin MD35.
    - b. 36 x 12 IN and less:
      - i. Frame: 22 GA galvanized steel, flat or angle.
      - ii. Blades: 22 GA galvanized steel, equipped with brass pin running on stainless steel pivot for vertical axis.
      - iii. Axle: Continuous, steel 3/8 IN hex.
      - iv. System pressure and velocity rating: 2.5 IN WG and 1500 fpm.
      - v. Basis of design: Ruskin MD25 or MD15.
- C. Damper, manual (round):
  - 1. Butterfly type with circular blade mounted to shaft.
  - 2. Frame: Minimum 20GA galvanized steel 7 IN segment duct.
  - 3. Blade: Minimum 20 GA galvanized steel.
  - 4. Shaft: Continuous, Steel 3/8 IN hex.
  - 5. System pressure and velocity rating: 2.5 IN water gauge and 1500 fpm.
  - 6. Hand quadrant: Locking type with 2 IN standoff bracket.
  - 7. Bearings: Self-lubricating nylon or stainless steel sleeve.
  - 8. Basis of design: Ruskin MDRS25.
- D. Dampers, backdraft, low pressure:
  - 1. Counterbalanced, gravity operated.
  - 2. Fabricate of aluminum.
  - 3. Blades: Provided with common linkage rod and felt seals.

#### 2.04 DIFFUSERS, REGISTERS AND GRILLES

- A. Diffusers, ceiling:
  - 1. Square type.
  - 2. Size, type and manufacturer: As scheduled.
  - 3. Finish of steel units: Factory applied, baked or electrocoated enamel; color as selected by Architect or as indicated.
  - 4. Finish of aluminum units: Satin anodized.
  - 5. Provide sponge rubber gasket for ceiling diffusers.
  - 6. Provide necessary screws, duct collars, transitions and air pattern deflectors.
  - 7. Provide opposed blade dampers where indicated.

B. Diffusers, radial throw type:

1. Size, type and manufacturer: As scheduled.
2. Provide with steel housing with hinged face to allow filters to be replaced from within the room without requiring access to the ceiling.
3. Diffusers: Capable of 180 degree radial throw pattern.
4. Provide gasket material around frame body on frame face of air seal.

C. Air grilles and registers:

1. Size, type and manufacturer: As scheduled.
2. Finish of steel units: Factory applied, baked or electrocoated enamel; color as selected by Architect or as indicated.
3. Finish of aluminum units: Satin anodized.
4. Provide sponge rubber gasket for ceiling and wall units.
5. Provide necessary screws, duct collars and transitions.
6. Provide opposed blade dampers in registers where indicated.

D. Diffusers and grilles, linear:

1. Size, type and manufacturer: As scheduled on drawings.
2. Adjustable pattern controller (on supply units only) capable of 180 degree air pattern adjustment and volume control. All adjustments accessible from the face of the diffuser.
3. Extruded aluminum or steel ceiling linear diffuser.

2.05 COMBINATION LOUVERS

A. Combination louvers:

1. Construction: Extruded aluminum frames, front fixed blades, and rear adjustable blades.
2. Birdscreen: Aluminum.
3. Seals: Vinyl blade and compressible aluminum jamb.
4. Bearings: Stainless steel sleeve.
5. Frame: 4 IN deep.
6. Concealed linkage.
7. All sections shall be joined together by a common jack shaft with lockable arm to allow damper (adjustable blades) to be adjusted manually. Locate arm locations to ensure ready access for adjustment.

B. Size and performance: As indicated.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install and coordinate systems and components.

### 3.02 INSTALLATION OF DUCTWORK

- A. Ductwork Cleanliness:
  - 1. Reference Standard: SMACNA – Duct Cleanliness for New Construction.
  - 2. Intermediate Level:
    - a. Under this level of ductwork cleanliness it is acknowledged that ductwork leaving the premises of the manufacturer will include some or all of the following:
      - i. Internal and/or external self-adhesive labels or marking for part(s) identification.
      - ii. Exposed mastic sealant.
      - iii. Light zinc oxide coating on the metal surface.
      - iv. A light coating of oil on machine formed ductwork.
      - v. Minor protrusions into the airway of rivets, screws, bolts and other jointing devices.
      - vi. Internal insulation and associated fasteners.
      - vii. Discoloration marks from plasma cutting process.
    - b. Site storage: The area provided for storage shall be clean, dry and exposure to dust minimized.
    - c. The working area should be clean and dry and protected from the elements.
    - d. The internal surfaces of ductwork shall be wiped to remove excess dust immediately prior to installation.
    - e. Open ends on completed ductwork and overnight work-in-progress shall be sealed.
- B. Conceal ductwork in finished spaces unless indicated otherwise.
- C. Exercise special care to provide tight fitting well fabricated, well braced ductwork systems.
- D. Field assemble rectangular, round or flat oval ductwork as follows:
  - 1. Use duct joint sealer applied slip joints.
  - 2. Use Ductmate Spiralmate or Ovalmate systems.
  - 3. Isolate dissimilar metals with elastomeric sealant tape or fiber gaskets, and gaskets and washers for bolts.
  - 4. Install TDC flanged duct connection systems in accordance with SMACNA construction standards.
- E. Do not kink, bend or otherwise restrict the free area of flexible ductwork.

### 3.03 INSTALLATION OF MANUAL DAMPERS

- A. Provide volume dampers, to facilitate air balancing, whether shown on the plans or not.
- B. Provide additional branch main volume dampers required by the balancing contractor, refer to Section 20 08 00.

**3.04 PERFORMANCE TESTS**

- A. Use a pressure blower with volume control and orifice flow meter to provide supply air for test.
- B. Submit reports to Architect.

**3.05 CLEANING**

- A. At substantial completion, clean work installed under this section.

**3.06 EQUIPMENT DEMONSTRATION**

- A. At substantial completion, inspect and test, and operate satisfactorily, in presence of Engineer and representative of Owner, operation of each piece of equipment and its accessories.
- B. If inspection or test indicates defects, replace defective work or material.
- C. Repeat inspections and tests until defects are eliminated.

**END OF SECTION 23 31 13**

SECTION 23 35 00 - EXHAUST AND VENTILATING FANS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Description of system:
  - 1. Ceiling exhaust fans.
- B. Abbreviations:
  - 1. AMCA: Air Movement and Control Association.
  - 2. ADC: Air Diffusion Council.
  - 3. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers.

1.02 QUALITY ASSURANCE

- A. Standards:
  - 1. ADC Standard 1062R2, Air Diffusing Equipment Test Code.
  - 2. AMCA Standard 204, Balance Quality and Vibration Levels for Fans.
  - 3. ASHRAE Standard 70, Method of Testing for Rating the Performance of Air Outlets and Inlets.
  - 4. NFPA-90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
  - 5. ABMA : American Bearing Manufacturers Association.

1.03 SUBMITTALS

- A. Product data:
  - 1. Performance data.
  - 2. Physical dimensions.
  - 3. Fan curves.
  - 4. Sound data.
- B. Contract closeout information:
  - 1. Operating and maintenance data.
    - a. Owner instruction report.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Acceptable manufacturers:
  - 1. Fans (General):
    - a. Base:
      - i. Members of AMCA.
  - 2. Ceiling exhaust fans:
    - a. Base:
    - b. Optional:
      - i. Carnes.
      - ii. Acme Engineering and Manufacturing.

- iii. Greenheck.
- iv. Cook, Loren.
- v. PennBarry.

**B. Fans - General:**

- 1. Performance ratings: Based on laboratory tests conducted in accordance with latest edition of ASHRAE/AMCA Standard Test Codes.
- 2. UL 705 listed.
- 3. Capacity and ratings: As indicated.
- 4. Arrangement and drive: As indicated.
- 5. Finish:
  - a. Aluminum, galvanized, and stainless steel fan components: Unfinished.

**C. Motors and control: As specified in Section 20 05 00.**

- 1. For direct drive fans, provide TEFC motors when motor is located in the airstream.

**2.02 CEILING EXHAUST FANS**

**A. Ceiling exhaust fans:**

- 1. Centrifugal, direct driven type as indicated.
- 2. Housing: Galvanized steel lined with acoustical insulation.
  - a. Specifically designed and manufactured for ceiling installation.
  - b. Integral backdraft damper at fan discharge.
  - c. Removable inlet grille mounted on housing.
- 3. Fan: Forward curved centrifugal wheel mounted on motor with fan shrouds.
- 4. Motor: Permanent split capacitor or capacitor start, induction run.
  - a. Permanently lubricated bearings.
  - b. Provide with overload protection.
  - c. Provide vibration isolation on motor fan assembly.
- 5. Electrical: Provide junction box for electrical connection on housing and receptacle for motor plug-in.
- 6. Provide duct collar connections.
- 7. Accessories:
  - a. Wall cap.

**2.03 VIBRATION ISOLATION**

- A. Vibration isolation: Section 20 05 50.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Install in accordance with manufacturer's recommendations and as specified.

**3.02 VIBRATION ISOLATION**

- A. Vibration isolation: Section 20 05 50.

END OF SECTION 23 35 00

SECTION 26 00 10 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Drawings use and interpretation:
  - 1. Drawings are diagrammatic and indicate general arrangement of systems and equipment, except:
    - a. Specific installation details.
    - b. When specific dimensions are indicated for electrical equipment it is intended that these be limiting dimensions. When proposed equipment exceeds these limiting dimensions, advise Architect.
  - 2. For exact locations of building elements, refer to dimensioned architectural drawings.

1.2 QUALITY ASSURANCE

- A. Perform all work in accordance with but not limited to:
  - 1. Federal, state and local codes, regulations and ordinances.
  - 2. Underwriters Laboratories, Inc. (UL) requirements.
  - 3. NFPA-70 National Electrical Code (NEC).
  - 4. Occupational Safety and Health Act (OSHA).
  - 5. All authorities having jurisdiction.
  - 6. Factory Mutual System (FM) requirements.
  - 7. North Carolina Building Code (NCBC).

