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# Project Manual

Constructed For and Contract Administered By:  
Leon County Division of Facilities Management  
Tallahassee, FL

Community Services Building

HVAC Improvements – Phase I

100% Construction Documents  
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Set Number:  
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## **SECTION 15010 - MECHANICAL GENERAL PROVISIONS**

### **PART 1 - GENERAL**

#### **GENERAL CONDITIONS**

The work described hereunder shall be installed subject to the Contractual Conditions for the entire Specifications.

#### **CORRELATION**

This Section of the Specifications and its accompanying Drawings are made separate for the convenience of the General Contractor in preparing his bid and in no way relieves the General Contractor of his responsibility to correlate the work under this Section with that of all other trades as regards the items to be furnished by various Subcontractors, the exact location of all equipment and materials and the necessity of planning the work of all trades to avoid interference.

#### **PLANS AND SPECIFICATIONS**

Drawings and Specifications are intended to clearly set forth all work, and the detailed description is added to assist in establishing the scope and the location of the several parts of the work. Collectively, they shall govern and control the scope, character, and design of the Work, and any item called for in any one of the documents shall be as though mentioned in all.

Failure to make reference in the Specifications to any items of the work shown on the Drawings, but necessary to the completion of the Work shall not relieve the Contractor of the full responsibility to furnish the materials and perform the work of such items, in a manner comparable to other items of similar nature for which detailed Specifications are included.

#### **PROJECT FAMILIARIZATION**

The bidder is expected to visit the site and familiarize himself with conditions at the site before submitting his bid. He shall familiarize himself with the work required throughout the entire project and shall make allowances for contingencies which may occur in the interconnection of the various systems.

#### **ALTERNATES AND ADDENDA**

The Contractor shall investigate all Alternates, Addenda and Allowances as they relate to the Work of this Section.

#### **TESTING**

The Work shall include complete testing of all equipment and piping at the completion of the Work and making any connection changes or adjustments necessary for the proper functioning of the system and equipment.

#### **WORK INCLUDED**

Work covered under this Section consists of furnishing all labor, materials, tools, equipment, transportation, scaffolding, services, supervision, and performing of all operations required to properly complete all mechanical work in accordance with this Division of the Specifications and as indicated on the applicable Drawings, subject to terms and conditions of the Contract.

## **SUPERVISION OF WORK**

The Mechanical Contractor shall have a qualified and experienced superintendent on the job when any related work is in progress.

## **RELATED WORK SPECIFIED ELSEWHERE**

The Contractor is cautioned to note carefully other Sections of the project Specifications with their cross references to other specific standard specifications, standard detail, etc., describing work to be furnished under these Specifications as well as any mechanical work that may be shown on electrical, structural, architectural, or other drawings, in order that he may fully understand the requirements and work to be provided under this Section of the Specifications.

## **ORDINANCES AND REGULATIONS**

All work shall conform with all local and State ordinances or regulations governing the installation of such equipment. If work as laid out, indicated or specified is recognized to be contrary to or conflicting with local ordinances or regulations, the Subcontractor shall report same to the Architect/Engineer before submitting a bid. The Architect/Engineer will then issue instructions as to procedure.

## **CODES AND STANDARDS**

The standards of the following organizations, and individual standards named, shall be followed the same as if they were fully written herein and constitute a part of the Specification requirements except where otherwise specified: For the specific editions that are applicable see Section B, INSTRUCTIONS TO BIDDERS, Exhibit 'A'.

- National Fire Protection Associations - Standards
  - NFPA 70, National Electric Code
  - NFPA 101, Life Safety Code
  - NFPA 90-A Installation of Air Conditioning and Ventilating Systems.
- FL Building Code 2007 edition with addenda
- FL Mechanical Code 2007 edition with addenda
- FL Plumbing Code 2007 edition with addenda
- Florida Energy Efficiency Code for Building Construction
- National Board of Fire Underwriters
- SMACNA Standards

The foregoing rules, standards, regulations, specifications, recommendations and requirements shall be followed by the Contractor as minimum requirements. They shall not relieve the Contract from furnishing and installing higher grades of materials and workmanship which are specified herein or indicated on the Drawings.

Any material, equipment or workmanship specified by reference to the number, symbol or title of Specification or detail, or other standard rules, codes, regulations, etc., shall comply with the latest edition amendments and revisions thereto in effect on the date of these Specifications.

The Contractor shall submit proof, if requested by the Engineer or his representative, that the materials, appliances, equipment or devices that he furnishes and installs under this Contract meet the requirements of the Underwriters' Laboratories, Inc., or Factory Mutual, as regards fire and casualty hazards.

## **PERMITS, INSPECTIONS AND UTILITY FEES**

The Contractor shall obtain necessary permits and inspections required for work and pay all charges incidental thereto. Contractor shall coordinate all utility taps and shall pay all associated fees, impact charges, etc. Upon completion of the work the Contractor shall deliver to the Engineer a certificate of inspection and approval from the local inspection department, if required.

## **MINOR DEVIATIONS**

The Contractor shall note that the Mechanical Drawings are intended to indicate only the extent diagrammatically, general character and location of the work included. Work intended, but having minor details obviously omitted or not shown, shall be furnished and installed complete to perform the functions intended.

Arrangements of piping, ductwork, and equipment that differ materially from the obvious intent of the Drawings will not be permitted except where necessary to avoid interferences, and only where specifically approved by the Architect/Engineer. Drawings shall be furnished showing all changes. Any change resulting in a saving in labor and materials shall be made in accordance with a Contract change order.

## **BASIC MATERIALS AND METHODS**

The materials and methods specified in this article are to be used for work specified throughout this Section of the Specifications.

All materials and workmanship shall be of the highest quality.

Any materials on the job rejected by the Architect/Engineer shall be removed from the premises.

The installation shall be made in a workmanlike manner in accordance with acceptable industry standards except where specific procedures are called for in these Specifications, in which case they shall be followed.

All materials shall be new, free of defects and of the manufacturers latest standard design.

Reference to a particular material or specific equipment by name, make or catalog number is to describe equipment which will meet the requirements of the project and is not intended to restrict bidding.

It is the intent that all of the equipment of a similar type shall be the products of the same (one) manufacturer when practicable, providing unit responsibility for each group.

## **REVIEW OF MATERIALS**

Submittals shall be made in compliance with the General Conditions of the Contract for Construction and the following:

Submittals shall be identified by items numbers as listed in the pertinent section of the specifications and shall be accompanied by a letter of transmittal.

Certificates shall be in triplicate and where required in conjunction with other submittals shall accompany such submittals.

Materials and other items subject to approval shall not be purchased or incorporated in the work before receipt of written approval.

Submittals shall be rendered all at one time for the entire project. Partial submittals will not be accepted or acknowledged. Exception: If a few items have long shop drawing preparation time, then these items will be accepted later to avoid delaying the shop drawing procedure.

## **SHOP DRAWINGS**

Shop Drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are prepared by the Contractor or any subcontractor, manufacturer, supplier or distributor and which illustrates some portion of the Work.

All shop drawings submitted shall bear the stamps of approval of the Contractor as evidence that the drawings have been checked by the Contractor. Any drawings submitted without this stamp of approval will not be considered and will be returned to contractor for proper resubmission. If the shop drawings show variances from the other requirements of the contract because of standard shop practice or other reason, the Contractor shall make specific mention of such variation in his letter of transmittal in order that, if acceptable, suitable action may be taken for proper adjustment. Otherwise, the Contractor will not be relieved of the responsibility for executing the work even though such shop drawings have been approved.

Submit six (4) copies of the shop drawings to be retained and additional copies as required by the Contractor, all items required under appropriate sections of the Specifications.

All materials are to be submitted in a hard cover, three ring binder. All materials are to be labeled with the pertinent Specification Section and are to be separated with dividers for each section of the Mechanical Specifications.

All materials submitted late or re-submitted shall be 3-ring punched and marked with the appropriate Specification Section Numbers.

## **PROJECT CLOSEOUT**

The Contractor shall remove all temporary work and temporary facilities prior to final pay request.

The Contractor shall clean spaces that were occupied by temporary work and temporary facilities. Remove debris, rubbish and excess materials from the sites. Burning or burying is not permitted on the sites.

Repair damages caused by installation or use of temporary facilities. Restore to original condition.

Restore grass, landscaping, hardscaping to original condition.

## **GUARANTEES, BONDS AND AFFIDAVITS**

### Warranties:

The Contractor shall submit to the Owner all manufacturer's warranties on equipment furnished and installed under this Contract.

In addition, to the guarantee of equipment by the manufacturer of each piece specified herein, the Contractor shall also guarantee such equipment and shall be held for a period of one year from final acceptance test to make good any defects of the materials or workmanship occurring during this period, without expense to the Owner.

Affidavits:

The Contractor shall provide affidavits as required in the non-technical portion of these Specifications.

**OPERATION AND MAINTENANCE DATA**

Manuals and Instructions:

The Contractor shall deliver to the Engineer, upon substantial completion of the Work, two copies of descriptive literature related to the equipment installed under this Contract, including parts lists, wiring diagrams, maintenance and operation manuals and warranties customarily supplied by manufacturers for equipment incorporated in this work. The literature shall be neatly bound in a 3-ring binder and delivered to the Engineer prior to final acceptances. Each manual shall include a copy of the Control Diagrams and a complete description of the operation of the control systems.

The Contractor shall give physical demonstration and verbal instructions for proper operation and maintenance of equipment to the Owner or his designated representative. Schedule these demonstrations and instructions at the Owner's convenience.

Provide four (2) hours of tour and demonstration of all equipment installed under this project.

**AS-BUILT DRAWINGS**

As-Built Drawings are required. Maintain a current and legible record set on the job. Final record prints will be drafted by the Engineer and signed off by the contractor. The Contractor is solely responsible for providing accurate asbuilts.

**QUALITY ASSURANCE**

Products Criteria:

Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least two (2) years prior to bid opening. Provide list of users upon request.

Equipment having less than a two-year use record, which in the opinion of the Engineer, provided significant benefits to the Owner such as improved energy efficiency, will be acceptable if it is a product of a manufacturer who has been regularly engaged in the manufacture of that specific type of product which has been used in similar applications for a period of two years. The Engineer reserves the right to require the Contractor to submit evidence to this effect for his approval.

Equipment Service: Products shall be supported by a service organization which maintains an adequate inventory of repair parts and is located, in the opinion of the Engineer, reasonably close to the site.

Manufacturer's Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

Welding: Before any welding is performed submit a copy of the Welding Procedure Specification (WPS) together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code.

Before any welder performs any welding, submit a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests as required by Section IX of the ASME Boiler and Pressure Code. The letter or symbol (as shown on the qualification test form) shall be used to identify the work of that welder and shall be affixed, in accordance with appropriate construction code, to each completed weld.

The types and extent of non-destructive examinations required for pipe welds are shown in Table 136.4 of the Code for Pressure Piping, ANSI/ASME B 31.1.

Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

### **FIRESTOPPING**

Provide for firestopping of all mechanical systems. UL listed methods conforming to the situations present shall be utilized. Submit shop drawings of intended methods, including installation instructions and proof of UL Listing.

### **WALL, FLOOR AND CEILING PLATES**

Material and Type: Chrome plated brass or chrome plated steel. Use plates that fit tight around pipes, cover openings around pipes, and cover the entire pipe sleeve projection.

Thickness: Not less than 3/32 inch for floor plates. For wall and ceiling plates, not less than 0.025 for up to 3 inch pipe, 0.035 for larger pipe.

Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, except mechanical rooms or chases. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

### **INSTALLATION**

Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.

#### Protection and Cleaning:

Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Engineer. Damaged or defective items, in the opinion of the Engineer, shall be replaced.

Protect all finished parts of equipment, such as shafts and bearings, where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt,

water, chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

Concrete and Grout: Use concrete and shrink-compensating grout, 3000 psi minimum.

Install gauges, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gauges to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

### **PAINTING**

Paint all bare steel pipe, supports, hangers, fabricated parts, etc. with two coats of enamel paint. Prepare surfaces in accordance with the manufacturer's recommendations. Coordinate colors with existing like components or per the Owner.

Paint all cut or heat affected galvanized steel components with two coats of cold galvanizing spraypaint, ZRC Cold Galvanizing compound or equal. Prepare surfaces per the manufacturer's recommendations.

### **PIPE AND EQUIPMENT SUPPORTS**

Generally, support in accordance with industry standards and as described in Section 15150.

Use of chain, wire or strap hangers, wood for blocking, stays and bracing, nor hangers suspended from piping above will not be permitted.

Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 1/2 inch clearance between pipe or pipe covering and adjacent work.

### **LUBRICATION**

Field check and lubricate equipment requiring lubrication prior to initial operation.

### **END OF SECTION**

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## **SECTION 15150 – SUPPORTS AND ANCHORS**

### **PART 1 - GENERAL**

#### **DESCRIPTION OF WORK**

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

This section is a Division 15 Basic Materials and Methods section, and is part of each Division 15 section making reference to or requiring supports, anchors, and seals specified herein.

Extent of supports, anchors and seals required by this section is indicated on drawings and/or specified in other Division 15 sections.

Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports, anchors and seals.

MSS Standard Compliance:

Provide pipe hangers and supports of which materials, design and manufacture comply with ANSI/MSS SP-58.

Select and apply pipe hangers and support, complying with MSS SP-69.

Fabricate and install pipe hangers and supports, complying with MSS SP-89.

Terminology used in this section is defined in MSS SP-90.

UL Compliance: Provide products which are Underwriters Laboratories listed.

### **PART 2 - PRODUCTS**

#### **ACCEPTABLE MANUFACTURERS**

Subject to compliance with requirements, provide supports and hangers by Grinnel, Michigan Hanger Company, B-Line Systems, or approved equal.

#### **HORIZONTAL PIPING HANGERS AND SUPPORTS**

Except as otherwise indicated, provide factory fabricated horizontal piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and support to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulating piping. Provide copper plated hangers and support for copper piping systems.

Adjustable Steel Clevises: MSS Type 1.

Steel Double Bolt Pipe Clamps: MSS Type 3.

Adjustable Steel Band Hangers: MSS Type 7.

Steel Pipe Clamps: MSS Type 4.

Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast iron floor flange.

Vertical Piping Clamps: Except as otherwise indicated, provide factory fabricated vertical piping clamps complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper plated clamps for copper piping systems.

Two-Bolt Riser Clamps: MSS Type 8.

Four-Bolt Riser Clamps: MSS Type 42.

#### HANGER-ROD ATTACHMENTS

Except as otherwise indicated, provide factory fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal piping hangers and building attachments, in accordance with MSS-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper plated hanger-rod attachments for copper piping systems.

Steel Turnbuckles: MSS Type 13.

Malleable Iron Sockets: MSS Type 16.

#### BUILDING ATTACHMENTS

Except as otherwise indicated, provide factory fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.

Center Beam Clamps: MSS Type 21.

C-Clamps: MSS Type 23.

Malleable Beam Clamps: MSS Type 30.

