SECTION 23 01 00 - 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 currently adopted 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:

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
FL Mechanical Code
FL Gas Code
FL Plumbing Code
Florida Fire Prevention Code
National Board of Fire Underwriters
SMACNA HVAC Duct Construction Standard
ANSI/ASME B31.1, Power Piping
ANSI/ASME B31.9, Building Services Piping

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

Coordinate costs of taps with the Owners Representative & the CM.

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 electronic 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.

Provide Warranty Labels:

All warrantied mechanical equipment see Mechanical Identification requirements.

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 (4) 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 (full size 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 as-builts.

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 spray paint, 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 23 15 00.

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" 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 23 05 29 – 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 23 Basic Materials and Methods section, and is part of each Division 22 & 23 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 23 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 Grinnell, 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 ping 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 ANDI/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. Provider 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 wit 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.

Locate pipe hangers/supports within 1’ of elbow when pipe turns up or down, e.g. for suppy/return piping to AHU coils/headers.

Support piping to not bear on coil headers or on flexible piping connections.

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 noncompressible insert and use a coated protective insulation shield.

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 Spacing: 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 23. 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 ¾" 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 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

RELATED DOCUMENTS:

Drawings and general provisions of contract, including General and Supplementary Conditions and Division-23 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Provide identification of the following:

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

Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division 23 sections.

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

Laminated Self-adhesive Identification Materials.
Self-Adhering Pipe 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 electronic copies of 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

EQUIPMENT IDENTIFICATION:

General: Coordinate names, abbreviations with the schedules on the plans.

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

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 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 23 05 93 -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 one test report to engineer for review and comments.

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

Submit 2 final signed/sealed copies in accordance with general submittal requirements.

Submit one final electronic/scanned copy to engineer.

DESCRIPTION OF WORK:

The TAB work shall include:

Adjust and balance the HVAC systems covered in the construction documents. This includes but is not limited to the ventilation, return, and supply air distribution systems; chilled water pump

Record all test data and submit preliminary reports upon substantial 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.

Permanently mark settings on speed controllers, potentiometers, etc. to denote TAB setting. 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, return, 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. Measure pressure readings at fan inlets, outlets, coils, filters, etc. and depict readings on equipment diagrams in the report.

Coordinate all work with the mechanical and controls’ contractors.

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, dead bands, 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 23 07 10 - MECHANICAL INSULATION

PART 1 - GENERAL

GENERAL CONDITIONS

The work described hereunder shall be installed in accordance with the "Mechanical General Conditions," Section 23 01 00.

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 board
- Closed-cell elastomeric

Piping System Insulation:
- Cellular glass
- Closed-cell elastomeric
- Preformed fiberglass
- Calcium Silicate

RELATED WORK

Refer to Division 7 for fire caulking; 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 electronic 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, performance data, etc.

Mastics, tapes, mechanical fasteners, etc.

Jacketing materials

Schedule of insulation systems that includes materials, insulation thickness, mastics, tapes, etc. for each type of system included in the project.

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

DUCTWORK INSULATION MATERIALS:

Fiberglass Duct Wrap: Federal Specification HH-1-558B, 1 pcf density, k=0.24, 2.2” thick (out of package), 1-5/8” thick (installed), R-value = 6.0 (installed), rated to 450 degrees F operating temperature. FSK reinforced foil vapor retarder. Owens / Corning SoftR or an approved equivalent.

Fiberglass Duct Board: Federal Specification HH-1-558B, 3.8 pcf density, k=0.23, 1-1/2” thick, R-value = 6.50, rated to 450 degrees F operating temperature. FSK reinforced foil vapor retarder. Owens / Corning Quiet R, Manville Type 814 or an approved equivalent.

PIPING INSULATION MATERIALS:

Cellular Glass Piping Insulation (limited to above-grade installations): 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 barrier 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.

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

Calcium Silicate Pipe Insulation: ASTM C533 molded, asbestos free, 14 pcf. Johns Manville Thermo-12 or equal. Abrasion resistant canvas jacketing.

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

Closed Cell Elastomeric 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 JACKETING

Aluminum roll jacketing conforming to ASTM B209, 3003 alloy, H-14 temper, 0.016” thick, with preformed aluminum elbows.

PART 3 - EXECUTION

INSULATION SYSTEMS:

General Duct Systems: Insulate concealed supply, return, outside air, and transfer air ductwork with fiber glass duct wrap unless otherwise specified herein. Duct that is in exposed ceilings and beyond the reach normal wear-and-tear, can be insulated with duct wrap.