1.3 DEFINITIONS

- A. Weatherproof (WP): Indicates rating suitable for wet or damp location.
- B. Shop Drawings.
  - 1. Fabricated items in this Division in accordance with the requirements of the Contract Documents. Includes data on specially constructed equipment and items normally not referred to as stock items.
- C. Product Data.
  - 1. Data for stock items of equipment and materials may be technical catalog information or other engineering data.
- D. Samples
  - 1. Submit samples in accordance with the provisions of the Contract Documents.
  - 2. Although indicated as not required in the specification section, a sample will be required if submittal compliance with specification is not clear.
  - 3. All samples requested by the Engineer shall be promptly submitted upon request, in accordance with applicable provisions of the Contract Documents.
- E. Specification Comparison
  - 1. Specification comparison is to be submitted with shop drawings, product data, or samples where indicated for each section. Provide the number of copies required by shop drawings or product data.



2. Specification comparison shall be a typewritten document listing each specification paragraph by number, and stating if the product or system complies with the specification. If product or system does not comply state how the product or system satisfies the specification intent to justify its approval.
3. Shop drawings, product data, or samples will not be reviewed if specification comparison is not included where requested.
4. Specification comparison shall be signed by the manufacturer or suppliers authorized representative.
5. Although indicated as not required in the specification section, a specification comparison will be required if submittal compliance with specification is not clear.

**F. Test Reports**

1. Submit test report where required by the individual sections.
2. Records of all tests and inspections, with complete data on all readings taken, shall be made and incorporated into a legible report. Contractor shall submit 4 copies of the test report in accordance with contract documents.
3. Test report shall be conducted by an independent testing agency where indicated or by the person responsible for the test as indicated in the individual section. If not specifically indicated otherwise, the contractor may conduct tests.
4. Test report shall list date tested, test instruments, personnel who conducted test, and test results.
5. All items that fail test shall be repaired or replaced and retested. Include all information listed above on retest.
6. The person responsible for the test shall sign report.
7. Submit test report after all items have passed tests.
8. Test reports shall be submitted and approved, before final completion, and before inspection by AHJ.

**G. Qualifications of installer**

1. Where required, submit Qualifications of installer where required by the individual sections. Refer to individual sections for additional requirements.
2. Installer will supervise the installation and components of the system. Installer shall have a minimum 2 years experience successfully installing the same type and design as indicated.
3. Where required, submit the names, locations, point of contact, and telephone number of at least 2 installations of the same type and design that the installer has installed.

**H. Operation and Maintenance Data**

1. Where required, furnish operation and maintenance data on all electrical equipment installed under this Division of the Specifications. Data shall conform to the requirements set forth under Division 1.

**1.4 PROTECTION**

- A. Provide covering and shielding for all equipment to protect from damage.
- B. Protect nameplates on motors and similar equipment, to prevent defacing.
- C. Repair, restore or replace damaged, corroded and rejected items.

**1.5 JOB CONDITIONS**

- A. Examine Contract Documents to determine how other work will affect execution of electrical work.
- B. Make arrangements for and pay for necessary permits, licenses, and inspections.
- C. Cause as little interference or interruption of existing utilities and services as possible.
  - 1. Schedule work which will cause interference or interruption in advance with Owner, Architect, authorities having jurisdiction and all affected trades.
- D. Determine and verify locations of all existing utilities on or near site.
- E. Temporary construction power and communications (See Division 01)
- F. Record drawings:
  - 1. Keep a complete set of all electrical drawings in job site office for indicating actual installation of electrical systems and equipment.
  - 2. Use this set of drawings for no other purpose.
  - 3. Where any material, equipment, or system components are installed differently from that indicated, indicate differences clearly and neatly using ink or indelible pencil.
  - 4. At project completion, submit record set of drawings .

#### 1.6 ENVIRONMENTAL CONDITIONS

- A. General:
  - 1. Provide NEMA 1 enclosures for electrical equipment unless otherwise indicated.
- B. Conduit: See Section 16110.
- C. Cable: See Section 16120.
- D. Boxes and Fittings: See Section 16130.
- E. Damp and wet locations:
  - 1. Exterior applications:
    - a. Provide NEMA 3R enclosures for electrical equipment.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Use only prime quality, new materials, apparatus and equipment.
- B. Material and equipment: Current and standard design of manufacturers regularly engaged in their production.
- C. Use UL labeled electrical materials and fabricated assemblies.
- D. Structural steel for supports: ASTM-A36.
  - 1. Galvanize members installed in areas of high humidity or condensation.
  - 2. Furnish other members with shop coat of rust inhibiting primer.
  - 3. Shop fabricate for field assembly using bolts.
  - 4. Minimize field welding.
  - 5. Retouch primer and galvanizing after field welding.
- E. Rain hoods and counter flashings not exposed to view:

1. Stainless steel: Minimum 20 GA.
- F. Access doors, panels and frames:
  1. Provide where indicated on Drawings.
  2. Where not indicated on Drawings, provide access panels and/or doors at walls, and inaccessible ceilings as required to permit access to equipment, devices and piping requiring service, adjustment, or inspection.
  3. Size:
    - a. As required to allow access, inspection, service, and removal of items served.
    - b. Minimum 18 x 18 IN.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. When changes in location of any work are required, obtain approval of Architect before making change.
  1. Make changes at no extra cost.
- B. Do not change indicated sizes without written approval of Architect.
- C. Provide all necessary offsets and crossovers in conduits, raceways, cabletrays and ducts.
- D. Install exposed conduits parallel to walls and ceilings and vertically plumb, unless otherwise indicated.

#### **3.2 CUTTING AND PATCHING**

- A. Provide cutting, fitting, repairing, patching and finishing of installed work.
  1. Include installed work of other sections where it is necessary to disturb such work to permit installation of electrical work.
  2. Repair or replace existing or new work disturbed.
- B. Avoid cutting, where possible, by setting sleeves or frames, and by requesting openings in advance.
- C. Before cutting, obtain approval of Architect.
  1. Use only approved methods.
  2. Do not weaken walls or floors; locate holes in concrete to avoid structural members.
- D. Locate openings and sleeves to permit neat installation of conduits and equipment.

#### **3.3 EXCAVATING AND BACKFILLING**

- A. Excavating, trenching, and backfilling:
  1. See Section, 16375.

#### **3.4 INSTALLATION OF EQUIPMENT**

- A. Install all equipment in accordance with manufacturer's recommendations.
- B. Provide all necessary anchoring devices and supports.
  1. Use structural supports suitable for equipment.
  2. Check loadings and dimensions of equipment with shop drawings.

3. Do not cut, or weld to, building structural members.
  4. Provide equipment supports even though not detailed on architectural and structural drawings.
- C. Make all penetrations through roofs prior to installation of roofing.
- D. Install equipment to permit easy access for normal maintenance.
1. Maintain easy access to switches, motors, drives, pull boxes, receptacles, etc.
  2. Relocate items which interfere with access.
- E. Provide all wiring and connections as required for connecting ready for use all indicated equipment. All connections shall be verified and coordinated with equipment manufacturer's drawings before installation and all adjustments shall be made to satisfy the manufacturer's requirements.
- 3.5 REMODELING
- A. Field verify locations and arrangement of all existing systems and equipment.
- B. Maintain all existing services and equipment unless indicated to be removed.
- C. Perform demolition as directed by General Contractor.
1. Remove all equipment indicated.
- 3.6 FIELD QUALITY CONTROL
- A. Perform indicated tests to demonstrate workmanship, operation, and performance.
1. Conduct tests in presence of Architect and, if required inspectors of agencies having jurisdiction.
  2. Arrange date of tests in advance with Architect, manufacturer and installer.
  3. Give minimum of 24 hours notice to all inspectors.
- 3.7 PUTTING SYSTEMS IN OPERATION - START UP
- A. Put all systems into satisfactory operation prior to final acceptance, at time agreed to by General Contractor, Owner and Architect.
- B. Operate all systems in good working order for period of 5 working days.
- 3.8 DEVICE MOUNTING SCHEDULE
- A. See symbol legend for device mounting heights unless otherwise noted.
- 3.9 IDENTIFICATION AND LABELING
- A. Flash hazard warning signs: Provide for all panelboards, per NEC Article 110.
- B. Label all junction boxes and pull boxes with circuit numbers of all conductors in box. i.e., NL2A-22,24,26. Label shall be permanent black marker, 1/4" thick, 1" high, readable from floor.
- 3.10 DEVICE MOUNTING SCHEDULE

- A. Dimensions are to center of device unless otherwise indicated. Coordinate outlet locations with all architectural millwork and/or casework elevations. Coordinate device mounting height with wainscoting where provided. Where top of wainscot and device mounting height overlaps, shift device down to provide 2 IN gap between top of device and top of wainscot.
- B. Mounting heights as indicated below:

Flush tumbler switch -----	48 IN
Flush tumbler switch in bathroom and toilets -----	44 IN
Flush tumbler switches and other control devices above counters -----	44 IN
Dimmer switch-----	48 IN
Receptacle -----	18 IN
Receptacle above counter -----	4 IN
above backsplash or 4 IN above work surface if no backsplash provided unless otherwise indicated.	
Receptacle for electric water cooler -----	center vertically and horizontally behind unit
GFCI receptacle in bathrooms and toilets -----	44 IN
Telephone outlets for desk phone -----	18 IN
Telephone outlet for wall mounted phone -----	48 IN
Exit light (over door trim, center in space) -----	90 IN
Bracket light above lavatory; bottom of fixture shall be -----	1 IN above mirror
or 78 IN AFF if no mirror provided.	
Fire alarm manual pull station -----	48 IN
Fire alarm notification device -----	80 IN
above highest floor level within space (from bottom of faceplate) or 6 IN below the ceiling (from bottom of faceplate), whichever is lower. Fire alarm notification devices shall be wall mounted unless otherwise indicated.	
Fire alarm zone light annunciator (to top) -----	72 IN
Safety switch -----	54 IN
Panelboard (to top) -----	72 IN
Motor starter -----	54 IN
Push button motor control station -----	48 IN

END OF SECTION 26 00 10

SECTION 26 00 20 - ELECTRICAL SERVICE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for electrical service as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades and with Utility Company.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, appurtenances, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 DIVISION OF WORK

- A. The electric utility company will provide the following:
  - 1. Secondary electric service to the meter.
  - 2. Revenue meter and meter base for mounting and installation by the Contractor.
  - 3. Connection of service entrance conductors to load side of meter.
- B. The Owner will pay the electric utility company for all line extensions and charges for providing underground service. Upon written request, Owner will assist the Contractor in obtaining licenses and permits from the electric utility company.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All products shall be as specified in division 26, and as required by the Utility Company.