Side Beam Brackets: MSS Type 34.

Concrete Inserts: MSS Type 18.

#### SADDLES AND SHIELDS

Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

Protection Saddles: MSS Type 39; use with rollers, fill interior voids with segments of insulation adjoining insulation.

#### MISCELLANEOUS MATERIALS

Metal Framing: Provide products complying with NEMA STD ML 1.

Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A 36.

Cement Grout: Portland cement (ANSI/ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ATM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

Heavy Duty Steel Trapezes: Fabricate from steel shapes or continuous channel struts selected for loads required; weld steel in accordance with AWS standards.

## **PART 3 - EXECUTION**

### **PREPARATION**

Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, and installers of other work requiring coordination with work of this section for purpose of reviewing material selection and procedures to followed in performing the work in compliance with requirements specified.

### **INSTALLATION OF BUILDING ATTACHMENTS**

Install building attachments as required locations within concrete or structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is places; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

In areas of work requiring attachments to existing concrete, use self-drilling rod inserts, Phillips Drill Co., "Red-Head" or equal.

### **INSTALLATION OF HANGERS AND SUPPORTS**

General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69 or as listed herein, whichever is most limiting. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do no use wire of perforated metal to support piping, and do not support piping from other piping.

Horizontal steel pipe and copper tube 1-½" diameter and smaller: support on 6-foot centers.

Horizontal steel pipe and copper tube over 1-½" diameter: support on 10-foot centers.

Vertical steel pipe and copper: support at each floor.

Plastic pipe: support in accordance with manufacturer's recommendations.

Fire protection piping: support in accordance with NFPA 13.

Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

Paint all black steel hangers with black enamel. Galvanized steel and copper clad hanger do not require paint.

Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

#### Provision for Movement:

Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

Insulated Piping: Comply with the following installation requirements.

Shields: Where low compressive strength insulation or vapor barriers are indicated, install coated protective shields.

Clamps: Attach clamps, including spacers (if any) to piping projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

Support fire protection piping independently of other piping.

#### INSTALLATION OF ANCHORS:

Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

Fabricate and install anchors by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and elbows. Make provisions for present of anchors as required to accommodate both expansion and contraction of piping.

Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

#### EQUIPMENT BASES

Where specified, provide concrete housekeeping bases for all floor-mounted equipment furnished as part of the work of Division 15. Size bases to extend minimum of 4" beyond equipment base in any direction; and 4" above finished floor elevation unless otherwise specified. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top edge or corners  $\frac{3}{4}$ " on all sides.

Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe fittings. Provide factory fabricated tank saddles for tanks mounted on steel stands. Prime and paint with black enamel.

#### END OF SECTION

## **SECTION 15190 - MECHANICAL IDENTIFICATION**

### **PART 1 - GENERAL**

#### **RELATED DOCUMENTS:**

Drawings and general provisions of contract, including General and Supplementary Conditions and Division-15 Specification sections, apply to work of this section.

#### **DESCRIPTION OF WORK:**

Provide identification of the following:

Mechanical Equipment (air handlers, condensing units, etc.)  
Mechanical Controls (panels, equipment, devices, sensors, etc.)  
Mechanical Piping (refrigeration, chilled water, hot water, etc.)

Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division 15 sections.

Types of identification devices specified in this section include the following:

Laminated Self adhesive Identification Materials.

#### **QUALITY ASSURANCE:**

Manufacturer's Qualifications: Firms regularly engaged in manufacturer of identification devices of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

#### Codes and Standards:

ANSI Standards: Comply with ANSI A13.1 for lettering size, colors, and viewing angles of identification devices.

#### **SUBMITTALS**

Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

### **PART 2 - PRODUCTS**

#### **ACCEPTABLE MANUFACTURES:**

Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:

Allen Systems, Inc.  
Brady (W. H.) Co.; Signmark Div.  
Industrial Safety Supply Co., Inc.  
Seton Name Plate Corp.

## **MECHANICAL IDENTIFICATION MATERIALS:**

General: Provide manufacturer's standard products of categories and types required for each application. Where more than one type is specified for application, selection is Installer's option, but provide single selection for each product category. Labels and lettering shall be neat and machine made.

## **EQUIPMENT IDENTIFICATION MATERIALS:**

Plastic or phenolic self-adhesive labels with 3/8" high stenciled letters. Label shall be black color with white stenciling.

## **PAINTED IDENTIFICATION MATERIALS:**

Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendation of ANSI A13.1

Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

Identification Paint: Standard identification enamel to match existing systems elsewhere in the building.

## **PLASTIC PIPE MARKERS:**

Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1 and matching existing.

Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1 and matching existing.

Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location.

Large Pipes: For external diameters 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height.

Lettering: Comply with piping system nomenclature to match existing systems elsewhere in the building.

Arrows: Apply printed pipe markers with arrows indicating direction of flow.

## **PART 3 - EXECUTION**

### **PIPING SYSTEM IDENTIFICATION:**

General: Coordinate names, abbreviations, pipe colors and other designations used in mechanical identification work, with existing corresponding designations with plans and existing equipment. Consult with the engineer regarding conflicts with existing equipment names.

Install equipment labels on all new and affected panels, and equipment. Place labels in conspicuous location. Ensure label does not interfere with access.

Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

Plastic pipe markers, with application system as indicated under "Materials" in this section.

Stenciled marker, black or white for best contrast.

Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine room, accessible maintenance spaces and exterior non-concealed locations.

Near each valve and control device.

Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

Near locations where pipes pass through walls or floors/ceiling, or enter non-accessible enclosures.

At access doors, manholes and similar access points which permit view of concealed piping.

Near major equipment items and other points of origination and termination.

Spaced intermediately at maximum spacing of 25' along each piping run, except reduce spacing to 15' in congested areas of piping and equipment.

On piping above removable acoustical ceilings, except omit intermediately spaced markers.

**END OF SECTION**

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## **SECTION 15250 - MECHANICAL INSULATION**

### **PART 1 - GENERAL**

#### **GENERAL CONDITIONS**

The work described hereunder shall be installed in accordance with the "Mechanical General Conditions," Section 15010.

#### **DESCRIPTION OF WORK:**

Extent of the mechanical insulation required by this section is indicated on the Drawings and schedules, and by the requirements of this section.

#### **Types of mechanical insulation specified in this section include the following:**

Ductwork Systems Insulation:

- Fiberglass duct wrap
- Semi-rigid Ductboard
- Closed-cell elastomeric

Piping System Insulation:

- Cellular glass
- Closed-cell elastomeric

#### **RELATED WORK**

Refer to Division 7 for fire caulking; not work of this section.

Refer to Division 15 section "Metal Ductwork" for duct linings; not work of this section.

#### **QUALITY ASSURANCE:**

Manufacturer's Qualifications: Firms regularly engaged in the manufacture of mechanical insulation products, of types required, whose products have been in satisfactory use in similar service for not less than three (3) years.

Installer's Qualifications: Installer shall be an insulation specialty sub-contractor. A professional insulator with adequate experience and ability shall install all insulation. Firm with at least 5 years successful installation experience on projects with mechanical insulations similar to that required for this project.

Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) having flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) methods.

Comply with the manufacturer's recommendations for installation of insulation materials.

#### **SUBMITTALS**

Submit to the Architect/Engineer for approval six (4) copies of brochures, technical data and/or shop drawings of the following, and as many additional copies as required for Contractor use:

Each type of insulation material, protective coverings, and accessories.

## **DELIVERY, STORAGE, AND HANDLING:**

Deliver insulation, coverings, cements, adhesives and coatings to the site in containers with manufacturer's stamp or label, affixed and showing fire hazard indexes of products.

Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

## **PART 2 - PRODUCTS**

### **ELECTRIC HEAT TRACE CABLE:**

Self limiting electric heat trace system for freeze protection of insulated hydronic piping and devices. Cable shall consist of 16 AWG nickel-plated copper bus wire, semi-conductive self-limiting matrix and cross linked polyolefin insulating jacket. System shall be designed to produce 5 watts / ft with 120 Volts. System shall employ a pipe wall sensing thermostatic control. System shall be FLX by Thermon or an approved equivalent.

### **DUCTWORK INSULATION MATERIALS:**

Fiberglass Duct Wrap: Federal Specification HH-1-558B, 1 pcf density, k=0.24, rated to 450 degrees F operating temperature. FSK reinforced foil vapor retarder. Owens / Corning Type 100 or an approved equivalent.

Rigid Fiberglass Board Insulation: Federal Specification HH-1-558B, 3 pcf density, k=0.23, rated to 450 degrees F operating temperature. FSK reinforced foil vapor retarder. Owens / Corning Quiet R, Manville Type 814 or an approved equivalent.

Closed Cell Elastomeric Duct Wrap: ASTM C 534, k=0.27, rated to 200 degrees F operating temperature, maximum permeability = 0.17 perm-in. Armaflex II or an approved equivalent.

### **PIPING INSULATION MATERIALS:**

Cellular Glass Piping Insulation: ASTM C 552, 8 pcf density, k=0.38, rated to 900 degrees F operating temperature. Pittsburgh Corning Foamglass or an approved equivalent.

Cellular glass bedding mastic: Benjamin Foster 30-45

Indoor Insulation Jacket: All service kraft reinforced foil jacket with an elastomeric polymer reinforced with glass fabric. Vapor permeance less than 0.02 grains/hr.sf.in.Hg. Owens/Corning ASJ/SSL-II, Lamtec 30J or equal.

Indoor Insulation Fittings: Finish with glass fabric and vapor barrier mastic. Childers CP-30 or Pittcote 300.

Exterior Insulation Jacket: Aluminum jacketing 0.016" thickness with bands and seal of same product. Childers Products or equal.

Below Grade Jacket: Peel-n-stick, roll membrane, weather and UV barrier, designed specifically to stick to insulation facings such as FSK and ASJ. Alumaguard 60 Insulation Jacketing or equal.

Fiberglass Pipe Insulation: ASTM C 547, 3 pcf density, k=0.26, rated to 650 degrees F operating temperature. Owens/Corning, Fiberglass

Fiberglass insulation jacket: All service kraft Reinforced foil jacket. Owens/Corning, ASJ/SSL-II or an approved equivalent.

Closed Cell Elastomeric Plastic Pipe Insulation: ASTM C 534, k=0.27, rated to 200 degrees F operating temperature, maximum permeability = 0.20 perm-in. Armaflex AP or an approved equivalent.

Insulation Covering/Jacketing: Alumaguard 60 insulation jacketing consisting of rubberized bitumen, foil faced membrane to adhere to ASJ vapor barriers, peel & stick application.

### **PART 3 - EXECUTION**

#### **HEAT TRACE SYSTEM:**

Apply the heater linearly on the pipe after the piping has been successfully pressure tested. Secure the heater to the piping with the cable tie or type PF-1 polyester tape.

Apply "electric traced" signs to the outside of the thermal insulation.

After installation and before using, test heater using a 1000 VDC megger.

Entire installation shall be in strict accordance with the manufacturer's recommendations.

#### **INSULATION SYSTEMS:**

Duct Systems: Insulate new supply, return, outside air, and transfer air ductwork with 1-1/2" thick fiber glass blanket unless otherwise specified.

Interior Refrigerant Piping: Insulate with 3/4" closed-cell elastomeric insulation.

Exterior and/or Underground Refrigerant Piping: Insulate with 3/4" foam glass insulation with ASJ vapor barrier. Cover with Alumaguard 60 Insulation Jacketing. May use aluminum jacketing above grade.

Miscellaneous Cold Drain Piping: Interior: Insulate with 3/4" closed cell elastomeric insulation. Seal all seams joints, etc. Exterior: No insulation is required.

#### **GENERAL INSTALLATION REQUIREMENTS:**

Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

Surfaces shall be clean and dry before attempting to apply insulation. A professional insulator with adequate experience and ability shall install insulation.

Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose. Seal all joints, seams, etc. air and water tight.

Rated floors and partitions shall be penetrated only with insulation materials and techniques UL listed to maintain rated assembly. Any questions shall be referred to the Engineer.

Exposed/exterior piping shall be finished with an aluminum jacket or Alumaguard 60 Insulation Jacketing.

### **INSTALLATION OF DUCT WRAP**

Application: The insulation shall be applied over 4" wide brushed strips of Foster's 85-20 adhesive spaced 12" on center. The insulation shall be overlapped approximately 2" and stapled in place. All ducts 24" or larger in width shall have the insulation additionally secured with mechanical fasteners spaced approximately 18" on center.

Insulation shall be cut and applied to the ductwork with not less than 2" overlap of backing on each edge and on the linear seams. Insulation shall be removed from all overlapping tabs. Exterior insulation shall overlap internal ductliner 12" where ductliner is stopped and exterior insulation is continued.

On rectangular ducts install so insulation is not excessively compressed at corners.

Seams shall be stapled approximately 6" on center with outward clinching staples.

Seal all seams, tears, punctures, penetrations for hanger straps, or any other breaches of duct wrap facing with tape or mastic to provide a vapor tight system.

### **INSTALLATION OF RIGID FIBERGLASS BOARD INSULATION**

Application: The insulation joints shall be lapped, butted, or mitered and taped in place. All ducts 24" or larger in width shall have the insulation additionally secured with mechanical fasteners spaced approximately 18" on center. Tape all joints and staple with outward clinching staples. Final tape over staples.

Seal all seams, joints, tears, punctures, penetrations or any other breaches of insulation facing with tape. to provide a vapor-tight permanent system.

Use mastic over final taped joints for the connections to fan coil units, air handlers, etc.

### **INSTALLATION OF PIPING INSULATION:**

Insulation is not to be installed until the piping systems have been checked and found free of all leaks, and piping is dry, and free of debris.

Provide hanger type and support shields of 18 gauge galvanized steel over or embedded in the insulation. Shield shall extend halfway up the pipe insulation cover and at least 6" on each side of the hanger.

Provide standoffs and clamps for wall/floor mounted piping to accommodate insulation thickness. Insulate over clamp and seal all joints, gaps, etc. air and water tight.

Securely fasten shield with straps at each end. Insulate anchors adequately to prevent moisture condensation problems.

Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use pieces or scraps abutting each other.

Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

Maintain integrity of vapor-barrier jackets, and protect to prevent puncture or other damage. Gaps and openings in chilled water insulation vapor barrier will not be tolerated.

Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation applied to adjoining pipe. Optional: install factory molded, precut or job fabricated units.

Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

Exposed/outdoor piping with elastomeric insulation shall be protected by aluminum jacketing.

#### **INSTALLATION OF CELLULAR GLASS PIPE INSULATION:**

Fit insulation over piping and stagger joints. Butt ends tight and wrap/seal vapor barrier jacket along entire length and butted ends. Apply additional vapor-barrier tape where needed. Seal ends air and water tight with approved mastic.

Apply vapor-barrier jacket in accordance with the manufacturer's instructions. Insure integrity of the vapor barrier with properly apply butt strips. Repair all punctures, penetrations, and holes with tape approved by the manufacturer.

Protect buried insulated piping with Alumaguard 60 insulation jacketing.