Air Handler Duct Systems: Insulate new supply, return, and outside air ducts in mechanical rooms with rigid fiberglass board up to a height of 7 feet and then transition to flexible duct wrap. If all duct is below 7 feet, extend rigid insulation to 6” beyond the mechanical room walls.

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

Exterior Refrigerant Piping: Insulate with 3/4" elastomeric foam. Cover hard piping with aluminum jacketing and soft piping with 13-ply Venture Tape (or equal) with aluminum foil cover.

Exterior, and Under Roof Hot Water Piping (above grade): Insulate with 2” thick foam glass finish with vapor-barrier and cover with aluminum jacketing.

Exterior Heating Hot Water Piping (below grade): Insulate with 2” thick foam glass, provide finish vapor barrier coat, and cover with polyguard jacketing.

Interior Chilled Water Piping: Insulate with 2” thick foam glass with ASJ cover for pipes 4” and above, and 1-1/2” thick for all others sizes. Finish with vapor barrier coat.

Interior Heating Hot Water Piping & Hot Condensate: Insulate with 1.5” thick fiberglass insulation, cover with ASJ.

Interior Steam Piping: Insulate with 1.5” thick calcium silicate insulation, cover with canvas wrap.

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. Mechanical systems shall be turned off and the system shall be at room temperature before insulating. 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. Consult with firestopping product vendors and technicians in advance. Any questions shall be referred to the Architect/Engineer.

Exposed/exterior piping shall be finished with an aluminum 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. Mechanical fasteners shall be bonded to the duct with the appropriate mastic/adhesive. Self-stick type pins are prohibited.

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.

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 FIBERGLASS DUCT 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 air handlers, fan coil units, etc.

INSTALLATION OF FIBERGLASS AND ELASTOMERIC 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 (achieved room temperature) 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. Insulation shield edges shall be hemmed. Use incompressible inserts at each hanger/support to prevent compressing insulation due to weight of pipe.

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. Use incompressible inserts at each hanger/support to prevent compressing insulation due to weight of pipe.

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:

Install continuous coat of insulation adhesive/bedding on piping and on insulation butt and longitudinal ends. Install insulation sections and stagger joints. Butt ends tight, wipe excess bedding, and secure insulation with aluminum bands and wrap with 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. Ensure integrity of the vapor barrier with properly applied butt strips. Repair all punctures, penetrations, and holes with tape approved by the manufacturer.

INSTALLATION OF ALUMINUM JACKETING:

Install aluminum jacketing only after insulation installation is completed. Install full-length sections and overlap joints 2" minimum. Orient longitudinal seams at bottom of piping. Install aluminum or stainless-steel bands to secure insulation on 2' maximum centers. Install prefabricated aluminum fittings at elbows/offsets. Seal all seams joints, openings, etc. water tight with clear/gray 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.

SEALING WALL & FLOOR PENETRATIONS

Seal rated wall/floor penetrations to maintain fire rating. Coordinate firestopping in advance of installation.

Seal all wall/floor penetrations water tight.

END OF SECTION

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SECTION 23 21 13 - HYDRONIC PIPING & SPECIALTIES

PART 1 - GENERAL

GENERAL CONDITIONS

The work described hereunder shall be installed in accordance with the "Mechanical General Provisions," Section 23 01 00.

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:

Heating hot water system

Chilled water systems

Valves

Instrumentation

Hydronic specialties

QUALITY ASSURANCE AND CODES/STANDARDS:

Construct and install piping for highest pressures and temperature in respective systems in accordance with the latest revision of the ASME Code for Pressure Piping, ANSI/ASME B31.1 and Building Services Piping, ANSI/ASME B31.9.

Qualifications for Welding Processes and Operators: ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualification."

Regulatory Requirements:

ASME Compliance: fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

Quality Control Submittals:

Welders' certificates certifying that welders comply meet the quality requirements specified herein.

Certification of compliance with ASTM and ANSI manufacturing requirements for pipe, fittings, and specialties.

Submit reports/certifications specified in part 3 of this Section.

SUBMITTALS:

Submit to the Architect/Engineer for approval electronic copies of brochures, technical data and/or shop drawings and as many additional copies as required for Contractor use.