PART 3 - EXECUTION

3.1 THE CONTRACTOR SHALL PROVIDE THE FOLLOWING:

- A. Verify complete electrical service installation with electric utility company before commencing any work.
- B. Make application with electric utility company for electric service in a manner to permit utility company to provide service prior to completion of Work under this Contract.
- C. Complete and file all forms required by the electric utility company in connection with application for electric service. Pay for all required licenses, permits, fees, etc. necessary to obtain electric service.
- D. Provide all on-site trenching and backfilling required for installation of electric service. Verify size and routing of trenches with utility company prior to start of construction.
- E. Provide conduits under paved areas for use of utility company where required. Verify size and location of conduits with utility company prior to start of construction.

- F. Provide sealable meter compartment, for metering by electric utility company. Install metering revenue meter and other devices furnished by utility company. Install all equipment in conformity with utility company's requirements.

END OF SECTION 26 00 20

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for Low Voltage Electrical Power Conductors and Cables as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, appurtenances, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 SUBMITTALS

- A. Shop Drawings: Not required.
- B. Product Data: Not required.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acceptable manufacturers:
  - 1. Splices and taps for smaller than No.6 AWG wire:
    - a. Base:
      - 1) 3M.
      - 2) Ideal Electric.
      - 3) Heyco Molded Products.
      - 4) Elastimold.
      - 5) Buchanan Construction Products.
- B. Wire for 600 volts and below: Single conductor, soft drawn, copper wire with 600 volt insulation, UL listed.
  - 1. For feeders and branch circuits: Type THWN/THHN or XHHW.
  - 2. For exterior feeder and branch circuits: Type XHHW.
  - 3. For branch circuits served by GFCI circuit breakers: Type XHHW.
  - 4. Use no wire smaller than No.12 AWG, except as follows:
    - a. Smaller size wire may be used only where specifically indicated.
    - b. No.14 AWG may be used for pilot control and signal circuits.
  - 5. Size conductors to match over current protective device unless larger conductors are indicated.



- C. Splices and taps for No.6 AWG wire and larger: Use compression connectors with pre-stretched insulation to equal insulation of wire being spliced.
- D. Splices and taps - General: Do not make splices and taps with crimp or indenter-type connectors.
- E. Color coding: Color code all conductors in accordance with NEC as follows:
  - 1. Color code all wiring.
  - 2. Use following colors in lighting and power wiring:

120/208 VOLT

Phase 1	Black
Phase 2	Red
Phase 3	Blue
Neutrals	White
Ground	Green

- 3. Color coding of ends only will be acceptable for neutral and grounding conductors number 4 AWG and larger.

2.2 ARMORED CABLE: HCF TYPE AC OR MC

- A. Cable assembly shall be in accordance with NEC and UL.
- B. Assembly shall include an insulated green equipment grounding conductor, sized in accordance with the NEC in addition to an internal bonding strip of copper or aluminum in intimate contact with the armor for its entire length. Minimum size bonding strip shall be No. 16 AWG. The outer metal armor or sheath of the assembly shall be approved and identified as an acceptable grounding return path.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting and receptacle home runs indicated are for identification purposes only.
- B. Run panelboard and motor feeders in individual conduits.

3.2 ARMORED CABLE SYSTEM INSTALLATION, GENERAL

- A. Installation: Shall be in accordance with UL, NEC, as shown on drawings and as hereinafter specified.
- B. Install Type AC or MC cable as follows:
  - 1. Flattened, dented, deformed, or opened armor is not permitted. If damaged during installation, damaged cables shall be replaced with new undamaged material.
  - 2. Cut square with manufacturer's armor stripping tool and remove burrs.
  - 3. Remove enough armor from cable to permit sufficient conductor to extend into the enclosure.
  - 4. Cable shall be mechanically and electrically continuous.

5. Secure cable to cabinets, junction boxes, and outlet boxes with fittings approved for grounding.
- C. Bends: Bends shall be made so that the cable is not damaged. The radius of the curve of the inner edge of any bend shall not be less than five times the diameter of the cable.
- D. Concealed Work Installation: Cables installed above furred or suspended ceilings or in walls shall be supported as specified below.
  1. The cable shall be secured by approved straps, hangers, or similar fittings designed and installed as to not damage the cable.
  2. Where independent supports are used for the cable, support at intervals not exceeding 4.5 feet and within one foot of each outlet box, junction box, cabinet, or fitting.
  3. Through Metal Framing: Cable shall be supported in accordance with the NEC where run through metal framing members.
- E. Penetrations:
  1. Cutting of Holes
  2. Cut holes in concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for Grounding as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 SUBMITTALS

- A. Shop drawings: Not Required.
- B. Product data: Not Required.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Required.
  - 1. Operation and Maintenance Data: Not required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acceptable manufacturers:
  - 1. Compression fittings:
    - a. Base:
      - 1) Burndy.
  - 2. Other manufacturers desiring approval comply with Section 00440.
- B. Wire and cable: See Section 16120.
  - 1. Main ground: Copper conductor, sized as required by appropriate service grounding conductor table of NEC.
  - 2. Grounding copper conductor for non-metallic conduit and ducts: Copper bar or insulated conductor, sized in accordance with NEC or as indicated.

2.2 CONDUCTORS

- A. Grounding electrode conductors shall be bare copper sized in accordance with NEC Table 250-94.
- B. Equipment grounding conductors in raceways shall be copper with green insulation, sized in accordance with NEC 250-95. Bare copper grounding conductors will be acceptable in underground outside raceways.

- C. Use number 4/0 AWG bare copper (minimum) for ground grid and for connecting ground rods.

### 2.3 CONNECTIONS

- A. Ground connectors shall be UL listed for the application.
- B. Refer to PART 3 - EXECUTION for additional requirements for Connections.

### 2.4 GROUND RODS

- 1. Ground rods shall be copper clad steel, 10 foot in length, and 3/4 inch in diameter.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Ground all neutral conductors, conduit systems, cabinets, equipment, motor frames, etc., in accordance with NEC and applicable codes.
- B. Locate neutral ground disconnecting link or links in main panelboard so that low-voltage neutral bar with all interior secondary neutrals can be isolated from common equipment grounding bus.

### 3.2 MAIN GROUND

- A. Install main grounding conductor in conduit and connect to grounding electrode system using an exothermic weld or UL listed compression fitting.
  - 1. Make connections easily accessible for inspection.
  - 2. Provide grounding electrode system in accordance with NEC.
  - 3. Resistance to earth of the grounding electrode system shall not exceed 25 ohms.

### 3.3 DISTRIBUTION

- A. Do not solder grounding circuit connections.
- B. In nonmetallic conduits or ducts maintain continuity of equipment grounding system by conductor installed and connected by approved method to conductive noncurrent-carrying equipment at both ends.
- C. Ground all conduit, panelboards, receptacles, accessible fixtures, switchgear, transformers, motors and motor equipment.
- D. Make ground continuity positive throughout entire project.

### 3.4 CONNECTIONS

- A. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

### 3.5 TESTING

- A. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method according to IEEE 81.
  - B. Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify Owner promptly and include recommendations to reduce ground resistance and to accomplish recommended work.
  - C. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- A. Submit test report in compliance with Section 16010.

END OF SECTION 26 05 26

SECTION 26 05 33 - RACEWAYS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for raceways as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, appurtenances, and devices incidental to, or necessary for, a sound, secure, and complete installation.
- D. Conduit runs are diagrammatic. Verify locations in field.

1.2 SUBMITTALS

- A. Shop drawings: Not Required.
- B. Product data: Not Required.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Not Required.
- F. Operation and Maintenance Data: Not required.

PART 2 - PRODUCTS

2.1 CONDUIT:

- A. Rigid steel conduit: Hot dipped, sherardized or galvanized after fabrication.
- B. Intermediate metal conduit (IMC): Galvanized steel.
- C. Thinwall electrical metallic tubing (EMT): Galvanized steel.
- D. Flexible steel conduit for motor and equipment connections: Galvanized with continuous copper content or separate grounding conductor.
  - 1. PVC-coated type: With approved liquid-tight connectors; Anaconda Seal-Tite type UA.
- E. Rigid PVC conduit: High impact polyvinyl chloride, meeting minimum requirements of NEC.
  - 1. Direct burial type: Carlon Electric Products, Type 40.

2.2 SCHEDULE OF CONDUIT APPLICATIONS

- A. Use rigid steel conduit in following locations:
  - 1. Underground.
  - 2. Outdoors.
  - 3. In concrete.
  - 4. Under concrete slabs on grade.

- B. Intermediate metal conduit may be used in lieu of rigid galvanized steel unless otherwise noted.
- C. Thinwall EMT shall be used for other 600 volt and below indoor dry applications.
- D. PVC conduit may be used as follows:
  - 1. Rigid PVC conduit may be used underground.
  - 2. Exterior lighting.
  - 3. Underground distribution.
  - 4. Provide a green grounding conductor of proper ampacity in each PVC conduit.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION – GENERAL

- A. Unless otherwise indicated install all conduits concealed within walls and above finished ceilings.
- B. Run exposed conduit in straight lines at right angles to or parallel with walls, beams or columns.
- C. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

#### 3.2 UNDERGROUND INSTALLATIONS

- A. Encase underground PVC conduits in 2 IN minimum of concrete where passing under roadways.
- B. Install underground conduit 30 IN minimum below grade.

#### 3.3 CONDUIT INSTALLATION

- A. Support all conduit systems from building structure or walls with approved hangers.
  - 1. Do not support from piping, ducts or support systems for piping or ducts.
  - 2. Do not install to prevent ready removal of equipment, piping, ducts or ceiling tiles.
  - 3. Do not support from ceiling or ceiling support systems.
  - 4. Space groups of conduits uniformly. For bends and offsets, use an approved hickey or bending machine.
  - 5. Cut all conduit with hacksaw or approved cutting machine and ream after threading to remove all burrs.
- B. Do not install conduit under pads for fans, pumps, or other machinery.
- C. Sum of angles in any conduit run shall not exceed 360 degrees.
  - 1. Where more bends are necessary, install conduit or pullbox.
- D. Fit all conduit ends at switch and outlet boxes with approved lock nuts and bushing forming approved tight bond with box when screwed tightly in place.