#### **INSTALLATION OF ALUMINUM JACKETING:**

Install aluminum jacketing only after insulation installation is completed. Install full length sections and overlap joints per the manufacturer's requirements. Orient longitudinal seams at bottom of piping. Install stainless steel bands to secure insulation on 2' centers. Install prefabricated fittings at elbows/offsets. Seal all seams joints, openings, etc. water tight with clear silicone sealant.

#### **PROTECTION AND REPLACEMENT:**

Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

Protection: Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

#### **END OF SECTION**

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## **SECTION 15400 - PLUMBING**

### **PART 1 - GENERAL**

#### **GENERAL CONDITIONS**

The work described hereunder shall be installed in accordance with the "Mechanical General Conditions," Section 15010.

#### **DESCRIPTION OF THE WORK**

The extent of the work is indicated on the Drawings. In general, the work consists of, but is not limited to, the following:

Condensate Piping

#### **RELATED WORK**

Insulation is specified in Section 15250.

#### **QUALITY ASSURANCE**

All materials and installations are to comply with the following. If conflicts occur between plumbing codes and the specifications, the most restrictive requirements shall govern.

National Electric Code

Florida Building Code

Florida Plumbing Code

Florida Energy Efficiency Code For Building Construction

Florida Administrative Code, 10D-10, Sanitary Facilities for Buildings Serving the Public and  
Places of Employment.

Accessibility Requirements Manual, Florida Board of Building Codes & Standards

State Requirements for Educational Facilities

Furnish and install equipment having the characteristics and accessories indicated on the drawings or in these specifications. The manufacturer's specifications for the models shown on the drawings or given as basis for design, plus all features, options, and accessories indicated on the drawings or in these specifications, whether or not standard for the model scheduled or offered as a substitute, shall constitute the minimum requirements for equipment furnished under this section.

#### **SUBMITTALS**

Submit to the Architect/Engineer for approval six (5) copies of brochures, technical data and/or shop drawings of the following, and as many additional copies as required for Contractor use:

Condensate plumbing fixtures.

Valves, cleanouts, and floor drains.

Proposed fire proofing systems at penetrations of rated walls

## **CHANGES**

The Drawings indicate generally the locations of plumbing fixtures, apparatus, piping, etc., and while these are to be followed as closely as possible, if before installation, it is found necessary to change the location of same to accommodate the conditions at the building, such changes shall be made without additional cost to the Owner and as directed by the Architect/Engineer.

## **PART 2 - PRODUCTS**

### **MATERIALS WHICH PENETRATE FIRE WALLS**

Where insulated piping or plastic materials penetrate fire walls, provide a UL listed systems for maintaining the rating.

Where bear metal piping systems penetrate fire walls, provide a permanent sleeve which is grouted or rocked into wall. Provide a UL listed fire caulk for the annular space.

### **PIPING**

Where more than one material is specified for a particular application, the contractor may select.

All materials shall comply with latest ASTM specifications in each instance that ASTM has specifications and standards relating to such materials.

#### Condensate

Copper tubing, DWV grade, hard temper conforming to ASTM B306, with solder joint, cast bronze fittings conforming to ANSI B16.23. Tubing larger than 2 inches shall use wrought copper fittings conforming to ANSI B16.29.

#### Domestic Water Pipe:

Domestic water pipe shall be type L copper conforming to ASTM B88. Piping above grade shall be hard drawn. Piping below grade shall be annealed soft copper with bituminous coating.

Below Grade & Below Slab Piping & Fittings: Ductile iron pipe: AWWA C151, working pressure 150 psig, exterior and interior bituminous coating. Provide flanged and anchored connection to interior piping.

Below Grade Piping Alternative: PVC pipe: ASTM D2241, Class 150, working pressure 150 psig, fittings to be AWWA C151. J-M Ring-Tite or approved equal.

Below Piping Alternative 4" and Above: PVC pipe: AWWA C900, Class 150, working pressure 150 psig, fittings to be AWWA C151. J-M Ring Tite or approved equal.

#### Exposed Pipe in Toilet Areas:

Exposed pipe shall be chrome plated brass, American Brass Co., or equivalent. Furnish and install chrome plated brass wall plates.

#### Lavatory and Similar Waste Arms:

Type M or L copper water tube, Mueller or equivalent.

Urinal Waste Arms:

PVC.

### **PIPE ACCESSORIES:**

Pipe sleeves: metal (pvc may be used where appropriate) sized to allow minimum clearance between pipe and sleeves or insulation and sleeves.

Provide chrome-plated brass escutcheon plates where exposed pipe passes through walls, floors, or ceiling in finished areas.

Furnish and install dielectric or isolation fittings at all points where copper pipe connects to steel pipe.

Adjustable wrought clevis type hanger and rods: Grinnel Company or equivalent. Provide copper hangers for copper piping.

Install water hammer arrestors as shown on the Drawings.

### **VALVES**

Ball Valves: 125 lb., bronze ball valve.

### **TRAPS**

For Lavatories and Sinks: Fully Cast Brass, 17ga., chrome plated.

### **PIPE INSULATION**

## **PART 3- EXECUTION**

### **INSTALLATION OF PIPING**

Condensate piping shall be sloped same as sanitary waste and vent.

On vertical sanitary drain lines, connect all soil and waste inlets through sanitary tees, wyes, or wyes and eighth bends. Short radius fittings may be used for vent piping. On horizontal lines connect all waste and soil connections through wyes or wyes and eighth bends. Double branch fittings may be used on vertical lines and horizontal runs, providing proper grades can be maintained.

Make joints in PVC plastic pipe with solvent cement in accordance with pipe manufacturer's instructions.

Lay horizontal drain pipes to uniform grade; riser pipes, vertical. Make changes in directions of drain pipes with long bends. No screwed joints permitted in drain pipes, except as described herein.

Lay all sewers and branches, where practicable, on undisturbed earth cut at proper grade. Where laid on fill, provide adequate supports to maintain pitch of the line.

Sizes of risers and mains of water system piping shall be as designated on the Drawings. Verify any omitted sizes before installation.

Cover pipe openings at all times that the work is not in progress at that point.

Cut brass and copper pipe by means of hacksaw. Remove all burrs and metal chips, dirt, etc., before joining pipe. Chrome plated pipe shall show no wrench marks after installation; no threads shall show.

Adequately support all piping above floors inside the building from or on the building structure. Support piping suspended from the building structure by means of the specified pipe hangers and rods. Make maximum spacing between pipe supports as follows:

<u>Nominal Pipe Size</u>	<u>Maximum Span</u>
3/4" and under	5'
1"	7'
1-1/4"	7'
1-1/2"	9'
2"	10'
2-1/2"	11'
3"	12'
4"	14'

Sanitary and storm drain piping shall be supported by at least one hanger on each full length of pipe close to hub where possible and at least one within 24 inches of each fitting, and wherever else required to prevent tendency toward deflection due to load. Provide a hanger at upper angle at each drop. Locate hangers adjacent to hubs on multiple fittings not more than four feet on centers.

For support spacing of all other horizontal piping refer to MSS-SP-69 and provide additional supports at valves, strainers, in line pumps and other heavy components. Provide a support within one foot of each elbow.

Vertical Pipe Supports: Up to 6 inch 60 feet long or not over 12 inch pipe up to 30 feet long, Riser clamps bolted to pipe below couplings, or welded to pipe and resting securely on the building structure. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure. Vertical runs less than 15 feet long may be supported by the hangers on the connecting horizontal runs.

Bases of drain stacks: If not buried in earth support on concrete, brick in cement mortar, or metal brackets permanently attached to building structure.

Make joints in PVC plastic pipe with solvent cement in accordance with pipe manufacturer's instructions.

Yard supply main piping: Piping shall be installed in strict accordance with the manufactures recommendations. Provide 6" clean sand fill for pipe bedding. Insure minimum 18" of cover. Provide concrete thrust blocks at all changes of direction. Hand dig thrust block area just behind fittings. Bevel ends of PVC piping. Test piping in accordance with manufactures instruction.

### **INSTALLATION OF VALVES**

Isolate all major piping assemblies as shown on the Drawings and as required for proper operation and maintenance. All valves shall be accessible. Provide valve boxes and access panels where required for accessibility.

Install service valve for hot and cold water at each plumbing fixture.

### **INSTALLATION OF TRAPS**

Trap each fixture by water sealing trap placed as near the fixture as possible.

Vent all traps and place within 5 feet of the fixture which it serves unless otherwise noted.

### **INSTALLATION OF PIPE SLEEVES**

Install pipe sleeves at all locations where pipe passes through walls, floors, or ceilings above or below grade.

Where subject to moisture or weather, seal sleeves with watertight sealant.

### **INSTALLATION OF FIXTURES, TRIM, AND FITTINGS**

Install the fixtures, trim and fittings specified, taking care to properly anchor each fixture.

Installation of carriers shall comply with manufacturers' maximum recommendations. Carriers shall be bolted to floor slab using all bolt holes or slots provided on carrier. Bolt size shall match hole or slot. Provide lock washer on each bolt. Use "Red Head" self drilling anchors as manufactured by Phillips Drill Co. or approved equal product to set bolts.

When the use of a wrench is necessary on chrome plated piping, protect the pipe from marring by use of felt or cloth wrapping beneath wrench jaws.

### **INSULATION**

Insulate all domestic hot water lines.

Insulate all interior condensate piping.

Hot water pipe insulation shall be rigid glass fiber insulation with a nominal density of 3 pounds per cubic foot with a thermal conductivity of not more than 0.23 at 75 deg F mean temperature. Insulation cover shall be an all service jacket with double self-sealing laps, with self-sealing butt strips. Insulation thickness shall be as follows:

One half-inch (1/2") thick for pipe sizes 1/2" to 1".

One inch (1") thick for pipe sizes 1-1/4" to 4".

Insulate all domestic cold water lines subject to ambient conditions. Use minimum 1/2" thick closed-cell elastomeric thermal insulation, minimum density of 5.5 pounds per cubic foot with a thermal conductivity of not more than 0.27 at 75 deg F mean temperature. The material shall have a flame spread of 25 or less and a smoke-developed rating of 50 or less as tested by ASTM C534, E84 (25/50) UL-723 (25-50) and NFPA 255 (25-50). Seal all joints, seams, etc. air tight.

Pipe insulation is not required in crawl spaces where located more than 10' from a ventilation opening.

Install insulation in accordance with manufacturer's recommendations.

### **TESTS AND INSPECTIONS**

Make all water and air tests of the piping systems in the presence of and to the satisfaction of the Architect/Engineer or his designated representative. Conduct these tests at such places and with timing to permit work to proceed with as little interruption as possible. Make tests before work is concealed.

Test water piping to hydrostatic pressure at 125 psi and hold for 4 hours.

After the installation of sanitary piping and before the pipe is concealed or the fixtures are installed, cap or plug the ends of the system and fill all lines with water to top of vents above roof and allow to stand until a thorough inspection has been made. Should leaks appear, repeat the tests until the system is tight.

Do not use resin, candle wax or any other such substance for stopping leaks in cast iron soil, waste or vent lines or in storm drain lines. Caulking of screw joints to stop leaks will not be permitted.

### **STERILIZATION**

The sterilization process shall comply with all governing regulations and with the sterilization procedures recommended by the American Water Works Association. The chlorination process may be simplified by first flushing the system thoroughly clean, then charging with water containing a minimum of 50 parts per million of chlorine, allowing this to stand for 24 hours, then thoroughly flushing. After sterilization and final flushing, the local health authority is to be notified and their approval obtained in writing.

### **END OF SECTION**

## **SECTION 15760 - SPLIT SYSTEMS**

### **PART 1 - GENERAL**

#### **GENERAL CONDITIONS**

The work described hereunder shall be installed in accordance with the "Mechanical General Provisions," Section 15010.

#### **DESCRIPTION OF THE WORK**

The extent of the work is indicated on the Drawings.

In general, the work consists of, but is not limited to, the following:

- Split system heat pumps.
- Refrigerant and condensate piping and insulation.
- Air filters

#### **RELATED WORK**

Ductwork is specified in Section 15891.

Electrical wiring is specified in the Electrical Sections. Disconnects are provided under electrical sections. Smoke detectors are provided under Electrical Sections.

Control wiring, is to be installed by this Contractor or Controls Contractor. Conduit is included under the Electrical Sections. Materials and procedures shall be in accordance with the Electrical Sections.

#### **SUBMITTALS**

Submit product data indicating rated capacities, required clearances, field connections weight, specialties and accessories, electrical nameplate data, and wiring diagrams.

Submit manufacturer's installation instructions.

Submit to the Architect/Engineer for approval six (4) copies of brochures, technical data and/or shop drawings of the following, and as many additional copies as required for Contractor use:

- Heat Pumps
- Piping and Insulation
- Filters and Housings
- Thermostats/Controls

#### **OPERATION AND MAINTENANCE DATA:**

Submit operation and maintenance data. Include manufacturer's descriptive literature, start-up instructions, installation instructions, and maintenance procedures.

## **OWNER'S INSTRUCTION & DOCUMENTATION:**

Provide two (2) hours instruction specifically associated with programming and operation of the programmable thermostats.

Provide "As-Built" wiring Diagrams. Wiring and terminals shall be coded or numbered. A system point-to-point wiring diagram showing wire and terminal codes or numbers shall be furnished to the Owner. Wires shall maintain color coding at throughout their runs.

Wiring diagrams shall be schematic in nature, but shall show all wire runs from point-to-point, and point connections to terminal blocks, control devices, or sensors. Diagrams shall be in "ladder" format, with hot on the left and neutral or common on the right. Location of components shall be indicated by dashed boundaries with the enclosure designation and room number indicated. A comprehensive legend shall be included. A control device schedule shall be included, showing make and model of control devices cross-referenced to wiring diagram codes. Conductors, terminals, terminal blocks, enclosures, and control devices shall have alpha-numeric identification numbers or color codes which shall be shown on the wiring diagram.

## **DELIVERY, STORAGE, AND HANDLING:**

Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

Protect units on site from physical damage. Protect coils.

## **EXTRA MATERIALS**

Extra air filters: Provide one complete extra set of filters for each filter system. Material shall be packaged with protective covering for storage and identified with labels clearly identifying contents. Deliver to Owner at time of Substantial Completion.

## **WARRANTY:**

Provide a one year parts warranty and a five year compressor replacement warranty.

## **PART 2 - PRODUCTS**

### **SPLIT SYSTEM HEAT PUMPS**

#### **General:**

Furnish an air-to-air heat pump units designed for use with Refrigerant R-410A (Puron).

All coils shall be of nonferrous construction, having copper tubes and aluminum fins.

Units shall have 24-volt control transformer with fusing.

Capacity and performance data are scheduled on the Drawings. Ratings shall be in accordance with ARI 240 standards.

Provide low-ambient controls for units where indicated on the drawings.

Provide long-line installation modifications. Comply with the manufacturer's recommendations/requirements. Use best practices for the installation and piping.