Valve Product Data: Provide data from manufacturers, for each hydronic specialty and special duty valve specified. Include rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties and accessories, and installation instructions. Submit manufacturer's installation instructions.

Pipe Product Data: Submit data from manufacturer regarding material properties, test data, properties data.

Pipe Fitting Data: Submit manufacturer's product data including certifications, material properties, test data, etc.

Submit copies of the Welders' qualifications, certificates, and driver's licenses.

MAINTENANCE DATA:

Maintenance Data: for hydronic specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 23 Section "Basic Mechanical Requirements."

PART 2 - PRODUCTS

PIPE AND TUBING MATERIALS:

General: Refer to Part 3 Article "PIPE APPLICATION" for identification of systems where the below specified pipe and fitting materials are used.

Steel Pipe: ASTM A53B or A106B, Schedule 40, seamless or ERW, black steel pipe, beveled ends for weld pipe.

CPVC Plastic Pipe: ASTM D2846.

FITTINGS:

Cast-Iron Threaded Fittings: ANSI B16.4, Class 125, standard pattern, for threaded joints. Threads shall conform to ANSI B2.1.

Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B2.1.

Steel Fittings: ASTM A234B, seamless or welded, for welded joints.

Cast-Iron Threaded Flanges: ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.

Steel Flanges and Flanged Fittings: ANSI B16.5.

Gasket Material: thickness, material, and type suitable for fluid to be handled, and design temperatures and pressures.

CPVC Plastic Fittings: ASTM D 2846 solvent cemented joints.

SPECIAL DUTY VALVES:

Two-Way Control Valves: Pressure-independent, characterized control valves, forged brass body, nickel plated; chrome plated brass ball and stem, fiberglass reinforced Teflon PTFE seat, Viton O-rings, stainless steel spring, 200 psi close-off rating, 0 to 212 deg F temperature range, 5 to 50 psid maximum differential pressure across valve, 400 psi minimum pressure rating with 24 volt multi-function operator, 2 to 10 VDC, 4-20 mA operating range, spring return, 45 in-lb torque (minimum), 95 deg max rotation, and 100 second running time.

Three-Way Control Valves: Same as two-way but not pressure independent and A-port equal percentage and B-port modified for common port flow.

Automatic Flow Control Valves: Spring type constructed with stainless steel wear surfaces and spring, variable side porting and single orifice end hole with minimum flow restriction capable of controlling flowrates to +/- 5% of design, and two integral pressure/temperature ports.

Calibrated Plug Valves (Circuit Setter): 125 psig water working pressure, 250 deg F maximum operating temperature, bronze body, plug valve with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2 inch and smaller shall have threaded connections and 2-1/2-inch valves shall have flanged connections.

Pressure Reducing Valves: Diaphragm operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shut-down, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory-set at operating pressure and have the capability for field adjustment.

Safety Relief Valves: Unless specified otherwise, one hundred twenty-five (125) psig working pressure and 250 deg F maximum operating temperature; designed, manufactured, tested, and labeled in accordance with the requirements of Section IV of the ASME Boiler and Pressure Vessel Code. Valve body shall be cast-iron, with all wetted internal working parts made of brass and rubber. Select valve to suit actual system pressure and Btu capacity.

BUTTERFLY VALVES:

Comply with MSS SP-67, Butterfly Valves. Provide butterfly valves designed for tight shut-off. Provide gear operators on all butterfly valves 6” and larger. Provide lever operators for valves under 6 inches.

Wafer type valves are prohibited.

Types of Butterfly (BF) Valves: Lug Type 3” and Larger (BF1): 200 CWP, cast iron body, cadmium plated ductile iron disc, Type 410 stainless steel stem, EPT seat. Stockham LG-712. Nibco LD 2110-3. Nibco WD 2110-5. Crane 44-FXB-TL. Milwaukee ML123B-8416.

Lug Type 3” and Larger (BF2): 150/200 CWP, cast iron body, cadmium plated ductile iron disc, Type 410 stainless steel stem, EPT seat. Stockham LG-722 and LG-721. Nibco LD 2110-5. Crane 44-FXB-G. Milwaukee ML 123B-8115.

Lug Type 4” and Larger (BF3): 175 WWP, cast iron body, nickel-plated ductile or aluminum bronze disc, Type 410 stainless steel stem, EPT seat, UL listed. Stockham LG-72U. Nibco LD 3510-8.