#### 3.4 CONNECTIONS AND FITTINGS

- A. Above lay-in tile ceilings, make connections to lay-in type fixtures with flexible steel conduit.
  - 1. Arrange conduit and box systems for easy removal of lay-in ceiling.

- B. Use flexible metal conduit for connections to motors and other equipment subject to vibration, and for connections to recessed or semi-recessed lighting fixtures.
  - 1. Use liquid-tight metal conduit with liquid-tight connectors in areas subject to moisture, for motor connections, in mechanical rooms, and in damp locations.
- C. Provide sealing fittings on raceways subject to different temperatures including but not limited to:
  - 1. Conduits passing from the interior to the exterior of structure.

END OF SECTION 26 05 33



SECTION 26 05 34 - BOXES AND FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for all boxes and fittings as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, appurtenances, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 SUBMITTALS

- A. Shop drawings: Not Required.
- B. Product data: Not Required.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Not Required.
  - 1. Operation and Maintenance Data: Not required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Acceptable manufacturers:
  - 1. Galvanized boxes:
    - a. Base:
      - 1) Appleton Electric.
      - 2) Thomas & Betts.
      - 3) Raco Manufacturing & Engineering.
  - 2. Corrosion resistant boxes and fittings:
    - a. Base:
      - 1) Crouse-Hinds Lighting.
      - 2) Appleton Electric.
  - 3. Conduit fittings:
    - a. Base:
      - 1) T & B.
      - 2) Appleton Electric.
      - 3) Thomas & Betts.
      - 4) Raco Manufacturing & Engineering.
      - 5) O-Z/Gedney.
      - 6) ETP.
  - 4. PVC coated conduit fittings and boxes:
    - a. Base:

- 1) Robroy Industries.
- 2) Occidental Coating.
5. Box supporting brackets:
  - a. Base:
    - 1) Caddy.
- B. Galvanized boxes and fittings shall be galvanized after fabrication.
- C. Lighting outlet boxes: Hot-dip galvanized, 4 IN octagon.
  1. Use extension and plaster rings as required.
  2. Verify proper depth with partition thickness.
  3. Provide with proper fittings to support and attach lighting fixtures.
  4. Support outlet boxes for incandescent fixtures and other ceiling-mounting devices in lay-in acoustical tile ceilings by bar hangers anchored to ceiling construction members which do not interfere with tile removal.
- D. Switch and receptacle boxes for concealed wiring: Hot-dip galvanized.
- E. Exposed switch and receptacle boxes: Corrosion resistant, cast, ferrous metal, with threaded hubs; Crouse-Hinds Type FS.
- F. Concealed gang-switch and junction boxes not dimensioned: 4 IN square, hot-dip galvanized.
- G. Weatherproof receptacle boxes: Corrosion resistant cast ferrous metal type, with threaded hubs and neoprene gasket; Crouse-Hinds Type FS.
- H. Pull and junction boxes: Code-sized galvanized steel boxes provided with plain blank removable covers held in place with screws unless otherwise indicated.
  1. Where sizes are not indicated, use 4 IN square or NEC size.
- I. Conduit bodies: Corrosion resistant conduit fittings, cast ferrous metal type, with sharp clean threads.
- J. Bushings for conductors No.4 and larger: Separate insulated bushings.
  1. Use at all points where such conductors enter boxes, raceways, cabinets, auxiliary gutter etc., and all other points required by NEC.
  1. Do not use insulated throat connectors.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Mounting of outlet boxes for concealed wiring.
  1. Boxes mounted adjacent to studs shall be attached directly to stud with a minimum of 4 metal screws.
  2. Boxes that are not attached directly to studs shall be attached to bracket spanning studs. Bracket shall be attached to studs with 2 screws at each end. Attach box to bracket with 2 screws minimum.
  3. Junction boxes with openings on opposite faces of rated walls shall have a horizontal separation of 24 inches as a minimum, regardless of box size, unless protected by an approved method.

4. Locations of studs do not have any bearing on the above requirements, nor does the use of mineral wool fire safing alter these requirements.
  - B. Fill unused punched-out openings in boxes with proper closures.
  - C. Use outlet boxes sized to accommodate quantity of conductors enclosed.
- A. Provide pull boxes or junction boxes in conduit runs where indicated or as required to facilitate pulling of wires or making of connections. Make covers of all boxes accessible.

END OF SECTION 26 05 34

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for panelboards as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, and devices incidental to, or necessary for, a sound, secure, and complete installation.
- D. Provide power panelboard(s) and lighting and appliance panelboard(s) as specified herein and as indicated on associated schedules and drawings.

1.2 QUALITY ASSURANCE

- A. System standards:
  - 1. NEMA PB-1 – Panelboards.
  - 2. NEMA PB-1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards rated 600 volt or Less.
  - 3. NEMA KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
  - 4. UL 50 – Enclosures for Electrical Equipment.
  - 5. UL 67 – Panelboards.
  - 6. CSA Standard C22.2 No. 29-M1989 – Panelboards and Enclosed Panelboards.
  - 7. Federal Specification W-P-115C – Type I Class 1.
  - 8. Federal Specification W-P-115C – Type II Class 1.

1.3 SUBMITTALS

- A. Shop drawings: Required.
  - 1. Identify panelboards by alphanumeric designation with branch circuit breaker sizes and types indicated in panelboard schedules or one-line-diagram.
- B. Product data: Required.
  - 1. Technical data on each type of panelboard.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Required.
  - 1. Operation and Maintenance Data: Required.

PART 2 - PRODUCTS

2.1 PANELBOARDS

- A. Acceptable manufacturers:
  - 1. Panelboards:

- a. Base:
    - 1) Cutler-Hammer.
  - b. Optional:
    - 1) Square D.
    - 2) Siemens.
    - 3) General Electric.
  - 2. Cutler Hammer types listed for quality and performance reference.
- B. All panelboards: Dead front type.
- 1. Provide with non-insulated equipment grounding terminal strip located in top or bottom gutter including main grounding lug and individual terminals for at least 50 percent of panel circuits including spare circuits and space provisions; increase gutter space accordingly for grounding strip.
  - 2. Panelboard bussing to be tin-plated aluminum.
  - 3. Provide panelboard buses fully rated for specified interrupting rating. Series rating of panelboards and overcurrent protective devices is not acceptable.
  - 4. All space provisions shall be totally bussed.

## 2.2 CIRCUIT BREAKER PANELBOARDS:

- A. Bolted-on circuit breaker type. Plug-in circuit breakers not acceptable.
- B. A branch circuit breaker shall not be allowed to be used as a main breaker unless specifically indicated.
- C. All multi-pole breakers, 100A rated and larger shall include means for padlocking in off position.
- D. All multi-pole breakers of single handle and common trip.
- E. Equipment Ground Bus: Adequate for feeder and branch - circuit equipment ground conductors. Bonded to box.
- F. Circuit breakers for motors and equipment shall be Type HACR.
- G. Size all lugs for cable size indicated.

## 2.3 CIRCUIT BREAKERS

- A. Thermal-magnetic type unit construction, employing quick-make and quick-break toggle mechanisms for manual operation as well as automatic operation.
  - 1. 1, 2 and 3 pole circuit breaker ratings:
    - a. In 120/208 V panelboards: Minimum 10,000 AIC symmetrical, or greater as indicated.
  - 2. Handles with three positions: "OFF", "ON", and "TRIPPED".
  - 3. When circuit breaker opens on overload or short circuit, operating handle shall automatically assume "TRIPPED" position and clearly indicate abnormal condition of circuit.
  - 4. Units operable in any position and removable from front of panelboard without disturbing adjacent units.
  - 5. Tandem or half-size circuit breakers not allowed.

## 2.4 CABINETS

- A. Trim, door and box, of galvanized sheet steel, code thickness.

1. 5-3/4 IN deep with gutter space meeting NEC Article 384 requirements for wire termination space in panelboards.
  2. Equip door with chrome-plated combination lock and catch; supply two milled keys with each lock; key locks alike.
  3. Provide directory frame on inside of door.
  4. Finish: Primed, one coat gray.
  5. Identify all circuit locations in each respective panel with load and location served.
    - a. Directory shall be typed.
    - b. Room names and numbers in directory shall be final building room names and numbers as identified by Owner and not name or number indicated on plans.
- 
1. Provide flush - or surface - mounted cabinets as indicated. NEMA PB 1, Type 1, enclosures, unless otherwise indicated.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Support panelboard cabinets from wall structure via unistrut cross members or 3/4 IN fire retardant plywood bolted to wall structure.
- C. Install cabinets so that center of top breaker or switch does not exceed 6 feet 6 inches above finished floor.
- D. Install all panelboards in compliance with NEC 384-4 and 110-16. Coordinate with all other trades. Notify other trades when they violate NEC.

#### 3.2 LABELING

- A. Provide panelboard labeling as specified in Section 16010.
- B. Entries on directory cards shall be typed, complete and accurate with final room numbers as recommended by the owner. Spares and spaces shall be neatly handwritten in pencil.
- C. All circuit breakers shall have circuit number indicated in panel.
- D. Trip rating shall be visible for all circuit breakers, without removing covers. If trip rating is not visible, provide label indicating trip rating.
- E. On/Off positions shall be visible for all circuit breakers, without removing covers. If On/Off positions are not visible, provide label indicating On/Off position.

#### 3.3 BRANCH CIRCUITS

- A. Circuits shall be arranged and numbered as indicated in Drawing schedules.
- B. Provision for Future Circuits at Flush Panelboards; For each flush mounted panelboard, provide a 1 inch empty conduit to 6 inches above nearest accessible ceiling for each 3 spare circuit breakers and spaces.

#### 3.4 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.5 TESTING

- A. Verify compliance with NEC 384-4.
  - B. Verify interrupting and overcurrent rating of all protective devices.
  - C. Verify proper torque for all bus connections and cables. Check all insulators for damage.
  - D. Check for proper anchorage, alignment, and required clearance.
  - E. Verify proper grounding and neutral connections.
  - F. Check all movable parts, screws, and covers for proper operation and missing hardware.
  - G. Repair or replace damaged items.
- A. Submit test report in compliance with Section 16010.

END OF SECTION 26 24 16

SECTION 26 24 19 - MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for Motor Control Equipment as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 STANDARDS

- A. NEMA Pub. No. ICS.