### Condensing Unit:

Compressor shall be of the welded hermetic or scroll type with internal vibration isolation. Provide two-step capacity control on indicated units. Compressor motor shall have both thermal and current sensitive overload device. Compressor shall be equipped with a crankcase heater and have internal high-pressure protection, loss of refrigerant protection and short cycle protection.

Heat pumps shall have reversing valve, check valve, and defrost control.

Heat pumps 7.5 tons and up shall have suction line accumulator, and discharge muffler.

Fan motor shall be factory lubricated and internally protected. Fans shall be statically and dynamically balanced.

Cabinet shall be eighteen-gauge, zinc-coated steel with baked enamel or approved equivalent finish. Coils shall be protected by louver or pvc coated steel wire guard.

### Air Handling Unit:

Fan shall be forward curved with double inlet, dynamically and statically balanced. The fan motor shall have internal overload protection.

Provide integral filter rack/housing that is factory fabricated and insulated to accept 1", 30% standard size pleated filters.

Provide extra set of filters for installation at completion of building clean-up.

### **PROGRAMMABLE THERMOSTATS:**

Provide battery-free programmable heating/cooling and relative humidity control "thermidstat" as necessary, with emergency heat and Off, cool, heat, auto, and Eheat (emergency heat on heat pump models) control. Two setpoints, one for heating and one for cooling. Auxiliary heat indicator, (heat pump units only). Seven-day programming, with four (4) time periods per day. Hold function for temporarily overriding program schedule. Liquid crystal display and backlighting upon demand.

Provide outdoor sensor for systems with electric heat such that electric heat can be locked out when ambient temperature is above 40 deg F.

### **AIR FILTERS**

Design Basis: FARR 30/30 1" thick pleated media filter. Other manufacturers having equal or greater performance characteristics and meeting the following requirements will be acceptable.

Quality Assurance: Filters and installation shall comply with the following codes and standards:

NFPA 90A & 90B

ASHRAE Standard 53

ARI Standard 850

Filters shall have a "dust spot" efficiency of 25% in accordance with ASHRAE Test Standards. Initial resistance at 500 fpm shall not exceed 0.28" wg.

Filters shall be constructed of 1" fibrous material formed into deep V-shaped pleats and held by self-supporting wire frames. Each filter shall consist of a cotton and synthetic media, supporting grid and holding frame. Grid shall be welded wire on 1" centers with an open area of not less than 96%. Grid shall be bonded to the media to eliminate oscillation and pull away. The grid shall be formed to effect a radial pleat, allowing total use of media. Frame shall be a rigid, high wet-strength beverage board, with diagonal support members bonded to the air entering and air leaving side of each pleat. The enclosing frame shall be chemically bonded to the filter rack.

### **REFRIGERANT AND CONDENSATE PIPING AND INSULATION**

Refrigerant piping shall be ACR Type L copper tubing with wrought copper fittings.

Elbows shall be long radius.

Brazing shall be sil-fos with 15% silver.

Condensate piping shall be copper type DWV.

Insulate suction and condensate lines in building interior with 3/4" closed cell rubberized insulation that meets the flame and smoke developed ratings per the FBC.

Exterior/Exposed insulation shall be protected with aluminum jacketing and fittings that are strapped in place.

Buried refrigerant piping shall be insulated with 3/4" wall cellular glass insulation and protected by an exterior wrap. See section 15250.

Provide liquid line sight glass and liquid line dryers.

Provide service valves both liquid and suction lines.

Provide additional fittings, devices, controls, etc. for long-line applications, i.e. refrigerant runs over 60'.

### **PART 3 - EXECUTION**

#### **PROCUREMENT/INSTALLATION**

The contractor is responsible for coordinating the procurement with the manufacturer to determine final options and accessories in order to ensure operation meets design intent. The Contractor shall advise the Architect/Engineer of any equipment discrepancies/incompatibilities in writing prior to procurement.

Entire installation shall be in accordance with the Drawings, Specifications and applicable requirements of the manufacturer's of the equipment and shall perform satisfactorily at the completion of the work.

#### **NOISE AND VIBRATION**

Equipment shall operate quietly and the design of the base shall be such that the operation of the equipment shall cause no perceptible vibration in the structure adjacent to the equipment, nor cause, directly or indirectly, vibration or objectionable noise in any other portion of the building and/or in the building structure itself.

## **SUPPORTS**

Furnish all supports for equipment covered in this Specification, as a part of this Section, unless otherwise indicated on the Drawings. Provide concrete base for condensing unit.

## **PAINTING**

Equipment with a factory applied finish shall have scratches, chips, etc., primed and touched up with materials which will protect the surface and match the adjacent areas.

## **CLEANING AND ADJUSTMENTS**

Upon completion of work, clean, oil, and grease all fans, motors, other running equipment, and apparatus and test systems to make certain that all such apparatus and mechanisms are in proper working order and made ready for formal testing, adjusting, and balancing.

## **CONTROLS INSTALLATION**

Install thermostats/controls where indicated on the Drawings. Install remote sensors in the return air duct in the mechanical room up stream from the fresh air duct, so as to sample the total space return air temperature, when indicated on the plans. Install thermostat in accordance with manufacturers recommendations.

Set outdoor ambient thermostat to lockout strip heat when ambient is above 40°F. Emergency heat switch shall override lockout and allow strip heat operation.

Perform complete checkout of all controls operation. Verify proper sequence in all modes of operation.

## **REFRIGERANT PIPING INSTALLATION**

Route refrigerant lines to minimize fittings, offsets, pipe lengths, and pressure drop. Systems over 60' long require long-line installation requirements per the manufacturer.

Rack and secure refrigerant piping in a neat manner and support per the contract documents.

When penetrating building exterior walls, core drill holes for piping and provide galvanized steel sleeves per the FBC.

Clean joints prior to assembling and braze connections.

Leak check refrigerant piping immediately after its installation. Provide a holding charge of dry nitrogen, CO2 or refrigerant if pipe is not placed into immediate service.

Vacuum shall be measured using an absolute pressure manometer or electronic meter with divisions to allow accurately reading the required pressures as set forth below. Compound gauges are not acceptable. Submit data/report of test indicating system, vacuum level, and duration.

### **Leak Testing:**

The Engineer shall be notified 24 hours in advance of the time when any leak test or evacuation is to begin.

Ends of piping shall have one end capped and the other fitted with equipment service valves, gauge cock, and gauge. If piping is connected to equipment, equipment service valves may be used for pressurizing and gauge readout.

System or piping shall be leak tested by pressurizing to 300 psig with dry nitrogen or CO<sub>2</sub>. Check all new joints with refrigerant leak detector.

If piping is connected to equipment, proceed with the "Charging" paragraphs in this section, regardless of whether both the air handler and outdoor unit are connected or whether the system is to be placed into service immediately.

If only piping is installed reduce internal pressure to 5-15 psig and leave gauge in place. System should remain under positive pressure at all times.

If pressure is lost on piping which has been leak tested and left with a holding pressure, and if the Engineer so directs, the piping shall be evacuated and re-checked as follows:

- a. Using a vacuum pump, pump the piping down to 0.05 psig (2500 microns, 0.1 in Hg) and hold for two hours.
- b. Repeat the 300 psig pressure test, except holding time shall be two hours after a one hour stabilization period.
- c. Reduce pressure to holding level.

#### Charging:

The "Deep Vacuum" method of evacuation and dehydration shall be used. See the "Carrier Charging Book". Following is the outline procedure:

- a. If system has been leak tested and no leaks are evident, evacuate system to 2.5-3.0 inches Hg absolute. Close system and check for loss of vacuum over a 15 minute period. A steady loss indicates a leak which must be repaired before proceeding.
- b. If no leaks are found, continue evacuation to 5000 microns (0.204 in Hg absolute).
- c. Break vacuum with dry refrigerant, and pressurize to 10 psig. Hold for 30 minutes.
- d. Re-evacuate system to 1000 microns (0.05 in Hg absolute). Hold for 5-10 minutes.
- e. Proceed with charging.

#### **INSTALLATION OF REFRIGERANT INSULATION:**

Proceed with insulation only after system has successfully passed the leak check and filled with refrigerant.

Insulate underground refrigerant piping with cellular glass protected by a peel-n-stick wrapping, see insulation section.

Provide hanger or pipe support shields of 18 gauge galvanized steel over or embedded in the insulation. Shield shall extend halfway up the pipe insulation cover and at least 6" on each side of the hanger. Securely fasten shield with straps at each end. Insulate anchors adequately to prevent moisture condensation problems.

Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use pieces or scraps abutting each other. Miter cut elbows.

Clean and dry pipe surfaces prior to insulating. Glue and butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

Maintain integrity of vapor-barrier jackets, and protect to prevent puncture or other damage.

Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe. Installer's option: install factory molded, precut or job fabricated units.

Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

Cover exposed/exterior elastomeric insulation with aluminum jacketing. Seal all joints and seams.

**END OF SECTION**

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## **SECTION 15891 - METAL AND FLEXIBLE DUCTWORK**

### **PART 1 - GENERAL**

#### **GENERAL CONDITIONS**

The work described hereunder shall be installed in accordance with the "Mechanical General Conditions," Section 15010.

#### **DESCRIPTION OF WORK:**

Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section. In general, the work consists of, but is not limited to, the following:

A system of heating and air-conditioning supply and return ductwork.

Smoke/fire dampers, air diffusers and miscellaneous accessories.

Miscellaneous volume/control dampers.

Ventilation air intake ductwork.

#### **RELATED WORK**

Insulation is specified under Section 15250.

#### **QUALITY ASSURANCE:**

Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

Installer's qualifications: Firm with at least three (3) years of successful installation experience on projects with metal ductwork systems similar to that required for project.

#### **Codes and Standards:**

SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilation Systems".

NFPA Compliance: Comply with NFPA 96 "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment".

#### **SUBMITTALS:**

Submit to the Architect/Engineer for approval six (4) copies of brochures, technical data and/or shop drawings of the following, and as many additional copies as required for Contractor use:

Ductwork materials

Grilles & accessories

Smoke and fire dampers, miscellaneous dampers and installation instructions

**DELIVERY, STORAGE AND HANDLING:**

Handle ductwork and equipment carefully to prevent damage. Do not install damaged sections or components; replace with new.

Store ductwork and equipment in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

**PART 2 - PRODUCTS**

**DUCTWORK MATERIALS:**

Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525.

Prefabricated Double-Wall Duct: Preinsulated round duct with mechanical fastening, spiral flat seams, complying with ASTM A527, with G-90 zinc coating in accordance with ASTM A 525, with perforated inner wall, one-inch thick fiberglass insulation with acrylic coating on exposed surface, equal to McGill Airflow LLC ACOUSTI-k27. All fittings, assembly hardwares, seals, etc. shall be by the manufacturer of the duct.

**MISCELLANEOUS MATERIALS:**

General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connections of ductwork and equipment.

Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

Flexible Ducts: Insulated spiral-wound spring steel with flame proof vinyl sheathing complying with UL 181, Class I air duct (duct connectors will not be accepted).

Smoke Dampers: Dampers shall meet the requirements listed in NFPA 90A, 92A and 92B and shall be classified as leakage rated dampers for use in smoke control systems in accordance with the UL555S. Provide factory installed electric actuators qualified under UL555S. For each damper provide an access door 4" smaller than sheet metal size in width (up to 18") and 18" in length.

Fire Dampers: Dampers shall meet UL 555 for dynamic systems and shall be provided with angles, hardwares, etc. Dampers shall be air foil blade type or Style "B" out of the airstream type. Damper procurement and installation shall accommodate existing conditions. Provide damper access either via the duct or grille.

Smoke Damper Actuators: Actuators to be normally closed (powered open), spring return (selectable), 120 VAC with end position indication (two built in auxiliary switches), overload protection with disconnect switch. It will meet UL555 and UL555S requirements and be factory mounted to the smoke damper.

Grilles & Registers: Provide as scheduled on the drawings or an approved equivalent.

### **FABRICATION:**

Duct sizes are internal free area unless otherwise noted.

Shop fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards".

Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

## **PART 3 - EXECUTION**

### **INSTALLATION OF METAL DUCTWORK**

Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.

Install metal ductwork in accordance with SMACNA HVAC "Duct Construction Standards". Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless systems, capable of performing each indicated service. Install each run with minimum number of joints. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling.

Seal all transverse and longitudinal joints, seams, etc. regardless of pressure class with approved duct mastic.

Routing: Field verify duct route prior to any fabrication. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

Hangers for steel ducts shall be fabricated from sheet metal. Ducts shall be supported from the structure.

Penetrations: Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct insulation with sheet metal flanges/collars two gauges heavier than duct. Minimum width of flanges/collars shall be 1-1/2" or as required to completely seal opening. Overlap opening on rectangular openings by at least 1-1/2". Fasten to duct and substrata. Where ducts pass through fire-rated floors, walls, or partitions, provide in accordance with details and accepted industry practice.

Supply Connections: Provide insulated boots sized to fit the supply grille size as indicated. Boot insulation shall be foil faced where exposed to the air stream and sealed with tape.

### **INSTALLATION OF SMOKE/FIRE DAMPERS:**

General: Install dampers in accordance with the manufacturers' installation instructions in order to maintain the UL listing. Fire dampers shall be out of the air stream as specified on the plans.

**INSTALLATION OF FLEXIBLE DUCTS:**

Maximum Length: For any duct run using flexible ductwork, do not exceed five (5) feet extended length. Install shortest possible length.

Installation: Install in accordance with Section III of SMACNA "HVAC Duct Construction Standards, Metal and Flexible". No bends shall be made with center-line radius of less than one duct diameter.

Flexible duct hangers shall be constructed from hanger wire and 4" wide sheet metal saddles. Wire gauge shall be per SMACNA and saddles shall have hemmed edges and corners.

**END OF SECTION**

## **SECTION 15975 - HVAC CONTROLS**

### **PART 1 - GENERAL**

#### **GENERAL CONDITIONS**

The work described hereunder shall be installed in accordance with the "Mechanical General Provisions," Section 15010.

#### **DESCRIPTION OF THE WORK**

In general, the work consists of, but is not limited to, the following:

Provide specified controls for new split systems, dampers, and exhaust fans. This work involves smoke detectors, current transducers, pilot lights, and interlock wiring, where specified.

Provide programming to accommodate current functions including scheduling, alarms, setpoints, etc.

Provide Owner instructions

The extent of the work is indicated on the Drawings. The control system shall consist of stand-alone equipment controls and sensors, interlocking relays, current transducers, pilot lights, wiring, smoke detector wiring/interlocking, operator training, installation labor, warranty, and all other necessary material and labor to provide a complete and functioning system in accordance with the design intent and to meet the Owner's satisfaction.

Equipment to be controlled includes: New fan coil and condensing units, and an existing exhaust fan.

#### **RELATED WORK**

Electrical power wiring for controls is to be provided for by the Controls Subcontractor.

Electrical power wiring for equipment is specified in the Electrical Sections.

Coordination: It is the responsibility of the controls' subcontractor to read and conform to all sections of the specification and to coordinate all equipment supplied by others with his work. General equipment operational controls and starters are provided under other sections.

#### **WARRANTY**

Provide a full one (1) year unconditional parts and labor warranty on the controls from the date of substantial completion. Travel for warranty related work shall be inclusive, i.e. no charge to Owner.

#### **SUBMITTALS**

Submit to the Architect/Engineer for approval four (4) copies of brochures, technical data and/or shop drawings of the following, and as many additional copies as required for Contractor use:

- a. Product data submittals on all equipment, bill of material, and wiring diagrams/schematics.

Upon Completion: Provide certificate stating that control systems have been tested and adjusted for proper operation.

## **QUALITY ASSURANCE**

Furnish and install equipment having the characteristics and accessories indicated on the drawings or in these specifications. The manufacturer's specifications for the models shown on the drawings or given as basis for design, plus all features, options, and accessories indicated on the drawings or in these specifications, whether or not standard for the model scheduled or offered as a substitute, shall constitute the minimum requirements for equipment furnished under this section.

Skilled electricians and mechanics, all of which are properly trained and qualified for this work, shall install the control system. All requirements of Division 16 shall apply to low voltage control wiring and raceway, except as modified or expanded herein.

Upon completion of the installation, the Control System Contractor shall start up the system and perform all necessary testing and run diagnostics to ensure proper operation. An acceptance test in the presence of the Owner's representative, the Architect, and the Engineer shall be performed.

Provide a one-year warranty, including all hardware and software components (labor and material). Any manufacturing or installation defects arising during this period shall be corrected without cost to the Owner.

The publications listed below form a part of this Specification. The publications are referenced in the text by basic designation only.

National Fire Protection Association (NFPA):

70 National Electrical Code

90A Installation of Air Conditioning and Ventilating Systems

All Controllers for fan coil units, like mechanical equipment, etc. shall be the same manufacture.

## **OWNER'S INSTRUCTION & DOCUMENTATION**

The Contractor shall give 2 hours of physical demonstration and verbal instructions for proper operation and maintenance of equipment to the Owner or his designated representative. Schedule demonstrations and instructions at the Owner's convenience.

Provide "As-Built" Wiring, Controls' Diagrams, and Sequence of Operations:

Wiring and terminals shall be coded or numbered. A system point-to-point wiring diagram showing wire and terminal codes or numbers shall be furnished to the Owner. Wires shall maintain color-coding at throughout their runs.

Wiring diagrams shall be schematic in nature, but shall show all wire runs from point-to-point, and point connections to terminal blocks, control devices, or sensors. Diagrams shall be in "ladder" format, with hot on the left and neutral or common on the right. Location of components shall be indicated by dashed boundaries with the enclosure designation and room number indicated. A comprehensive legend shall be included. A control device schedule shall be included, showing make and model of control devices cross-referenced to wiring diagram codes. Conductors, terminals, terminal blocks, enclosures, and control devices shall have alphanumeric identification numbers or color codes, which shall be shown on the wiring diagram.

Control Diagrams shall identify all controlled equipment, points names, point type, and be in agreement with the sequence of operations.

Sequence of Operations shall be in detail to explain the operation sequences, safeties, etc. and updated for the specific application.

Submit copies of controlled equipment manufacturer's wiring diagrams indicating where relays and other devices have been introduced.

## **PART 2 - PRODUCTS**

Similar controls shall be by the same manufacturer. Only those controls provided by the unit manufacturer shall be used to control the split systems.

## **PART 3 INSTALLATION**

General: The control equipment and connecting wiring shall be installed in a neat and professional manner by trained mechanics under direct supervision of the control contractor, conforming to all applicable state and local codes.

Control wiring: All control wiring that is not concealed above accessible ceilings shall be installed in raceways. Wiring in walls shall be in EMT conduit.

Identification: All points, devices, panels, etc. shall be permanently tagged and labeled.

Perform complete checkout of all controls operation. Verify proper sequence in all modes of operation.

### **CONTROL SCHEME & SEQUENCE**

See drawings for specific controls and devices.

Interlock smoke detector to shut down fan coil unit, where specified.

Interlock outside air dampers to close when the building is unoccupied.

Interlock the exhaust fan to shut off when the building is unoccupied.

### **FINAL COMPLETION**

Preliminary Testing: Prior to the system test and balance, each system shall be thoroughly checked out and operated. Operating discrepancies shall be resolved. The control contractor shall assist the Test and Balance contractor.

Final Completion: To achieve final completion, the control contractor shall:

- a. Completely adjust or calibrate, ready for use, all thermostats, sensors, damper operators, relays, etc., provided under this section.
- b. Test all connected devices so that the displayed controlled variable is within the limits/tolerances of the specific equipment.
- c. Test all smoke detectors and associated controls.
- d. Test all other controls indicated or specified by the contract documents.

- e. Provide personnel and the equipment necessary to operate the HVAC system to ensure proper coordination, resolution of discrepancies, and completion of the Test, Adjust and Balance (TAB) contractor's work.

**END OF SECTION**

## **SECTION 15980 -TEST AND BALANCE**

### **PART 1 - GENERAL**

#### **QUALITY ASSURANCE**

The Testing Contractor shall be independent of the Mechanical Subcontractor, certified by NEBB member of AABC.

#### **Codes and Standards:**

NEBB: "Procedure Standards for Testing, Adjusting, and Balancing of Environmental Systems."

AABC: "National Standards for Total System Balance."

The personnel involved in performing the tests shall be experienced and specifically trained in balancing mechanical systems.

#### **SUBMITTALS:**

Prior to any test & balance work, submit the TAB agency and job supervisor qualifications for approval. Also submit TAB agenda including sample forms, system diagrams for each lab and a synopsis of testing and adjusting procedures.

After completion of test, submit draft test reports.

Prior to Contractors request for final completion inspections, submit final test reports.

Submit 3 copies in accordance with general submittal requirements.

#### **DESCRIPTION OF WORK:**

#### **The TAB work shall include:**

Adjust and balance the complete HVAC system in the affected areas of the facility. This includes but is not limited to the new fan coil units, their air distribution, outside air and return air systems, existing restroom exhaust system including fan and grilles, and controls, etc. All new and existing grilles in the affected area shall be balanced to the specified flowrates.

Record all test data and submit reports upon completion.

Install at each piece of mechanical equipment a "Data Sheet" showing all significant operating temperatures, pressures, amperes, voltage, brake horsepower, etc. "Data Sheet" to be enclosed in vinyl holder securely attached to the equipment or wall in the immediate area.

Check all control devices for proper operation, calibration and location.

Testing and balancing shall not begin until the systems have been completed and in full working order. The mechanical contractor shall be responsible for putting all heating, ventilating, air conditioning and exhaust systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing.

The Contractor shall furnish the Test and Balance Subcontractor with a full set of Drawings and Specification, applicable submittal data, and manufacturer's performance data.

The contractor shall make any changes required for correct balance, as recommended by the balancing contractor, at no additional cost to the owner. Such changes may encompass but are not necessarily restricted to replacement or adjustment of pulleys, belts, ductwork, dampers, or the addition of dampers and access doors.

Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

## **PART 2 - PRODUCTS: (NOT APPLICABLE)**

## **PART 3 - EXECUTION:**

### **GENERAL**

All systems shall be tested, adjusted and balanced in accordance with applicable NEBB or AABC standards and the TAB agenda.

All instruments will have been calibrated recently and verification of calibration shall be provided with submittal data.

Coordinate TAB procedures with any phased construction requirements for the project so that usable increments of finished work may be accepted for beneficial occupancy. Systems serving partially occupied phases of the project may require balancing for each phase prior to final balancing.

The Agenda shall also include the following detailed narrative procedures, system diagrams and forms for test results.

Specific standard procedures required and proposed for each system. Additional procedures for variable flow systems shall be developed by the TAB Agency and included for review and approval.

System diagrams for each laboratory system. Diagrams may be single line. In addition to the information recorded for standard AABC or NEBB procedures, report the following information:

Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested for each lab area, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

1. General Information and Summary
2. Individual Rooms and equipment – HVAC systems: exhaust, supply/return, outside air systems, including temperature control.
3. Calibration Data

General Information and Summary: Inside cover sheet to identify testing, adjusting, and balancing agency, Contractor, Owner, Architect, Engineer, and Project. Include addresses, and contact names and telephone numbers. Also include a certification sheet containing the seal and name, address, telephone number, and signature of the Certified Test and Balance Engineer. Include in this division a listing of the instruments used for the procedures along with the proof of calibration.

Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards, within a period of six months prior to starting the project.

### **AIR BALANCE:**

Balance systems to the design flow rates. Record initial fan and pressure drop parameters with all dampers open and successive iterations of flowrates as the system is balanced. Indicate the "final" balance flowrate data column.

Record rpm and full load amps at the initial and successive balancing design flowrates. Indicate the "final" balance data column.

Make pitot tube traverse of each supply, exhaust, and outside air duct system to measure flowrates for each iterative balance and record the results. Seal all penetrations with plastic caps.

Record pressure drop readings at primary components in each system, e.g. fans, air handlers, duct systems, etc.

Coordinate all work with the controls' contractor.

Test function of variable fan speed response, on/off controls, damper interlocks, current transducers, temperature sensors, humidity sensors, etc. Check and report all controls for proper operation.

Record all setpoints, deadbands, for both heating and cooling modes.

### **EQUIPMENT ELECTRICAL OPERATION:**

Measure applied voltage, heater sizes, and running load current for all fan motors whether new or existing.

### **CONTROLS OPERATION:**

Verify proper operation of all new control devices.

Coordinate work with the controls' contractor.

### **END OF SECTION**

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## **SECTION 16010 ELECTRICAL - GENERAL PROVISIONS**

### **PART 1 - GENERAL**

#### **APPLICATION**

The work described hereunder shall be installed subject to the Contractual Conditions for the entire Specifications.

These provisions apply to all sections of Division 16 of this project except as specified otherwise in each individual section.

#### **CORRELATION**

This Section of the Specifications and its accompanying Drawings are made separate for the convenience of the General Contractor / Construction Manager in preparing his bid and in no way relieves the General Contractor / Construction Manager of his responsibility to correlate the work under this Section with that of all other trades as regards the items to be furnished by various Subcontractors, the exact location of all equipment and materials and the necessity of planning the work of all trades to avoid interference.

#### **DESCRIPTION OF WORK**

Furnish all labor, materials, equipment and incidentals required to complete all electrical work as specified in this Division and as shown on the Contract Drawings. Division 16 work shall include the installation of a complete and properly operating electrical system. This system required consists basically of, and is not limited to, the following:

Extend the distribution system for lighting and power including the necessary feeders, branch circuits, installation of and connection to devices, panelboards, switches, and all other equipment shown or specified, and the connection to motors, and other power loads furnished under separate divisions.

Extend the building ground system and provide special grounds as indicated.

Connect all control devices as indicated, including all line voltage connections to equipment provided under other sections of the Specification or by other trades.

Furnish and install all necessary access panels for work performed under this section.

Furnish and install a system of empty raceways for HVAC controls.

Refer to other Divisions of this specification for electrical requirements of factory installed motors, controllers, power supplies, etc. Electrical connections to equipment furnished as specified in other sections of these Specifications or shown on other than the Electrical Drawings shall be governed by this Division of the Specifications.

The bidder shall inspect the present jobsite conditions before preparing his bid. The submission of a bid will be considered evidence that such a visit and inspection was performed by the bidder and that he takes full responsibility for all factors governing his work.

The electrical work shall be complete, fully operational, and suitable in every way for the service required. Drawings are generally diagrammatic in nature and do not show all details, devices and incidental

materials necessary to accomplish their intent. Therefore, it shall be understood that such devices and incidental materials required shall be furnished at no cost to the Owner.

### **RELATED WORK**

Drawings and general provisions of Contract, including General Conditions, Supplementary General Conditions, and Special Conditions sections apply to work specified in Division 16.

The Contractor shall be aware that other divisions of these Specifications may apply to related work required to perform Division 16 requirements. All related work shall be performed in accordance with those divisions.

### **CONFORMANCE**

If the Contractor takes no exceptions to these Specifications in the Submitted Bid, the Contractor will be held totally responsible for failure to comply.

Any exception to the Specification shall reference the affected paragraph(s), subject(s), and list benefit to the Owner.

The Owner reserves the right to have the Contractor replace installed material or equipment which does not comply with these Specifications at the Contractor's expense.

### **SUBMITTALS**

Obtain approval before procurement, fabrication, or delivery of items to the job site. Submit manufacturers' data on the equipment listed below and as directed in other Sections of Division 16. Follow the procedures required in this specification. Data shall be in the form of manufacturer's descriptive data sheets and engineering drawings and will be reviewed by the Engineer before materials and equipment are delivered to the work site. Review of the submittal by the Engineer is to check for general conformance to the design intent and will not relieve the Contractor of the responsibility for the correctness of all dimensions, conformance and the proper fitting of all parts of the work.

Panelboards and Circuit Breakers  
Disconnect Switches  
Plugs and Receptacles  
Motor Starters

Submit manufacturers' names and catalog numbers for the following materials:

Conduit, Fittings, and Couplings  
Boxes and Fittings  
600 Volt Wire and Cables  
300 Volt Wire and Cables  
Grounding Equipment

The Contractor shall thoroughly check the submittal for accuracy and compliance with the contract requirements. Shop drawings and data sheets shall bear the date checked and shall be accompanied by the Contractor's statement that they have been checked for conformity to the Specifications and Drawings. Submittals not so checked and noted will be returned without review.

Deliver the entire electrical submittal to the Engineer complete and in one package. An incomplete submittal will be returned to the Contractor without review.

## **EQUIPMENT SUBSTITUTIONS**

Substitutions that do not increase installation value will not be accepted.

Contractor proposed substitutions may result in necessary changes to the construction documents. Coordination effort due to Contractor proposed substitutions shall be the complete responsibility of the Contractor. All potential conflicts are to be addressed. The Contractor shall also be responsible for any work of any other trades made necessary by the substitution. All potential conflicts with other trades are to be addressed.

The Engineer's review of the proposed substitutions and coordination documents is for the benefit of the Owner and not the Contractor and does not relieve the Contractor of responsibility for making any corrections necessary to insure the Owner receives full benefit of the original design intent.

Detailed coordination documents shall be provided for any equipment that, in the opinion of the Engineer, materially differs from the design documents. This difference includes but is not limited to any equipment having:

- access requirements that differ from the design / specification
- operating characteristics that differ from the design / specification
- footprints or elevations that differ from the design / specification
- connection requirements or locations that differ from the design / specification
- venting or combustion air requirements that differ from the design / specification
- electrical characteristics that differ from the design / specification
- control requirements that differ from the design / specification
- hydronic characteristics that differ from the design / specification
- plumbing requirements that differ from the design / specification

Documentation shall include a detailed listing of all differences from the design / specification. Also included will be a detailed explanation as to why these differences should be considered equal or an improvement.