1.3 GENERAL

- A. Starters and associated devices unless otherwise indicated shall have NEMA 1 enclosures where mounted indoors and NEMA 3R enclosures with space heaters where mounted outdoors.
- B. Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.
- C. When motors are supplied with horsepower ratings different from those indicated on the Drawings, provide starters, feeders, overloads, disconnects, and associated devices of the correct size and rating. Verify motor sizes and types from approved motor shop drawings.

1.4 SUBMITTALS

- A. Shop Drawings: Required.
  - 1. Motor control equipment:
    - a. Outline drawings of assembly.
    - b. One line diagrams and wiring diagrams for assembly and components.
    - c. Interconnection wiring diagrams.
- B. Product Data: Required.
  - 1. Technical data on each type of controller and/or feeder device.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test Report: Required.
- F. Contract closeout information:
  - 1. Operating and maintenance data.
  - 1. Owner instruction report.



## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Acceptable manufacturers:
  - 1. Base: Same manufacturer for all starters on project.
    - a. Square D.
    - b. Cutler-Hammer.
    - c. Siemens.
    - d. General Electric.
    - e. Allen-Bradley.
- B. Motors:
  - 1. Verify all motor sizes and types of control from approved mechanical shop drawings.
  - 2. Motors 1/2 HP and above: provide 1 phase combination magnetic starters.
  - 3. Do not provide starters if indicated as part of Division 15 work.
  - 4. Motors below 1/2 HP: 115V, single phase, 60 cycle; provide manual thermal element units.

### 2.2 ENCLOSURES

- A. General:
  - 1. Branch circuit short circuit protection: Motor circuit protector (MCP).
    - a. Operating handle shall clearly indicate whether MCP is on, off or tripped.
    - b. Provide means to lock each operating handle in off position with cover closed by means of one to three padlocks.
    - c. Interlock so that operating handle must be in off position before door can be opened.
  - 2. Finish: Thoroughly clean structure inside and out after fabrication and apply prime coat, and two coats of light gray (ANSI Color 61) or medium light gray (ANSI Color 49) enamel, inside and out.
- B. Flush or surface-mounted cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.

### 2.3 MANUAL STARTERS

- A. Manual starters shall have "quick-make" and "quick-break" mechanisms and be trip-free. They shall have provision for padlocking in the "on" and "off" positions.
- B. Manual starters shall have pilot lights.
- C. Manual thermal element units: 120/240 volt, single phase, maximum 1 HP, with overload protection and toggle switch.
  - 1. Provide means for padlocking in off position.
  - 2. Cutler Hammer/Westinghouse Type MS.

### 2.4 MOTOR STARTERS

- A. Motor starters shall be rated to withstand the fault current available. Each motor starter shall include:
  - 1. Hand-Off-Automatic (HOA) selector switch mounted in the cover.

2. A magnetic starter with NEMA size required for the motor controlled. Starters shall be electro-mechanical. Provide required seal in contacts and contacts required for interlocking, controls, and pilot lights. Provide 1 auxiliary normally open and 1 auxiliary normally closed spare contacts. Label all contacts.
  3. Provide starter wiring and control diagram with each starter mounted in clear plastic on the inside cover. Diagram shall be specific to that starter.
  4. Provide red pilot light, transformer or full-voltage type. Label motor running.
  5. Thermal overload protection, trip-free and the hand reset type. Overload relays shall be Class 10. Overload relays in outdoor starters shall be ambient compensated. Provide overload relays in each ungrounded phase to match the motor served.
  6. Control voltage shall be 120 volts obtained from within starter. Control transformers shall be part of starter. Ungrounded control wiring, including the primary to control transformers, shall be fused. Size control transformers for control load plus 50 percent.
  7. Provide 240/120 volt control transformer with 2 primary and one secondary fuse.
  8. Motor controllers for motors 1 horsepower and larger shall include single phase and undervoltage protection.
- B. Separately-mounted motor control stations: Heavy-duty type, push button and selector switch.
1. Flush-mounted only as indicated.
  2. Provide control wiring between control station and starter.

## 2.5 COMBINATION STARTERS

- A. Combination starters shall be the enclosed type with external operating handle with provision for padlocking in the "on" and "off" positions.
- B. Disconnecting means shall be "quick-make" and "quick-break" motor circuit protector (MCP) rated for the available fault current. MCP shall have instantaneous trip set to match the motor served.
- C. Combination full voltage non-reversing starters:
1. External manual reset thermal overload relays.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Select horsepower rating of controllers to suit motor controlled. Set adjustable trip settings of motor circuit protectors to match characteristics of motor installed.
- C. Provide heater elements which match characteristics of motor installed.
- D. Use fractional-horsepower manual controllers for single-phase motors, unless otherwise indicated.
- E. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks conforming to Division 16 Section "ELECTRICAL GENERAL REQUIREMENTS."

F. Motor-Controller Fuses: Install fuses in each fusible switch

### 3.2 LABELING

A. Provide labeling as specified in Section 16010.

### 3.3 TESTING

A. Motors (5 horsepower and above).

1. Inspect for physical damage and compare nameplate data with drawings and specifications.
2. Verify proper phase connections and grounding.
3. Verify proper voltage. Measure actual voltage at no load and compare with nameplate data.

B. Motor Starters

1. Compare overload heater rating with motor full load amps and verify proper sizing per NEC. Adjust as necessary.
2. Check cable connections for tightness.
3. Adjust instantaneous trip MCP circuit breakers as recommended by manufacturer for actual motor installed.
4. Verify nameplate data with drawings.

A. Submit test report per Section 16010. List motor nameplate, HP, FLA, LRA, code letter, motor voltage rating, measured voltage, overload trip rating, and MCP trip setting or fuse rating.

END OF SECTION 26 24 19

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for wiring devices as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 SUBMITTALS

- A. Shop drawings: Not Required.
- B. Product data: Required.
  - 1. Technical data on each type of device.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Not Required.
- F. Operation and Maintenance Data: Not required.

1.3 QUALITY ASSURANCE

- A. Provide wiring devices conforming to the following standards:
  - 1. Underwriter's Laboratories (UL).
    - a. Switches (UL 20).
    - b. Receptacles, plugs and connectors (UL 498).
    - c. Device plates (UL 514 and 514A).
    - d. Ground fault circuit interrupters (UL 943).
  - 2. National Electric Manufacturers Association (NEMA).
    - a. General purpose wiring devices (NEMA WD-1).
    - b. Wiring devices dimensional requirements (NEMA WD-6).
  - 3. US Federal Specifications.
    - a. Fed Spec switches (WS-896E).
    - b. Fed Spec receptacles (WC-596F).
  - 1. Fed Spec device plates (W-P-455).

PART 2 - PRODUCTS

2.1 MATERIALS - GENERAL

- A. Acceptable manufacturers:
  - 1. Wiring devices:
    - a. Base:
      - 1) Hubbell.

- 2) Cooper.
- 3) Leviton Manufacturing.
- 4) Pass & Seymour.
- 5) Arrow-Hart Wiring Devices.
- 6) General Electric.
- b. All wiring devices shall be provided by the same manufacturer.
- 2. Dimmers:
  - a. Base:
    - 1) Lutron.
    - 2) Prescolite.
    - 3) Leviton Manufacturing.
- 3. Occupancy Sensors:
  - a. Base:
    - 1) Wattstopper.
    - 2) Leviton Manufacturing.
    - 3) Mytech.

## 2.2 SWITCHES

- A. Lighting switches:
  - 1. Specification grade, quiet-operating toggle-type with back and side wiring, 120 volts, AC only, 20 amp rated unless otherwise indicated.
    - a. Switches shall be listed per UL 20 and certified by UL to Federal Specification WS-896E, and shall be visibly marked "Fed Spec WS-896".
    - b. All switches shall be equipped with a green grounding terminal.
  - 2. Use ivory devices for all circuits.
- B. Toggle-type switch:
  - 1. Single-pole: Hubbell HBL1221.
  - 2. Three-way: Hubbell HBL1223.
  - 3. Four-way: Hubbell HBL1224.
- C. Wall-box lighting dimmers:
  - 1. All devices shall be UL listed specifically for the required loads (i.e., incandescent, fluorescent, low voltage, electronic low voltage). Universal dimmers are not acceptable.
  - 2. Electronic solid state type, rated for load, 120 volts AC.
  - 3. Dimmers and faceplates shall be ivory.

## 2.3 DUPLEX AND SINGLE RECEPTACLES

- A. Receptacle outlets:
  - 1. Specification grade.
  - 2. Flush, grounding convenience outlets for side wiring, or side and back wiring.
  - 3. Use ivory devices for "normal" circuits.
- B. 20A, 125V, 2 pole, 3 wire grounding, duplex: NEMA 5-20R; Hubbell HBL5362.
- C. Weatherproof receptacles: Type as indicated on drawings.
  - 1. Mount on "FS" cast metal box.
  - 2. Suitable for wet location when receptacle is not in use.
    - a. Gasketed and self-closing lift cover.
      - 1) Single outlets: Hubbell HBL7423 WO.

- 2) Duplex outlets: Hubbell HBL5206 WO.
- 3) Duplex GFI receptacles: Hubbell WPFS26.
3. Suitable for wet location when receptacle is in use.
  - a. High impact polycarbonate with single gasketed lift cover; NEMA 3R rating while in use; tinted lid.
    - 1) Hubbell/Raco Rayn Tite II weatherproof cover with receptacle type as indicated.
- D. GFI type duplex receptacles: With built-in ground fault interruption, 5-mA sensitivity, indicator and reset. UL listed.
  1. 15A, 125V, 3 wire duplex: NEMA 5-15R; Hubbell GF5262.
  2. 20A, 125V, 3 wire duplex: NEMA 5-20R; Hubbell GF5362.

#### 2.4 DEVICE PLATES

- A. Device plates for concealed wiring: Same manufacturer as devices, to suit device covered, single or ganged in one piece with beveled edges that match faces of plates.
  1. Flush, brushed-finish, type 304 stainless steel.
  1. Device plates for surface type cast-metal boxes: Corrosion resistant cast ferrous metal designed for application.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated or required by code, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches and devices under single, multigang wall plates.
- D. Protect devices and assemblies during painting.
- E. Do not share neutral conductor on load side of dimmers.
- F. GFCI Receptacles shall be connected to provide ground fault protection of downstream devices within 6 FT of sinks. All other downstream device shall not be protected by GFCI receptacle. All protected downstream devices shall be labeled as protected by upstream GFCI receptacle.