Any physical differences shall be coordinated with drawings. All Coordination Drawings shall be produced by a competent drafts person and shall be equivalent in quality, detail, and scope to the Construction Drawings.

Acceptance of the substitution as an equal will be the sole descretion of the Engineer. Items of necessary coordination or review omitted from the documentation shall be grounds for rejection of the substitution.

No cost increase to the Owner for any changes due to coordination will be considered.

## **CODES, INSPECTION AND FEES**

Comply with the indicated edition of the following codes and ordinances. Where specific edition is not indicated, comply with the latest published edition.

NFPA 70 - 2008; The National Electrical Code  
NFPA 72 – 2005;The National Fire Alarm Code  
NFPA 90A – 1999; Standard for the Installation of Air Conditioning and Ventilating Systems  
NFPA 101 – 2006; The Life Safety Code  
NFPA 111 – 1996; Standard on Stored Electrical Energy Emergency and Standby Power  
Systems  
UL Standard 467; Electrical Grounding and Bonding Equipment  
UL Standard 506; Enclosures

UL Standard 869; Electrical Service Equipment  
ANSI C2 – 1994 - The National Electrical Safety Code  
ANSI/NEMA MG 1 - Motors and Generators  
ANSI/NEMA MG 2 - "Safety and Use of Electrical Motors and Generators"  
IEEE Standard 446 - "IEEE Recommended Practice for Emergency and Standby Power Systems  
for Industrial and Commercial Applications".  
NEMA ICS 1 and 2, and IEEE 472  
FBC 2007; The Florida Building Code (with 2009 Supplement)  
FBC 2007; The Florida Fire Prevention Code  
FBC 2007; The Florida Mechanical Code  
FBC 2007; The Florida Plumbing Code  
Serving Utility Company Policies  
State and Municipal Codes and Requirements

Obtain all permits required. Contractor shall pay all fees for permits and inspections.

### **COMPLIANCE AND REVIEW**

Within two weeks of the awarding of the contract, and before any work is commenced, the Contractor shall meet with all legal authorities having jurisdiction, review all materials and details of this project, and agree on any required revisions. A letter shall be forwarded to the Engineer listing the names, dates and place of such review and the revisions required. A copy of the letter shall also be sent to the reviewing authority.

The Contractor shall also meet with each serving utility and repeat the above procedure. A letter certifying each meeting shall also be written with the information as described above.

### **TEMPORARY LIGHTING AND POWER**

Provide temporary lighting and power during construction. The Contractor may utilize building power for temporary and construction power. Temporary power shall be 120/240 volt, single phase.

Temporary wiring shall be done in a safe and neat manner. See Article 590 of the NEC.

Provide a minimum of one (1) 100 watt incandescent lamp for every 300 square feet of interior space being constructed.

Provide 30 amp, 120/240 volt single phase power points throughout the construction area such that a power point will be within fifty feet of where any saws, drills, or other electrical tool is being used. Each power point shall have a disconnecting safety switch.

Provide 20 amp receptacles with ground fault interrupting circuitry. Outdoor or otherwise exposed receptacles shall have weatherproof covers. Provide any necessary special outlets required.

Size temporary power conductors so that voltage drop is kept below 5% at maximum designed load at the delivery point.

### **RECORD DOCUMENTS**

Prepare record documents in accordance with Division 1 requirements. Record documents shall be complete and accurate and clearly show deviations to the Contract Drawings. Additionally, indicate major raceway sizes and routings, locations of all control devices, all equipment and locations to scale, and fuse and circuit breaker ratings and arrangements.

Prepare bound sets of equipment Operation and Maintenance Instructions. These instructions shall include the name and location of the system, the name and telephone number of the Contractor, and all subcontractors installing the system or equipment, and the name and telephone number of each local manufacturer's representative for the system or equipment.

Furnish bound copies of all test results required in other sections of this division.

## **GUARANTEES**

Equipment (excluding lamps): one (1) year from final acceptance by the Owner. Materials and labor: one (1) year from final acceptance by the Owner.

All equipment shall be warranted to be free from defects in workmanship, design and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the unit(s) restored to service at no expense to the Owner. Warranty shall be unconditional.

In addition to the guarantee of equipment by the manufacturer the Contractor shall also guarantee such equipment for a period of one (1) year from final acceptance by the Owner. The Contractor's one (1) year guarantee shall be for equipment, materials, and labor.

The manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision will be allowed.

Additional guarantee requirements specific to certain parts or assemblies or installations may be in the General and Special Conditions, or other Sections of these Specifications.

## **PART 2 - PRODUCTS**

### **EQUIPMENT AND MATERIALS**

Furnish materials or equipment specified by manufacturers named.

Materials furnished shall be new, undamaged and packed in the original manufacturer's packing.

All equipment and apparatus shall bear the seal of approval of the Underwriter's Laboratory where testing and listing performance criteria has been established for like items.

Protect equipment and materials from mechanical and water damage during construction. Suitable storage facilities shall be provided. Equipment shall not be stored out-of-doors.

All items to be installed shall be free of rust and dirt. Damaged materials and equipment shall be replaced by the Contractor at no cost to the Owner.

All electrical panels, enclosures, raceways, conduit, and boxes shall be fabricated of metal unless indicated otherwise.

### **EQUIPMENT AND MATERIALS STANDARDS**

Design and fabrication of electrical equipment and materials:

The American National Standards Institute (ANSI)  
The American Society of Mechanical Engineers (ASME)  
The American Society for Testing and Materials (ASTM)

The Institute of Electrical and Electronic Engineers (IEEE)  
The National Electrical Manufacturers Association (NEMA)  
The Occupational Safety and Health Administration (OSHA)  
The Underwriters Laboratories (UL)  
The National Fire Protection Association (NFPA)

Comply with the latest edition and revisions of these codes and standards.

### **EQUIPMENT RATINGS**

Horsepower and wattages of equipment shown on the Drawings are estimated and comply with a certain basis of design. It is the Contractor's responsibility to coordinate with, and furnish proper connections to equipment substituted and accepted as equivalent to the basis of design.

Conduit, wire, disconnects, fuses, and circuit breakers shall be sized to suit the horsepower and wattage of equipment actually furnished. However, conduit, boxes, wire or disconnects shall not be sized smaller than shown on the Drawings.

### **PART 3 - EXECUTION**

#### **QUALITY ASSURANCE**

Installer's Qualifications: At least three years of successful installation experience on projects with electrical work similar to that required for this project.

Manufacturer's Qualifications: Manufacturers regularly engaged in the manufacture of electrical components and equipment of the types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

Electrical work shall be performed by experienced persons skilled in the trade.

Work shall be supervised by a licensed journeyman or master electrician who shall be on the job site at all times while work is in progress.

Work shall be done neatly and in keeping with good practice and conventions of the trade. The electrical installation shall be of high quality, and of the performance level associated with top level commercial electrical installations as determined by the Engineer and the National Electrical Code.

#### **IDENTIFICATION**

Provide laminated plastic nameplates for each panelboard, safety disconnect, equipment enclosure and all other major pieces of equipment installed or modified as part of this contract.

Furnish all starters, disconnect switches and control panels with engraved name plates identifying the equipment served. Attach nameplates to equipment, aligned with structural features of equipment, with two pressure pins (pop rivet) or #4 stainless steel screws, nuts, and lockwashers.

Identification of flush mounted panelboards and other cabinets shall be on the inside of the cabinet only.

Panelboards shall have typewritten directories with all loads thoroughly described for each circuit. Update existing panelboards and their directories to reflect new work.

## **CLEANING AND PAINTING**

Clean all equipment and boxes thoroughly inside and outside at the completion of installation. Do not leave dirt and debris inside panelboard and equipment cabinets, device and junction boxes, etc.

All painting shall be done according to the Finishes Section of these specifications.

Paint all exposed conduit and wiremold installed on painted surfaces to match surrounding surface. Paint exposed threads on conduits and touch up all scratches in galvanized pipe and fittings with a high quality cold galvanizing compound.

Touchup scratched or marred surfaces of lighting fixtures, panelboards, motor control centers, switchboards, etc. with paint furnished by the equipment manufacturer specifically for the purpose.

## **EXCAVATION, TRENCHING AND BACKFILLING**

Perform all excavation and trenching to install raceways indicated on the drawings.

No tunneling shall be allowed unless written permission is received by the Engineer.

Insure that the bottom of trenches are uniform, without large rocks or lumps of dirt which could damage the raceway or conductors.

Backfill with material that will compact readily. Compact backfill material from bottom of excavation up, to within 2" of surrounding undisturbed material. Excavated material not suitable for backfill shall be removed from the job site.

Cover shall not be less than surrounding grade and no greater than 2" above surrounding grade.

All trenching routing shall be coordinated with and approved by the Engineer before digging. Contractor shall contact the Engineer twenty four hours before work is scheduled to begin. Conduit routing shall be clearly laid out with paint or staking before inspection takes place. The Engineer reserves the right to specify final routing before digging begins, or at any point during the operation.

## **TESTS**

Contractor shall test all wiring for shorts and all equipment for proper grounding before energizing. Equipment shall be thoroughly checked and adjusted for proper operation. Check motors for proper rotation before energizing and adjust if necessary.

## **END OF SECTION**

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## **SECTION 16100 BASIC MATERIALS AND METHODS**

### **PART 1 - GENERAL**

#### **SCOPE OF WORK**

Furnish all labor, materials and equipment and incidentals required to construct and install the complete electrical systems as indicated on the Drawings and as specified in this Section.

#### **STANDARD OF MATERIALS**

All materials, equipment and apparatus covered by this specification shall be new, of current manufacture and shall bear the seal of approval of the Underwriters' Laboratories.

All equipment and materials shall have ratings established by a recognized independent agency or laboratory. The Contractor shall apply the items used on this project within the ratings and subject to any stipulations or exceptions established by the independent agency or laboratory.

All conduits and raceways, wire, devices, panelboards, switches, etc. of a given type shall be the product of one manufacturer.

#### **SUBMITTALS**

Manufacturer's data and shop drawings for all components, fixtures, assemblies and accessories indicated in this Division.

### **PART 2 - PRODUCTS**

#### **RIGID CONDUIT, TUBING AND FITTINGS**

Minimum size: rigid conduit and tubing used on this project shall not be less than ½" trade size.

Rigid steel conduit: zinc coated, threaded type conforming to the requirements of Federal Specification WW-C-581, UL 6 and ANSI C80.1 standards. Zinc coating shall be applied to both inner and outer surfaces.

Intermediate metal conduit: hot-dipped galvanized, threaded type conforming to the requirements of Federal Specification WW-C-581, UL 1242 and ANSI C80.6 standards.

A fitted thread protector shall protect threaded ends from damage during shipment and handling.

Fittings for rigid steel and IMC conduit: zinc coated, threaded type, conforming to Federal Specification W-F-408.

Electrical Metallic Tubing (EMT): Federal Specification WW-C-563, UL 797 and ANSI C80.3 standards.

Fittings for electrical metallic tubing: Federal Specification W-F-408. Steel compression or set-screw type, galvanized or cadmium plated, and suitable for location of installation. Conduit bushings shall be metallic with insulated throats. Insulating grounding type bushings shall be provided where required under "Grounding". EMT connectors shall be similar to T&B "Insuline" with completely insulated throats. Field applied insulated throats are not acceptable.

Rigid aluminum conduit: Federal Specification WW-C-540c, UL 6 and ANSI C80.5 standards.

Couplings, fittings, pipe straps and spacers used with aluminum conduit shall be fabricated of aluminum.

Fittings for rigid aluminum conduit: threaded type, fabricated of aluminum.

Plastic conduit for direct burial: UL labeled Schedule 40 PVC manufactured to NEMA TC 2-1983 specifications, WC-1094A Federal specifications, and UL 651 specifications.

Plastic interduct for installation in PVC conduits: UL labeled and listed for installation of inside/outside communication cable.

Couplings, fittings, pipe straps and spacers used with rigid plastic conduit shall be fabricated of plastic.

Fittings for plastic conduit: manufactured to NEMA TC 3-1982 specifications.

Acceptable Metal Conduit and Tubing Manufacturers:

EMT: Allied Tube & Conduit Co.  
Republic Steel Corp.  
Triangle PWC, Inc.

Fittings: Steel City  
Thomas & Betts (T&B)  
Raco Inc.

### **FLEXIBLE METAL CONDUIT, COUPLINGS AND FITTINGS**

Flexible metal conduit for dry interior applications: Federal Specification WW-C-566 and UL 1, continuous, spiral wound galvanized steel type.

Fittings for flexible metal conduit: screw-in type, of galvanized steel.

Flexible metal conduit for damp or exterior applications: liquid tight, UL listed, spiral wound galvanized steel with PVC outer jacket.

Fittings for liquid tight conduit: Federal Specification W-F-406. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and gasket sealing rings and insulated throats.

Acceptable Metal Conduit and Fittings Manufacturers:

FMC: Alflex Corp.  
American Flexible Conduit Co.  
Anaconda Metal Hose, ANAMET Inc.

FMC Fittings: Steel City  
Thomas & Betts (T&B)  
Raco Inc.

Wall and Floor Seals: O-Z/Gedney Co.  
Spring City Electrical Mfg. Co.  
Chase Technology Corp.

## **CONDUIT MOUNTING EQUIPMENT**

Hangers, rods, backplates, beam clamps etc. shall be hot-dipped galvanized iron or steel. They shall be as manufactured by the Appleton Electric Co., Thomas and Betts Co., Unistrut Corp., or approved equal.

## **JUNCTION BOXES**

Sheet Steel Outlet Boxes: conform to UL 514A, "Metallic Outlet Boxes, Electrical", UL 514B, "Fittings for Conduit and Outlet Boxes, Covers, and Box Supports", and NEMA OS1, "Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports".

Sheet Steel: Flat-rolled, code gauge galvanized steel.

Acceptable Manufacturers: Sheet-steel boxes shall be manufactured by RACO, Steel City or equal.

All junction boxes and pull boxes shall be sized per NEC requirements and be of the proper NEMA classification for the locations where they are installed. Where boxes occur above other than lift-out ceilings, access panels must be provided.

Wet location covers shall meet NEC wet location requirements.

## **OUTLET BOXES**

Switch, receptacle and wall or ceiling mounted junction boxes shall be the 4" X 2 1/8" square type. Tile, dry wall, or flat cover plates for one or two devices shall be furnished for each box as required.

## **OUTDOOR BOXES**

Cast Aluminum Boxes: exposed, exterior locations; copper free aluminum, threaded raceway entries, and features and accessories suitable for each location including mounting ears, threaded screw holes for devices, and closure plugs.

Boxes shall have a rear opening in addition to necessary top and bottom openings. Boxes shall be provided complete with a minimum of two closure plugs and self-threading ground screw. Boxes shall have a thermoset, baked enamel silver gray finish. Weatherproof cover plates for one or two devices shall be furnished for each box as required.

Covers shall be of heavy duty die-cast construction. Mounting screws shall be stainless steel. Covers shall have a thermoset, baked enamel silver gray finish and be equipped with a sealing gasket. Covers shall be equipped with a hasp-type locking tab.