#### 3.2 POSITION OF DEVICES

- A. Center outlets with regard to paneling, furring, trim, etc.
- B. Where several outlets occur in a room, symmetrically arrange them.
- C. Set outlets plumb or horizontal and extending to finished surface of wall, ceiling or floor as case may be without projecting beyond same.
- D. Install receptacles, switches, etc., indicated on wood trim, cases or other fixtures symmetrically. Where necessary, set with long dimension of plate horizontal, or gang in tandem.

3.3 CLEANING

- A. Internally clean devices, device outlet boxes, and enclosures.
- B. Replace stained or improperly painted wall plates or devices.

3.4 FIELD QUALITY CONTROL

- A. Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
  - B. Test ground-fault circuit interrupter operation with both local and remote fault simulations according to manufacturer recommendations.
- A. Replace damaged or defective components.

END OF SECTION 26 27 26

SECTION 26 28 16 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for disconnect switches as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 SUBMITTALS

- A. Shop drawings: Not Required.
- B. Product data: Not Required.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Not Required.
- F. Operation and Maintenance Data: Required.
  - 1. Maintenance materials: Spare fuses, 10 percent or minimum of 3 of each type and rating of installed fuses.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable manufacturers:
  - 1. Safety switches:
    - a. Base:
      - 1) Cutler-Hammer.
      - 2) Square D.
      - 3) Siemens.
      - 4) General Electric.
  - 2. Fuses:
    - a. Base:
      - 1) Bussmann.
      - 2) Shawmut.
      - 3) Brush.
      - 4) Littelfuse.
  - 3. All fuses in fusible-type devices: Same manufacturer.

2.2 SAFETY SWITCHES

- A. Safety switches shall be enclosed heavy duty type (Type HD) with quick-make, quick-break mechanism and external pad-lockable operating handle.



- B. Safety switches shall be rated 240 or 600 volts as applicable for the voltage and number of poles required for the circuit. They shall be horsepower rated for the motor they serve when used in motor circuits. Safety switches shall be UL listed for service entrance equipment where used as service disconnect.
- C. Switch blades fully visible in OFF position with door open.
- D. Safety switches shall be fusible or nonfusible, 2, 3 or 4 pole as indicated.
- E. Lugs shall be rated for copper or aluminum conductors and removable from the front. Provide a ground wire lug of suitable size in the enclosure. Provide isolated solid neutral bar for switches with neutral in the circuit.
- F. Safety switches shall be single throw unless otherwise indicated.
- G. LUG terminations:
  - 1. All Lug terminations on equipment shall have UL temperature rating of 75 degC minimum. Ampacity of wiring to equipment shall be based on conductors with temperature rating of 75 degC.
- H. Enclosures shall be NEMA 1 indoors and NEMA 3R outdoors unless otherwise indicated.
- I. Provide 1/4 inch high nameplate designating load served.

### 2.3 ENCLOSURE

- A. NEMA KS 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.
  - 1. Outdoor Locations: Type 3R.
  - 2. Other Wet or Damp Indoor Locations: Type 4.
  - 3. Finish: Baked enamel over rust-inhibiting primer.

### 2.4 EXTRA MATERIAL

- 1. Extra fuses: 10 percent or minimum of 3 of each type and rating of installed fuses.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturers instructions and recommendations.
- B. Mount safety switches securely between 3 and 6 foot levels above floor unless otherwise indicated.
- C. Furnish cartridge fuses for fusible switches of the size indicated or as required for the equipment served.
- D. For equipment protection verify the equipment manufacturers recommended fuse size and type and provide proper fuse.
- E. For switches serving motors locate so switch is easily accessible in an emergency condition for quick disconnect.

1. Locate so personnel do not have to cross between or around other equipment or obstructions.
  2. Locate in general area circulation space.
  3. Support with metal framing members fabricated per manufacturers recommendations.
- F. Switches for motor circuits controlled by AFD's shall be electrically interlocked to the controlling AFD via contacts provided in switch.
- A. Provide labeling per Section 16010.

END OF SECTION 26 28 16

SECTION 26 51 13 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for interior lighting as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 SUBMITTALS

- A. Shop drawings: Not Required.
- B. Product data: Required.
  - 1. Names of manufacturers, cuts, catalog numbers and photometric performance curves with candlepower distribution and C.U. tables of all lighting fixtures to be used on project.
  - 2. Identify fixtures by Fixture Schedule number, including special notations for finishes, colors, and mountings.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Not Required.
- F. Operation and Maintenance Data: Required.
  - 1. 5 year warranty for electronic fluorescent ballasts.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES - GENERAL

- A. Acceptable manufacturers:
  - 1. Lighting fixtures:
    - a. Base:
      - 1) As indicated on Fixture Schedule.
    - b. Optional:
      - 1) Lighting fixture schedule indicates required fixture type. Manufacturers names and catalog numbers indicate recommended fixture type for appearance, construction, and performance. Other manufacturers are acceptable and will be reviewed based upon recommended fixture criteria.
  - 2. Lamps:
    - a. Base:
      - 1) Osram/Sylvania.
      - 2) General Electric.
      - 3) Philips Lighting.

- 4) Venture.
3. Lenses:
  - a. Base:
    - 1) ICI Acrylics.
    - 2) As indicated.
4. Ballasts:
  - a. Base:
    - 1) Advance.
    - 2) Magnetek.
    - 3) Power Lighting Products.
    - 4) Motorola.
    - 5) Osram/Sylvania.
    - 6) Robertson.
5. Emergency battery units:
  - a. Base:
    - 1) Dual-lite.
    - 2) Prescolite.
    - 3) Emergi-Lite.
    - 4) Chloride.

- B. All lighting fixtures and electrical components: UL labeled, complete with lamps.
- C. Provide all recessed fixtures with gaskets of rubber, fiberglass, or equivalent material to prevent light leaks around flush trim.
  1. Provide recessed fixtures with trim gaskets cemented in proper position.
- D. Provide standard plaster frame for all recessed lighting fixtures installed in plaster walls or ceilings.
  1. Design, finish and fabricate material to preclude possibility of rust stain in plaster.
- E. Coordinate fixture types with ceiling construction.
- F. Provide pendant incandescent, compact fluorescent, and/or HID fixtures with swivel hangers which will allow fixture to swing in any direction but will not permit stem to rotate.
  1. Provide hangers with enclosure rating (NEMA 1, 4, or 7) equal to enclosure requirements of area in which they are installed.
  2. Swivel hangers for fixtures in mechanical equipment areas: Shock absorbing type.

## 2.2 LAMPS

- A. Incandescent lamps: As indicated in fixture schedule.
  1. Use only lamps that meet current Federal energy standards (EPACT 1992).
- B. Fluorescent lamps:
  1. T8 (265 mA) rapid-start medium bipin lamps.
    - a. Correlated color temperature of 3500 degrees Kelvin.
    - b. Minimum color rendering index (CRI) of 70.
- C. Contractor shall ensure that lamps provided have the correct bulb shape for the fixture specified.

## 2.3 BALLASTS

- A. Fluorescent high frequency electronic ballasts:

1. "High Frequency" electronic ballast shall operate lamps at a frequency of 20 KHz or higher without visible flicker.
2. Electronic ballast shall have a Power Factor greater than 90 percent.
3. Electronic ballast's input current shall have Total Harmonic Distortion (THD) of less than 20 percent.
4. Electronic ballast shall meet ANSI C82.11 standards regarding harmonic distortion.
5. Electronic ballast shall be Underwriters' Laboratories (UL) listed (Class P) and CSA Certified where applicable.

#### 2.4 EXIT SIGNS:

- A. Conform to UL 924 and the following:
  1. Sign Colors: Conform to local code.
  2. Minimum Height of Letters: Conform to local code.
  3. Arrows: Include as indicated.
  4. Lamps for AC Operation: Light-emitting diodes (LED), 70,000 hours minimum rated life.
- B. Self-Powered Exit Signs (Battery Type): Integral automatic high/low trickle charger in a self-contained power pack.
  1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.

#### 2.5 EMERGENCY LIGHTING UNITS:

- A. Each system shall include automatic power failure device, test switch, pilot light, charger, and battery.
- B. Conform to UL 924. Provide self-contained units with the following features:
  1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
  2. Charger: Minimum 2-rate, fully automatic, solid-state type, with sealed transfer relay.
    1. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. Relay disconnects lamps and battery and automatically recharges and floats on trickle charger when normal voltage is restored.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Locate fixtures in accordance with reflected ceiling plans.
- B. Locate in exact center of tile when indicated. Relocate misplaced fixtures and replace damaged ceiling materials.

#### 3.2 ADJUST AND CLEAN

- A. Wipe all lighting fixture reflectors, lenses, lamps and trims, clean, after installation. All fixtures shall be installed with caution so as to avoid any fingerprints or smudges on surfaces of parabolic louvers and downlight reflectors. Any fixtures with fingerprints or smudges shall be cleaned.

- B. Replace all inoperable lamps with new lamps prior to final acceptance.

### 3.3 CONNECTIONS

- A. Ground lighting units. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION 26 51 13

SECTION 28 10 00 - SECURITY SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish all labor, materials, tools, equipment, hardware, and services for Security System as indicated in accordance with contract documents.
- B. Coordinate with work of all other trades.
- C. Although such work is not specifically indicated, provide all supplementary or miscellaneous items, components, and devices incidental to, or necessary for, a sound, secure, and complete installation.

1.2 SUMMARY

- D. Section Includes:
  - 1. Electronic components necessary for a fully integrated intrusion detection system.

1.3 SUBMITTALS

- E. Product data: Required.
  - 1. Technical data on each type of device.
- F. Shop drawings: Not Required.
- G. Samples: Not required.
- H. Specification Comparison: Not required.
- I. Operation and Maintenance Data: Required.

1.4 QUALITY ASSURANCE

- J. Manufacturer Qualifications: Company specializing in security sensor and alarm control equipment for a minimum of 10 years.
- K. Installer shall have successfully installed similar systems and equipment.
  - 1. A complete technical specification for the submitted equipment, noting differences and adherence to this Section.

1.5 RECORD DOCUMENTS

- L. Provide project as built drawings identifying system organization and rack/component distribution.
- M. Provide directory listing of each input/output to include permanent identification of each wiring/wire conductor (i.e., door contact number, motion detector number).

1.6 WARRANTY

- N. Warranty Period: One year commencing from the date of final acceptance.
- O. Contractor shall agree to repair or replace defective components/materials and to correct defective work when given notice during the warranty period.
  - 1. Warranty response time to be within 12 hours upon receipt of request from Owner during normal working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers:
  - 1. Recessed/Surface-Mounted Door Position Switches
    - a. Sentrol, Inc. 800-547-2556
    - b. GRI, Inc. 800-445-5218
    - c. Ademco Sensor Co. 800-467-5875
    - d. Aleph International 818-365-9856
    - e. Flair Electronics 800-532-3492
  - 2. Motion Detection Equipment
    - a. Sentrol, Inc. 800-547-2556
    - b. Detection Systems, Inc. 888-289-0096
    - c. C & K Systems, Inc. 916-351-1131
  - 3. Glass Breakage Detector
    - a. Sentrol, Inc. 800-547-2556
    - b. Approved Equal.
  - 4. Electronic Siren
    - a. Ademco 800-573-0154
    - b. Approved Equal
  - 5. Central Station Communicator
    - a. Bosch 800-573-0154
    - b. Ademco 800-645-7568
    - c. Approved Equal

2.2 RECESSED MAGNETIC DOOR POSITION SWITCHES

- A. GRI 2020TWG Series used as basis of design, any/all substitution request must meet the following criteria:
  - 1. 3/8-inch diameter self-locking.
  - 2. Long gap series (up to 1-inch gap).
  - 3. Temperature range: -55° F to 212° F.
  - 4. Closed-loop configuration.

2.3 MOTION DETECTION EQUIPMENT

- A. Dual optic technology, PIR/Microwave.



1. Digital signal processing combining bi-directional pulse count with motion verification to reduce false alarms due to RFI, static or lightning, rapid temperature changes, vibration and noise.
2. Selectable pulse options.
3. Tamper switch cover.
4. Wire cage/protection for backstage environment.
5. Recess mount where available and coordinate locations with Architect.
6. Interchangeable lenses for coverage options.
7. Walk-test LED cover.
8. Swivel bracket for wall and corner mounting.
9. 7 to 16 VDC operating voltage.
10. Alarm duration 2 to 5 seconds.
11. Operating temperature 0° F to 120° F.
12. Humidity 10 to 90 percent non-condensing.
13. RFI immunity greater than 10 V meter from 0 to 1000 MHz.
14. Lightning immunity, 2.5 KV, 2 joules maximum energy impulse, 1 msec rise/50 msec decay. Static discharge 20 KV.

#### 2.4 CEILING MOTION DETECTION SENSORS

- A. Dual optic technology.
  1. 60 feet diameter coverage.
  2. Ceiling mount.
  3. 360 degree coverage.
  4. Mask all unused curtain areas.
  5. Utilize recessed mounting kit.
  6. Powered by 7 to 18 volts DC.

#### 2.5 GLASS BREAKAGE DETECTOR

- A. Detection Systems Inc. DS1101i Series used as basis of design, any/all substitution request must meet the following criteria
  1. Recessed mount
  2. Wall or ceiling mount
  3. Microprocessor based sound analysis technology
  4. Magnetic and acoustic test feature
  5. Coverage area of up to 25 feet for glass sizes over 12 inch by 12 inch.
  6. Alarm output, form C reed relay rated at 125mA at 28Vdc resistive load.
  7. Normally closed cover activated tamper switch with separate terminals. Contacts rated at 125mA at 28Vdc.

#### 2.6 ELECTRONIC SIREN

- A. Ademco 702 Series used as basis of design, any/all substitution request must meet the following criteria
  1. 6 to 12 volt DC combination speaker and siren driver
  2. Dual tone - warble or steady
  3. Built-in Tamper Plate to protect wires from attack.
  4. 30 watt power rating.

5. Furnish protective cabinet with tamper switch.
6. Output: 110dB
7. Current Draw: 1500mA
8. Power: 30 watt
9. Indoor/Outdoor Rated

## 2.7 CENTRAL STATION COMMUNICATOR

- A. Radionics 2000 Series used as basis of design, any/all substitution request must meet the following criteria
1. Six hardwire zones
  2. Minimum of eight user codes
  3. Alphanumeric control keypad
  4. Digital communicator
    - a. shall support all major formats including SIA and Contact ID
    - b. 3 phone numbers (3rd backs up primary)
    - c. 2 account numbers
    - d. DTMF or pulse dialing
    - e. DPDT line seizure
    - f. Anti-jam feature
    - g. Split reporting of selected events to each telephone number
    - h. Event initiated personal paging
    - i. Support cellular communications
  5. Alarm / communicator reset without user intervention
  6. Audible alarm output
    - a. Supervised bell output - 700 mA @ 12VDC, PTC protected, current limited at 3 A
    - b. Steady, pulsed, temporal pattern, or strobe output
  7. Supervision
    - a. AC power failure
    - b. Trouble by zone
    - c. Telephone line trouble
    - d. Low battery
    - e. Bell output trouble
    - f. Loss of internal clock
    - g. Tamper by zone
    - h. Fail to communicate
    - i. Aux power supply fault.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Use methods and lubricating compounds on cables and wires to prevent damage to cables and wires during pulling. Provide compounds that are not injurious to the cable and wire jackets and do not harden or become adhesive.
- B. Make the cable splices in tamper-resistive, accessible, junction boxes.

- C. Install sensors in accordance with manufacturer's instruction manuals and recommendations
- D. All equipment shall be supervised and report all faults and alarms to a remote monitoring central station.

**3.2 OPERATION TRAINING AND MAINTENANCE DATA**

- A. Demonstrate to the Owner's designated representatives, the features and functions of the system and subsystems. Instruct the Owner and designated representatives in the proper operation and maintenance of the system.

END OF SECTION 28 10 00

SECTION 28 31 00 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 SUMMARY:

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Fire Alarm Control Panel.
    - b. Signal Initiating Devices.
    - c. Notification Appliances.
    - d. Miscellaneous Devices.

1.02 SUBMITTALS

- A. Shop drawings: Required.
  - 1. Complete fire detection and alarm system design wiring diagrams, interface wiring diagrams, and operational details by system manufacturer or authorized technical representative.
  - 2. Submit documents after design has been approved by Authority Having Jurisdiction (AHJ).
- B. Product data: Required.
- C. Samples: Not required.
- D. Specification Comparison: Not required.
- E. Test report: Required.
- F. Operation and Maintenance Data: Required.

1.03 QUALITY ASSURANCE:

- A. Referenced Standards:
  - 1. Americans with Disabilities Act (ADA):
    - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
  - 2. FM Global (FM):
    - a. All applicable standards.
    - b. All components FM approved.
  - 3. National Electrical Manufacturers Association (NEMA).
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
    - b. 72, National Fire Alarm Code.

5. Underwriters Laboratories, Inc. (UL):
    - a. 38, Standard for Safety Manually Activated Signaling Boxes.
    - b. 268, Standard for Safety Smoke Detectors for Fire Protective Signaling Systems.
    - c. 268A, Standard for Safety Smoke Detectors for Duct Applications.
    - d. 464, Standard for Safety Audible Signaling Appliances.
    - e. 497B, Standard for Safety Protectors for Data Communication and Fire Alarm Circuits.
    - f. 521, Standard for Safety Heat Detectors for Fire Protective Signaling Systems.
    - g. 864, Standard for Safety Control Units for Fire Protective Signaling Systems.
    - h. 1971, Standard for Safety Visual Signaling Appliances.
  6. Building code:
    - a. North Carolina Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.
- B. Design Criteria:
1. Provide a complete fire alarm system as described in the Contract Documents and according to criteria of the Authority Having Jurisdiction (AHJ), NFPA and ADAAG.
  2. The Contract Drawings indicate a preliminary layout of the type, location and quantity of devices based on NFPA.
    - a. At a minimum, make the following adjustments to the Contract Drawing as required by the AHJ and the manufacturer:
      - i. Location and spacing of notification appliances.
        - a) Candela of strobes associated with the spacing.
      - ii. Location and spacing of initiating devices.
- C. Service Organization Qualifications:
1. Offer an annual maintenance contract including complete service and equipment costs for maintenance of complete system.
  2. Ten (10) years experience minimum serving fire alarm systems.
  3. Provide for 24 HR emergency service.

**1.04 SYSTEM DESCRIPTION:**

- A. Automatic and manual, analog addressable, general alarm and non-coded evacuation alarm, supervised, closed-circuit, 24 Vdc microprocessor based fire detection and alarm system.
- B. Provide components including but not limited to following:
  1. Main fire alarm control panel (FACP).
  2. Analog addressable heat sensors.
  3. Analog addressable smoke sensors.

4. Analog addressable duct smoke sensors.
  5. Combination fire alarm horns with strobe.
  6. General alarm strobes.
  7. Addressable manual pull station.
  8. Fire alarm system wire, with all wiring in conduit.
- C. Basic Performance:
1. Signal Line Circuits (SLC) shall be wired Class B (NFPA Style 4).
  2. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y).
1. Each SLC shall be limited to only 80 percent of its total capacity at the time of initial installation.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable.
1. Fire alarm system:
    - a. Edwards Systems Technology.
    - b. Gamewell.
    - c. Notifier.
    - d. Siemens Cerberus Division.
    - e. Silent Knight.
    - f. SimplexGrinnell.
    - g. Wheelock.
    - h. Approved Equal.
  2. Manufacturer must have local service organization.
- B. All Equipment:
1. UL listed as a product of a single manufacturer under appropriate category.
  2. Equipment shall not be modified or installed to alter or void UL label or listing.
  3. FM approved.
  4. Approved by Fire Marshal, when required by state or local codes.

### 2.02 FIRE ALARM CONTROL PANEL (FACP):

- A. FACP shall perform operations as described in Fire Alarm System Operation:
- B. The FA system shall have 100 point minimum initiating device capacity.
- C. Construction shall be modular with solid-state, microprocessor-based electronics.