Nonmetallic boxes shall be thermoplastic or polyester fiberglass types as manufactured by Carlon or Pass & Seymour.

## **LOCATION OF OUTLETS**

The approximate locations of outlets, etc. are shown on the drawings. The exact locations shall be determined at the building.

It is the responsibility of the Contractor to note the locations and heights of cabinets, counters, shelving units, etc. before the installation of outlets.

## **CONDUIT BODIES**

Conduit bodies shall be constructed of galvanized or cadmium plated malleable iron or copper-free aluminum. Galvanized steel or aluminum covers and gaskets shall be supplied.

LB's 3" and greater shall be mogul type with domed covers.

## **CONDUCTORS**

Compliance: Provide wires, cables and connectors that comply with the following standards as applicable:

UL Standard 83	Thermoplastic Insulated Wires and Cables
UL Standard 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL Standard 854	Service Entrance Cable
NEMA/ICEA WC-5	Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA/ICEA WC-8	Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
IEEE Standard 82	Test procedures for Impulse Voltage Tests on Insulated Conductors

Wire and cable manufactured more than twelve months before delivery to the jobsite shall not be used.

All conductors shall be soft-drawn copper of not less than ninety-eight percent (98%) conductivity, with NEC Type THW, THHN, or THWN for No. 4 and smaller, and Type RHW, THW, or THWN for No. 2 and larger, 600 volt insulation.

Jackets: Factory applied nylon or PVC external jacketed wires and cables for installation in raceways and where indicated.

Color coding of all ungrounded service, feeder, and branch circuits conductors shall be required according to the following convention:

120/208 Volt, 3 phase: black, red, and blue

Ground wires shall be green and neutrals shall be white. Green and white shall be used for these purposes only.

Conductors No. 12 AWG through No. 10 AWG may be solid or stranded, and No. 8 AWG and larger shall be stranded. No conductors smaller than No. 12 AWG shall be used except as otherwise noted.

Control conductors shall be No. 14 AWG Type TW, stranded unless indicated otherwise.

Multi-conductor control cable shall be stranded copper; 600 volt polyvinyl chloride insulated and jacketed Type PNR.

Acceptable manufacturers: Anaconda Wire and Cable Co., General Electric Co., Okonite Co., Southwire Co., or Rome Cable Co.

## **CABLE AND WIRE SPLICES**

General: the materials shall be compatible with the conductors, insulations and protective jackets of the respective cables and wires. Use connectors with ampacity and temperature ratings equal to or greater than those of the wires upon which used.

In handholes and other locations where moisture might be present, the splice shall be watertight and submersible.

Connectors: UL 486A. Aluminum and aluminum alloy fittings will not be accepted. Connectors shall be plated with tin or tin alloy.

Conductor Sizes No. 6 AWG and Larger: Splices in conductors shall be made with indenter, crimp connectors and compression tools or with bolted clamp type connectors to insure a satisfactory mechanical and electrical joint.

### **INSTRUMENTATION CABLE**

Process instrumentation wire shall be twisted pair, 600 Volt, polyethylene insulated, copper tape shielded, polyvinyl chloride jacketed, manufactured by General Electric Co., Okonite Co., Belden Corp., or equal.

### **WIRE AND CABLE MARKERS**

Wire and cable markers shall be "Omni-Grip" as manufactured by W.H. Brady Co., or equal.

### **RECEPTACLES**

Receptacles shall be furnished and installed where shown on the drawings and shall conform to the following requirements:

Grounding type duplex receptacle: rated 20 amperes, 125 volt, 2 wire, 3 pole with grounded shunt (yoke permanently grounded to third clip), NEMA Configuration No. 5-20R, and conforming to Federal Specification W-C-596F (submit proof of compliance).

All receptacles listed on the drawings shall be specification grade receptacles.

All exterior devices shall be designed for the application and shall be installed in a waterproof enclosure with proper cover. Receptacles intended for continuous use shall have NEC compliant in-use type covers.

Acceptable manufacturer: Eagle, GE, Hubbell, Leviton or Pass and Seymour.

### **SWITCHES**

Flush, enclosed type, specification grade, rated at 20 amperes, 120/277 volts, alternating current only, quiet operation, and shall comply with Federal Specification W-S-896F (submit proof of compliance). Switch housing shall be color coded for current rating.

Acceptable manufacturer: Eagle, GE, Hubbell, Leviton or Pass and Seymour.

Motor switches with inherent thermal overload protection shall be Square D, Type F for flush or surface mounting as required by the location of the unit. Units shall be furnished with pilot lights as indicated.

### **DEVICE PLATES**

All plates for switch, receptacles and telephone outlets located on finished walls shall be UL listed smooth surface nylon types with the number of gangs required for the application. Nylon plates shall match device color. All plates for outlets located on unfinished walls or on conduit type fittings shall be zinc coated sheet metal with rounded or beveled edges.

Weatherproof plates shall be of stainless steel, gasketed, sized with twin covers for duplex receptacles, and weatherproof switch for switch plates.

Device plates shall be factory engraved where indicated on the drawings. Letters shall be black filled.

## **RELAYS**

Relays shall be electrically held and operated. Relays shall be mounted in a NEMA-1 enclosure. The contactors shall be capable of switching inductive and resistive loads.

## **HOUSEKEEPING PADS**

Housekeeping pads shall be provided for all floor-mounted or grade-mounted equipment such as panelboards or transformers. Pads shall be made of concrete extending 3 to 4 inches vertically above finished floor and extending 6 inches horizontally around equipment.

## **PANELBOARDS**

Compliance: NFPA 70 National Electrical Code, UL 67, "Electric Panelboards", NEMA Publication PB1, "Panelboards", Federal W-P-115a Type 1, Class 1 specifications and NEMA PB 1.1, "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".

Provide factory assembled panelboards in sizes and rating as indicated. Panelboards shall be UL listed and labeled.

Provide dead front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Select unit with feeders connecting at the bottom of the panel. Equip with copper bus bars with not less than 98 percent conductivity, and with full size neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide molded case main and branch circuit breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple pole breakers are indicated, provide with common trip so overload on any pole will trip all poles simultaneously. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures.

Acceptable manufacturers: panelboards shown on the drawings shall be manufactured by Square D.

Refer to the drawings to determine each panelboards pertinent characteristics such as bus rating, main circuit breaker or lugs only, voltage rating, number of phases, number of positions required, etc.

Interrupting ratings shall be coordinated with the available short circuit current. Provide molded case main and branch circuit breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple pole breakers are indicated, provide with common trip so overload on any pole will trip all poles simultaneously.

All panels shall be provided with an equipment grounding bus similar to, but isolated from the solid-neutral bus. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures

Panels shall be carefully aligned and rigidly secured in place with the top of the cabinets located 78 inches above the finished floor or grade.

Each panel shall be furnished with an identification plate as specified in the "Equipment Identification" section of this specification.

Circuit Breakers:

Qualifications: NEMA AB3 - 1984 "Molded Case Circuit Breakers".

Panelboards shall be equipped with thermal-magnetic molded case circuit breakers with trip ratings as shown on the drawings.

Circuit breakers shall be quick-make and quick-break units with positive trip indicating mechanism and common trip on all multi-pole breakers.

Single pole 15 and 20 amp circuit breakers shall be UL listed as "Switching Breakers" and be marked SWD.

Circuit breakers shall be the frame type, bolt-on or plug-on with bolted attachment.

Bus Assembly:

Bus bar connections to the branch circuit breakers shall be the "phase sequence" type.

Bus bars shall be of copper construction. All current carrying parts of the bus shall be plated.

Buses shall be full length with constant cross sectional area, designed for the bus current indicated.

Cable lugs shall be furnished in the quantity and size required for the size and number of conductors indicated.

Mains ratings: as shown on the drawings.

Short circuit current rating: as shown on the drawings. Panelboards, as a complete unit, shall have a short circuit current rating equal to or greater than that indicated. It shall be understood that the minimum rating for 240 and 480 volt rated panelboards shall be 42,000 and 25,000 RMS symmetrical amperes respectively.

Cabinet construction:

Panel enclosures: UL 50. Enclosures shall be furnished without knockouts. All knockouts shall be field cut.

The panelboard bus assembly shall be enclosed in a dead front safety constructed steel cabinet.

The size of the wiring gutters and gauge of steel shall be in accordance with NEMA and UL standards; except that the thickness of steel shall not be less than 16 gauge.

The box shall be fabricated from galvanized steel. Boxes intended for outdoor duty, or where indicated, shall be rated NEMA 3R.

Select enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.

Construction shall be such that circuit breaker mounting hardware (other than threaded bolts) is not required when circuit breakers are added in the future.

The panelboard front shall include a door with completely concealed hinges and door swings, flush lock and key mechanism, and steel door pull.

A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Typed directory cards shall be furnished in each panel.

### **CIRCUIT BREAKERS INSTALLED IN EXISTING PANELS**

Circuit breakers installed in existing panels shall have an A.I.C. rating equal to that of the panel in which they are installed.

### **SAFETY DISCONNECT SWITCHES**

Compliance: NFPA 70 National Electrical Code, UL 98, "Enclosed and Dead Front Switches", NEMA Publication KS1, "Enclosed Switches", and NEMA KS 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)".

Safety switches shall be provided for all motors and equipment indicated or required by the National Electrical Code.

Safety switches shall be Type "HD" (heavy duty) unless noted otherwise, fused or non-fusible as indicated with number of poles as shown or required. Safety switches for equipment may be non-fused only if equipment is UL tested with circuit breaker protection.

Safety switches for indoor general purpose application shall be NEMA 1 and for exterior application shall be NEMA 3R.

Acceptable manufacturer: provide safety switches manufactured by Square D, General Electric, Cutler Hammer or Seimens.

Lugs shall be front removable and be UL listed for aluminum or copper conductors at 60 degrees C or 75 degrees C.

Disconnect switches shall be horsepower rated.

Construction: Gray baked enamel finish. NEMA 3R enclosures shall be manufactured from galvanized steel.

Ratings: Fusible disconnects shall be 240 or 600 Volt rated depending on the service voltage.

Fusible disconnects shall be furnished with Class R fuses of the indicated Ampere rating (up to 600 Amps) and be equipped with rejection clips.

Fusible disconnects shall be UL listed for 200,000 RMS symmetrical ampere short circuit current when equipped with Class R or Class L fuses.

Fuses: general use, dual element time-delay, current limiting. Manufactured by Bussman, Littlefuse, Edison, or equivalent.

### **GROUNDING AND BONDING**

Conductors: type THW, THHN/THWN, or RHW to match power supply wiring.

Bonding Jumper Braid: copper braided tape, constructed of 30 gage bare copper wires and properly sized for application.

Flexible Jumper Strap: flexible flat conductor, 48,250 circular mils, with copper bolt hole ends sized for 3/8" diameter bolts.

Grounding Electrodes: solid steel core with a heavy uniform covering of electrolytic copper, 5/8" X 10'. Provide sectional rods if required. Threads, on sectional rods, shall be rolled (not cut) into the composite metal after the copper covering has been applied. Sectional rod couplings shall be of a corrosion resistant alloy.

Plate Electrodes: plate electrodes are not permitted. If sufficiently low resistance cannot be obtained with driven rods, the Architect shall be notified and will provide written instruction on grounding methodology.

### **TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS)**

General: provide hybrid high-energy filter units utilized for a facility wide protection system. Each unit in the system shall incorporate transient voltage surge suppression (TVSS) and high frequency electrical line noise filtering. The system shall provide effective high-energy transient voltage suppression, surge current diversion, high frequency attenuation in all environments connected on the load side of the facility's main overcurrent device. Connection shall be parallel, located as shown on the Drawings. System shall feature fast response time and low clamping voltage with high current capability. TVSS shall be manufactured specifically for the intended service by a manufacturer having at least five years continuous experience designing and manufacturing power conditioning equipment of the type specified.

The TVSS unit shall be 7-mode with phase to neutral protection independent of phase to ground.

Manufacture units using redundant metal oxide varistors (MOV) installed in a parallel arrangement.

Standards: ANSI/IEEE C62.41-1991 and C62.45-1987; Federal Specification W-P-115b and W-C-375a,b; NEMA AB-1, PB-1, PB-1.1 and PB-1.2 (as applicable); NFPA 70, 75, and 78; UL 50, 67, 489, 943, 1283 and 1449 (3rd Edition) (as applicable).

The system and each TVSS module shall be UL listed for the service and conditions indicated on the Drawings and specified here and shall be enclosed in NEMA 1, 12, or 3R enclosure.

Module shall be tested in accordance with ANSI/IEEE C62.11, C62.41 and C62.45 Categories A, B and C3.

The system shall be protected from fault currents up to 100,000 amperes by suitable integral fuse network. All components shall be protected. High current capacitors shall effectively sink harmonic currents generated by line distortion and shall effectively attenuate line noise (RFI/EMI filtering).

The system shall be equipped with built-in monitoring with status indicators and test switch front panel mounted.

Enclosure shall be NEMA 4 rated where installed out-of-doors.

Warranty: 5 years.

Panelboard locations: The nominal unit operating voltage shall be coordinated with the service voltage indicated. The maximum continuous operating voltage of all components utilized in the unit shall not be less than 115% of nominal operating voltage. Operating frequency shall be 60±3 hertz. Protection modes shall be line-to-neutral, line-to-ground and neutral-to-ground.

Maximum repetitive surge current capacity, in amps, shall not be less than as follows:

L-L	100,000
L-N	50,000
L-G	50,000
N-G	50,000

Minimum line noise attenuation above 10 MHz - 50 dB

Install TVSS module adjacent to each panelboard as indicated on the Drawings. Provide molded case circuit breaker as indicated for isolating module.

Conductors shall be #8AWG stranded copper, minimum and shall be not more than 12" in length. All conductors shall cut to precisely the same length before installation. Conductor requirements apply to grounded conductor.

### **TIME CLOCK**

The electronic time switch shall be a solid state digital type capable of distributing set points on independent daily schedules throughout a 7 day time period. The time switch shall provide for 5 weekday programming, 2 weekend day programming or all 7 day programming to simplify program entry for typical 5/2 day load control. A copy feature shall be provided for duplicating full daily schedules where the 5/2 day scheduling is not applicable. The time and set points shall be programmable to the nearest minute with a minimum ON duration of 1 minute and a maximum of 6 days, 23 hours and 59 minutes. The time switch shall have a digital LED readout and prompt LEDs for each function to further simplify program entry. Each load control shall include an ON/OFF pushbutton, an ENABLE/DISABLE switch and an LED load status indicator. The time switch shall provide an operating temperature range of -40° F (-40°C) to 122° F (50° C).

The time switch shall provide full year control by providing automatic leap year and daylight saving time adjustment. A user selectable override shall be provided for states not observing daylight saving time. The time switch shall also provide holiday or special day control requirements by providing up to 99 holiday schedules. Each of the holiday schedules shall be programmable for a single day or any duration as required. Each holiday schedule shall provide automatic no load activity and shall be independently programmable for a unique load schedule if required.

A non-volatile memory shall maintain all program data for the life of the time switch without the need for battery backup. The time switch shall include a factory installed lithium battery backup which shall maintain clock time and calendar data for 8 years minimum. The single coin cell backup shall be user replaceable without removing the field wiring.

The time switch logic control circuitry shall be isolated and shielded to prevent EMI and RFI interference, for reliable operation in electrically noisy environments. The power board circuitry shall provide protection for transients up to 6,000 volts. All control times shall be accurate to the minute and synchronized to the 50 or 60 Hz input. The time switch shall provide user-selectable 12 hour AM/PM or 24 hour clock formats.

The time switch shall be enclosed in a lockable steel NEMA 1 enclosure. The time switch shall be powered by a user selectable 120, 208, 240 or 277 VAC 50 or 60 Hz source. Switch configuration to be SPDT for each circuit with a UL 916 Energy Management Equipment listed rating of:

#### Normally Open ContactsC

- 20 amp resistive/general purpose, 120/277 VAC
- 20 amp resistive/general purpose, 28 volts DC
- 20 amp ballast, 120/277 VAC

1 HP, 120 VAC 60 Hz; 2HP, 240 VAC 60 Hz  
5 amp tungsten, 120/240 VAC  
470 VA pilot duty, 12/240 VAC

Normally Closed ContactsC

10 amp resistive/general purpose, 120/277 VAC  
10 amp resistive/general purpose, 28 volts DC  
3 amp ballast, 120/277 VAC  
1/4 HP, 120 VAC 60 Hz.; 1/2 HP, 240 VAC 60 Hz  
275 VA pilot duty, 120/240 VAC

The time switch shall have two independent circuits with 15 second start delay between circuits.

**NAMEPLATES**

Nameplates: 0.125 inch thick laminated plastic; white and black finish; rectangular shaped; minimum of 1.0 X 2.5 inches with 0.25 inch high block style engraved lettering

**PART 3 - EXECUTION**

**RACEWAY INSTALLATION**

All interior and above grade exterior wiring shall be installed in a metal conduit and all embedded in concrete or below grade wiring shall be in PVC conduit unless indicated otherwise on the drawings.

Exterior low voltage (less than 50 volts) wiring may be installed in liquid tight, non-metallic flexible conduit ("Sealtite") where installation is above grade and not subject to damage.

No conduit smaller than 1/2 inch electrical trade size shall be used, nor shall any have more than three 90 degree bends in any one run. Pull boxes shall be provided as required or directed.

No wire shall be pulled until the conduit system is complete in all details.

The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction.

Conduit support shall be spaced at intervals of 8 ft. or less, as required to obtain rigid construction.

Exposed single conduits shall be supported by means of two-hole pipe clamps. Multiple runs of conduits shall be supported on trapeze type hangers with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8 inch diameter. The channel shall be not less than 1 1/2" nominal size.

Conduit hangers shall be attached to structural steel by means of beam or channel clamps.

All conduits on exposed work shall be run at right angles to and parallel with the surrounding walls and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduit shall be run straight and true.

Conduit terminating in sheet steel boxes shall have double locknuts and insulated bushings.

Flexible metal conduit shall be used for all motor terminations and other equipment where vibration is present. Flexible conduit length shall not exceed 1'-6" in length for this application.

Provide expansion coupling every 100 feet for long runs of conduit and at concrete expansion joints. Provide ground bonding jumpers around expansion couplings, used on metallic conduit, sized according to Table 250-122 of the NEC.

Transitions from below grade to above grade shall be with rigid galvanized steel long sweep nipples with a bituminous coating where in contact with earth or concrete. Area of transition shall not be subject to standing puddles of water.

Seal all wall penetrations to watertight condition. Finish as applicable to location.

Aluminum conduit shall not be embedded in concrete. Aluminum and steel conduit, when buried in soil, shall be treated with a protective coating of bitumastic or asphalt-base paint, or wrapped with plastic tape.

Approval by the Engineer shall be required to install conduit in structural members.

In general, the conduit installation shall follow the layout shown on the plans. This layout is, however, diagrammatic only, and where changes are necessary due to structural conditions, other apparatus or other causes, such changes shall be made without additional cost to the Owner. It is recognized that branch circuit routing shown on the drawings may not always be the most economical or the most feasible method. Routing may be changed by the Contractor subject to the following provisions:

Conduits shown routed overhead may not be installed in or below slabs or in walls.

Not more than three circuits may be installed in any one conduit. Care must be taken to provide the appropriate number of neutrals where two or three circuits are on the same phase.

All conduit shall be concealed unless otherwise noted on the drawings.

Exposed conduit will be permitted only as shown on the drawings. Exposed conduit shall be run parallel with or at right angles to the building walls.

All empty conduits shall be provided with a plastic pull wire.

Conduit stub-ups at panels shall be secured in place by use of Unistrut and clamps.

Conduit and tubing shall be kept at least twelve (12) inches from parallel runs of flues, steam pipes or hot water lines.

Where exposed connections to motors and equipment from overhead conduits are made without benefit of a wall for conduit mounting, the connection shall consist of vertical RGS or IM conduit (minimum size 1") from Type "LL", "LR" or "TT" Unilet to floor flange. Connection to equipment shall be with flexible liquid-tight from Type FDT boxes located in the vertical conduit.

Flexible conduit in all areas subject to moisture shall be liquid-tight flexible conduit.

All electrical connections to vibration isolated equipment shall be made with flexible conduit.

All conduit entering the building shall be suitably sealed to prevent the entrance of moisture.

All conduit passing through a structural expansion joint shall be provided with a UL approved expansion joint fitting and bonded as required by the National Electrical Code.

Any wiring in a finished area which cannot be concealed in conduit shall be installed in a surface metal raceway system as manufactured by Wiremold or equal. Utilization of surface metal raceway, if not indicated as such on the plans, will be accomplished only with the written approval of the Engineer.

Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.

Where flex conduit or cable assemblies are used from junction box to light fixture it shall be supported such that it does not touch ceiling tiles or interfere with their placement.

Where raceways are indicated installed under slabs, they shall be placed not less than 2" below surface of prepared fill. Under no circumstances shall raceways be laid directly on vapor barrier or in or on reinforcing.

Raceways concealed in ground outside building shall be a minimum of 2 feet below grade and topped with a two inch concrete cap before backfilling. Install plastic warning tape 12 inches above raceway, buried in backfill.

### **RACEWAY INSTALLATION - CONDITIONS**

Conduit raceways shall be installed as indicated herein. Where more than one type of raceway is listed under one condition, the Contractor may exercise his option of the raceway used. Conditions of raceway installation are as follows:

Exposed Raceway Below 8'-0" from Finish Floor and in Areas Subject to Moisture: Rigid galvanized steel conduit.

Raceway Concealed Overhead, or in Walls: Rigid galvanized steel conduit, intermediate metallic conduit or electrical metallic tubing (EMT).

Raceway Concealed in Ground Outside Building: Schedule 40 PVC or rigid steel. Rigid steel conduits installed below slab-on-grade or in the earth shall have a factory-applied PVC coating, two coats of a coal-tar system, or shall be field-wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50-percent overlay.

Final Raceway Connection to Recessed Fixtures in Accessible Locations: Flexible steel conduit maximum of 6'-0" long.

Final Raceway Connection to Pumps, Motors, Transformers, Etc.: Liquid-tight flexible steel conduit maximum of 1'-6" long.

Raceway That Extend Through the Slab or Above Finish Grade: 90° elbows, nipples and couplings of rigid galvanized steel or IMC shall be used where any raceway extends through the slab or above finished grade. In general PVC conduit shall not be allowed above finished slab inside the building or within 1 1/2' of finished grade outside the building.

### **WIRING**

All conductors shall be carefully handled to avoid kinks or damage to insulation.

All wires, cables and each conductor of multi-conductor cables shall be uniquely identified at each end by color or with wire and cable markers. Lighting and receptacle wiring shall be distinctly differentiated and junction boxes marked.

Lubrications shall be used, if required, to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.

Neutral wires shall be pigtailed to receptacles so that a receptacle can be removed for replacement without the neutral connection to other receptacles on the circuit being disconnected.

Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

When stranded wire is used for receptacle and lighting circuit, connections to the devices shall be made using vinyl insulated "Sta-Kon" connector terminals or similar.

Shielded instrumentation wire shall be installed from terminal to terminal with no splicing at any intermediate point.

Shielding on instrumentation wire shall be grounded at the transmitter end only.

All 600 volt wire insulation shall be tested with a "megger" after installation. Tests shall be made at not less than 500 volts.

## **OUTLET BOXES**

Outlet boxes for flush mounted lighting fixtures shall be accessible. If lighting fixture is in a non-accessible ceiling the box shall be accessible when the fixture is removed.

Set boxes plumb and such that their device mounting plane is within 1/8" of the finished wall.

Surface mounted boxes and wiremold boxes, both new or existing, shall be painted to match surrounding surfaces.

Above ceiling sub-system boxes shall be labeled and color coded. Junction box covers shall be color coded. The following conventions shall be used:

EMCS

BLUE

## **DEVICES**

Unless indicated otherwise on the drawings all light switches shall be mounted with the centerline of the device 46" to 48" above the finished floor.

Unless indicated otherwise on the drawings or in the specifications all receptacles shall be mounted with the centerline of the device 18" to 20" above the finished floor.

Receptacles shall be installed with the grounding contact at the top. Where receptacles are required to be mounted horizontally they shall be installed with the neutral contact at the top.

Receptacles above counters shall have major axis horizontal to counter surface and device centerline 6" to 8" above counter surface or backsplash (if present).

Mount all devices so that the cover plate edges are in contact with the wall and are parallel to building features.

## **PANELBOARDS**

Mount panelboards such that top most circuit breaker handles shall be not more than 6'-6" above finished floor.

Power circuits to fire alarm system control panel, auxiliary power supplies, command center console and any other fire alarm system component requiring line voltage power shall be dedicated branch circuits. Circuit disconnecting means shall be identified as follows: branch circuit breakers shall have an engraved plastic nameplate permanently attached adjacent to the circuit breaker, reading "FIRE ALARM CONTROL PANEL", "FIRE ALARM AUXILIARY POWER SUPPLY", or other suitable wording. Provide circuit breakers with lockable ON-OFF clips.

Where panelboards are to be installed on masonry unit walls, including poured reinforced concrete or brick veneer type, install two vertical sections of galvanized steel channel between enclosure and mounting surface. Channel shall be lagged to wall in three places (each length) and the enclosure bolted to the secured channel using stainless steel or galvanized steel hardware. Galvanized channel shall run the entire length of the enclosure, but shall not be exposed at either the top or bottom of the enclosure.

Only one conductor shall be allowed under each terminal of circuit breakers. No splices are permitted in panelboards. Tighten connectors and terminals in accordance with equipment manufacturer's published torque tightening values for equipment connectors.

Complete and install a typewritten directory for each panelboard that accurately indicates all loads being served by each breaker.

## **DISCONNECTS**

Motor circuit disconnects shall be mounted within ten feet and in sight of the load being served.

Disconnects shall be labeled in accordance with Section 16010.

Starters on air handler units shall be interlocked to fire alarm panel to shut down air handler on alarm as shown on drawings.

## **GROUNDING**

Ground all non-current carrying metal parts of the electrical system to provide a low impedance path for ground fault current. Route ground connections and conductors to ground and protective devices in shortest and straightest paths as possible.

Insulated grounding bushings shall be required for all raceways, service entrance panels, distribution panels, all raceways one inch and larger and any raceway entering a concentric knock-out.

In general a ground wire shall be installed in every conduit. The conduit installation itself shall serve as an additional grounding means.

Where there are parallel feeders installed in more than one raceway, each raceway shall have a ground conductor.

Where conduits terminate without mechanical connection (i.e., locknuts and bushings) to panelboards, and for all terminations of conduit sizes one inch and larger; and for all sizes of metallic conduit (rigid or flexible) terminating in concentric knockouts, the following procedure shall be followed: Each conduit shall be provided with an insulated grounding bushing and each bushing connected with a bare copper

conductor to the ground bus in the electrical equipment. The ground conductor shall be in accordance with Article 250 of the NEC.

Grounding conductors shall be attached to equipment with a bolt or sheet metal screw used for no other purpose. Use crimp-on spade lugs for stranded conductors.

## **IDENTIFICATION**

Equipment identification shall be made using engraved laminated plastic plates (indented tape labels will not be permitted). Characters shall be white on a black background and 1/4" high minimum. Plates shall be secured to the panels by means of screws or metal pressure pins. Cement, by itself, will not be acceptable. All nameplates shall be mounted on the outside surface of the piece of equipment.

Individually enclosed safety switches, circuit breakers, and motor starters, pull boxes, control cabinets and other such items shall be identified indicating load, electrical characteristics, and source. For example, a disconnect switch for a 7-1/2 horsepower, 208 volt, 3 phase air handling unit, Number 8 feed from Panel "MDP", Circuit Number 2 shall be labeled as follows:

AHU-8  
7-1/2 HP, 208V, 3Ø  
Cir: MDP-2

Distribution panels, panelboards, and transformers shall be identified indicating panel designation from the drawings, electrical characteristics and source. For example, a 277/480 volt 3 phase panel "LPA" feed from "MDP" Circuit No. 3 shall be labeled as follows:

LP-A  
277/480V, 3Ø  
(Feeder: MDP-3)

Distribution panels shall also have each circuit identified as to circuit number, load, and electrical characteristics of load. For example, a 5 HP, 208 volt, 3 phase hot water pump Number 6 feed from panel MDP, Circuit No. 4 would be labeled as follows with the plate attached adjacent to the circuit:

MDP-4  
HWP-6  
5 HP, 208V, 3Ø

All enclosures containing energized components shall be marked with Mylar labels identifying hazards. Such warning messages as "WARNING-HAZARDOUS VOLTAGE", 480 VOLTS", "240 VOLTS", etc. are acceptable. Labels shall be EZ-Code by Thomas & Betts or similar product.

Junction Box Identification: Each junction box cover shall be labeled with a permanent "magic" marker or other means to identify the circuits within. For example, a junction box containing lighting circuits 21, 23, 25 from Panel L2A would be labeled "L2A-21,23,25". Telephone junction boxes shall be labeled "T". Fire alarm system junction boxes shall be labeled "FA". Intercom and other system junction boxes shall be labeled accordingly.

All raceways leaving the service entrance panel and distribution panels shall be clearly marked as to their circuit number. For example, a conduit containing conductors for Panel MDP, Circuit No. 5 would be marked MDP-5. Empty conduits shall be marked "empty".

## **FIREPROOFING**

All conduit and boxes passing through or installed within fire walls and smoke walls shall be installed so as to maintain the integrity and rating of the wall through which it passes. Boxes shall be installed within 1/8" of wall surface. Conduits penetrating rated floors shall be installed to maintain the fire rating of the floor using UL approved sealing materials.

## **END OF SECTION**