1. An 80-character LCD display shall indicate alarms, supervisory service conditions and any troubles.
- D. Keyboards or keypads shall not be required to operate system during fire alarm conditions.
- E. Provide necessary switches, relays, indicator lamps, wiring terminals, etc., to provide complete operation supervising, control, and testing facilities for entire system.
- F. System shall have provisions for disabling and enabling all circuits individually for maintenance and testing purposes.
- G. System shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log.
  1. These events shall be stored in a battery protected random access memory.
  2. Each recorded event shall include time and date of that event's occurrence.
  3. System shall have capability of recalling alarms, trouble conditions, acknowledgments, silencing and reset activities in chronological order for purpose of recreating an event history.
- H. FACP shall be listed under UL 864.
- I. FACP shall be in an enclosed metal cabinet with glass door specifically designed for public areas.
  1. Mounting: Surface.
  2. Finish: Beige baked enamel.
- J. Each addressable device shall be represented individually in FACP.
  1. Indicate TROUBLE by a discreet LCD readout for each supervised circuit.
  2. Indicate ALARM by a discreet LCD readout for each alarm initiating addressable device.
  3. Include individual supervisory and alarm relays in each circuit arranged so that ground or open condition in any circuit or group of circuits, will not affect proper operation of any other device.
- K. FACP shall include the capability to report alarm and trouble conditions via a telephone line to a third party alarm reporting services.
- L. FACP shall include a system testing capability to help ensure that zoning and supervision have been maintained throughout system.
  1. Actuation of the enable walk test program at FACP shall activate "Walk-Test" mode of system which shall cause the following to occur:
    - a. City connection circuit shall be disconnected.
    - b. Control relay functions shall be bypassed.

- c. FACP shall indicate a trouble condition.
  - d. Alarm activation of any initiation device shall cause audible signals to activate for 2 seconds.
  - e. FACP shall automatically reset itself after code is complete.
  - f. Any momentary opening of alarm initiating or alarm indicating circuit wiring shall cause audible signals to sound continuously for 4 seconds to indicate trouble condition.
  - g. System shall have 7 distinctive walk test groups such that only a portion of system need be disabled during testing and an alarm in any other area will be processed normally.
- M. General Alarm Circuits: Positive non-interfering type so that a second device can be announced simultaneously, or closely following first zone.
- N. Power Supply:
- 1. Power limited operation per NFPA 70 Article 760.
  - 2. 120 Vac dedicated circuit from panelboard to integral 24 Vdc regulated power supply in FACP and battery charger.
    - a. The power supply shall provide all panel and peripheral device power needs.
- O. Battery:
- 1. Low maintenance sealed type, for fire alarm use with automatic battery charger.
  - 2. Batteries shall be capable of operating maximum normal load of system for 24 HRS and then capable of operating system for 5 minutes in alarm condition.
  - 3. Size batteries for the total maximum number of devices that can be connected to the FACP not the install number of devices.
  - 4. The notification appliance power extender shall have the same battery requirements as the FACP.

### 2.03 SIGNAL INITIATING DEVICES:

- A. Addressable Manual Pull Stations:
- 1. Pull-type with handle which shall lock in a protruding manner to facilitate quick visual identification of activated station.
    - a. Key reset after operation.
    - b. Non-coded.
    - c. Single action.
  - 2. High impact red Lexan with operating directions in white letters.
    - a. Semi-flush mounted in architecturally finished areas.
    - b. Surface mounted with clear Lexan weatherproof protective shield in areas designated as wet or in areas indicated in the schedules herein.
  - 3. Stations shall be keyed alike with FACP.
  - 4. Standards: UL 38.



- B. Addressable Sensor Base:
  - 1. Plug-in arrangement:
    - a. Sensor and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection.
    - b. Removal of the sensor head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the Control Unit.
  - 2. LED that will flash each time it is scanned by the Control Unit.
  - 3. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type.
  - 4. Addressability: Sensors include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP.
  
- C. Analog Addressable Heat Sensors:
  - 1. Fixed temperature type or combination rate-of-rise and fixed temperature type.
  - 2. Rated at 135 DegF for ordinary areas where normal ceiling temperatures do not exceed 100 DegF.
  - 3. Self-restoring: Sensors do not require resetting or readjustment after actuation to restore them to normal operation.
  - 4. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
  - 5. Layout is based on 30 FT spacing for fixed-type and 50 FT spacing for combination type for smooth ceiling.
  - 6. Standards: UL 521.
  
- D. Analog Addressable Smoke Sensors:
  - 1. Photoelectric type, dual chamber products of combustion sensors.
  - 2. An infrared sensor light with matching silicon cell receiver and actuated by the presence of visible products of combustion.
  - 3. Self-restoring: Sensors do not require resetting or readjustment after actuation to restore them to normal operation.
  - 4. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
  - 5. Standards: UL 268.
  
- E. Addressable Monitor Modules:
  - 1. Provides addressability and supervision to a conventional initiating device (e.g., tamper switches, pressure switches, flow switches).
    - a. The conventional initiating device shall be wired Class B, Style B.

2. Integral or remote LED shall be provide that will flash each time it is scanned by the Control Unit.
  - a. When the Control Unit determines that a monitor module is in an alarm or a trouble condition, the Control Unit shall command the LED on that sensor's base to turn on steady indicating that abnormal condition exists.
- F. Sprinkler System Sensors:
  1. Provide monitor module as specified herein for waterflow sensor(s).
    - a. Waterflow sensor(s) provided by Division 15.
  2. Provide monitor module as specified herein for pressure sensor(s).
    - a. Pressure sensor(s) provided by Division 15.
  3. Provide monitor module as specified herein, for tamper switches associated with main water valve, post indicator valve (PIV) or OS&Y valves.
    - a. Tamper switches provided by Division 15.

#### 2.04 NOTIFICATION APPLIANCES:

- A. Alarm Horns:
  1. Electric-vibrating polarized type, operating on 24 Vdc, with provision for housing the operating mechanism behind a grille.
  2. Horns produce a sound pressure level of 85 dB, measured at 10 FT.
  3. Housing: Red with white "FIRE" lettering.
    - a. Semi-flush or flush mounted in architecturally finished areas.
  4. Horns shall be weatherproof in areas designated as wet or in areas indicated in the schedules herein.
- B. Alarm Strobes:
  1. White tamper resistant lexan lens with 24 Vdc xenon strobe.
  2. Provide Candela rating as required per ADAAG and synchronize of multiple strobes when required.
  3. Housing: Red with white "FIRE" lettering.
    - a. Semi-flush or flush mounted in architecturally finished areas.
  4. Strobes shall be weatherproof in areas designated as wet or in areas indicated in the schedules herein.
- C. Combination Audio/Visual Devices:
  1. Shall be mounted in an integral unit and shall have the same features as the individual units specified herein.
- D. Standards: UL 464, UL 1971.

#### 2.05 WIRING:

- A. Conduit:
  - 1. 1/2 IN minimum.
- B. Conductors:
  - 1. Insulation type per NEC 760.
  - 2. 120 Vac and power supply connections: 12 GA, minimum.
  - 3. Low-voltage general alarm circuits: 14 GA, minimum.
  - 4. Low-voltage signal initiating circuits: 18 GA, minimum.
  - 5. Annunciator and data communication circuits: As required by manufacturer, UL listed.
  - 6. Use larger wire sizes when recommended by equipment manufacturer and per voltage drop calculations.

**2.06 SYSTEM OPERATION:**

- A. Activation of any signal initiating device, except tamper switches, shall cause the following:
  - 1. General audible horns and/or bells to sound, visual strobes to strobe and automatic control devices to operate.
  - 2. Alarm information shall be displayed at the FACP LCD display.
- B. All fire alarm signals are automatically locked in at FACP until originating device is returned to normal and FACP is manually reset.
  - 1. Audible alarm signals shall be silence-able from FACP allowing for re-initiation following a subsequent alarm.
    - a. Silencing of alarm signals shall not impair ability of system to continue to perform as specified.
- C. Activation of any system trouble shall initiate the following:
  - 1. Common audible trouble signal shall sound and common trouble light shall illuminate at FACP and any remote annunciators.
  - 2. FACP shall indicate specific device.
- D. Audible trouble signal shall be silenceable by FACP.
  - 1. Visual trouble indication remains until trouble condition is corrected.
    - a. A subsequent trouble condition received after manually silencing shall cause audible trouble signal to resound.
    - b. Restoration of system to normal causes audible trouble signal until silencing switch is returned to normal position.
    - c. Trouble signal will be initiated under following conditions:
  - 2. Open on an initiation or alarm indicating circuit.
  - 3. Ground fault condition.

4. Auxiliary manual control switch out of normal position.
  5. Loss of 120 volt operating power to FACP, transponders.
  6. Low or no battery voltage condition.
  7. Main sprinkler valve is closed.
  8. Post indicator valve is closed.
1. Any sprinkler or standpipe OS&Y valve is closed.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION:

- A. Install all fire alarm equipment and wiring in accordance with local and national codes and NFPA 72.
- B. Install all wiring in raceways:
  1. The inside of all boxes are to be painted red.
- C. Install all components as indicated and in accordance with manufacturer's wiring diagrams, instructions and recommendations.
- D. Make all fire alarm wiring continuous from terminal to terminal or from terminal to device pigtail lead.
  1. Circuit splices not permitted.
  2. Wiring joints, only when required at device pigtail leads shall utilize Scotchlok insulate conical spring connector.
- E. Color code all wiring by type of device.
- F. Cover all smoke detectors with plastic bags immediately after installation to maintain cleanliness.
- G. Device Mounting Schedule:
  1. Dimensions are to center of item unless otherwise indicated.
  2. Mounting heights as indicated below unless otherwise indicated on Drawings.
    - a. Manual pull stations: 48 IN.
    - b. Notification appliances: 80 IN.
    - c. Control panels: 72 IN to top.

3.02 TESTING:

- A. Obtain services of a factory trained representative of system manufacturer to supervise installation and its progress, supervise final connections to equipment and provide testing to assure that system is in proper operating condition, and is in compliance with all applicable regulations.
- B. Test system to satisfaction of state and local fire authorities in accordance with NFPA 72, state and local codes and manufacturer's requirements.

3.03 INSTRUCTION:

- A. Manufacturer shall provide an authorized representative to instruct and train Fire Department personnel and Owner's personnel in operation of system.

END OF SECTION 28 31 00