Grooved Type 4” and Larger (BF4): 175 WWP, cast iron body, nickel plated ductile iron or aluminum bronze disc, Type 410 stainless steel stem, EPT seat, UL listed. Stockham LG-82U. Nibco GD 1765-2.

BALL VALVES:

General: Select valve size equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.

Construction: Ball valves shall be rated for 150 psi saturated steam and 600 psi non-shock cold water. Pressure containing parts shall be constructed of ASTM B-584 alloy 844, or ASTM B-124 alloy 377. Valves shall be furnished with blowout proof bottom loaded stem constructed of ASTM B-371 alloy 694 or other approved low zinc material. Provide TFE packing, TFE thrust washer, chrome plated ball and reinforced Teflon seats. Valves 1” and smaller shall be full port design. Valves 1 ¼” and larger shall be

conventional port design. Stem extensions shall be furnished for use in insulated piping where insulation exceeds ½" thickness.

Comply with the following standards:

MSS SP-72. Ball Valves with Flanged or Butt-Welding Ends for General Service.

MSS SP-110. Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

Types of Ball Valves:

Threaded Ends 3" and Smaller: Bronze two-piece full port body with adjustable stem packing. Nibco T-585-70. Stockham S216-BR-R-T. Milwaukee BA 125. Apollo 77-100.

Soldered Ends 3" and Smaller: Bronze three-piece full port body with adjustable stem packing. Nibco S-595-Y-66. Milwaukee BA350. Apollo 82-200.

Threaded Ends 3" and Smaller: Bronze two-piece full port body, UL listed (UL842) for use with flammable liquids and LP gas. Nibco T-585-70-UL.

Threaded Ends 2" and Smaller: 175 WWP, bronze two-piece body, gear operator with handwheel, indicator flag, accepts tamper switch, for fire protection, UL listed. Nibco T-505-4 and G-505-4.

Threaded Ends 2" and Smaller: 400 WWP, bronze two-piece body, for fire protection service. Nibco KT-580.

Threaded Ends 2 ½" and Smaller: 300 WWP, bronze three-piece body, gear operator with handwheel, indicator flag, accepts tamper switch, for fire protection, UL listed. Nibco T-505-4 and G-505-4.

Flanged Ends 2 ½" and Larger: Class 150, carbon steel full bore two-piece body with adjustable stem packing. Nibco F515-CS series. Apollo 88-240.

Manual Air Vent: Bronze body and nonferrous internal parts; 150 psig working pressure, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew: and having 1/8-inch discharge connection and 1/2-inch inlet connection.

Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150 psig working pressure, 240-degree F operating temperature; and having 1/4-inch discharge connection and 1/2 inch inlet connection.

Y-Pattern Strainers: Cast-iron body (ASTM A 126, Class B), flanged ends for 2-1/2 inch and larger, threaded connections for 2 inch and smaller, bolted cover, perforated Type 304 stainless steel basket, bottom drain connection; 125 psig working pressure.

Flexible Pipe Connections: Rubber-bellows type for chilled water service and stainless steel reinforced for heating hot water systems. Working pressure rating shall be 150 psig (minimum) at 200 deg F. Rubber bellows shall include multi-layered Kevlar tire cord fabric and solid steel retention ring for higher ratings. Flexible pipe connectors shall be same size as the connecting pipe and either screwed or ANSI flanged.

INSTRUMENTATION:

ASME and ISA Compliance: Comply with applicable portions of ASME and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

Pressure Gauges: ASME B40.1, Grade A, phosphor bronze bourdon-tube type, bottom connection. Drawn steel or brass case, glass lens, 4-1/2 inches diameter. White coated aluminum scale with permanently etched markings. Accuracy of 1% of range span. Range of 2 times operating pressure.

Gauge Syphon: 1/4-inch NPS straight coil constructed of brass tubing with threads on each end.

Gauge Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

Mercury-in-glass Thermometers: Die cast case, aluminum finished in baked epoxy enamel, glass front, spring secured, 9 inches long. Adjustable joint finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device. Tube shall be red reading, mercury filled, magnifying lens. Scale shall be satin-faced, nonreflective aluminum, with permanently etched markings. Stem shall be copper-plated steel, aluminum or brass, for separable socket, length to suit installation. Accuracy shall be plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span. Temperature ranges for services listed as follows:

Chilled Water	0 to 100
Hot Water	30 to 240

Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

Test/Pete's Plugs: Shall be nickel-plated brass body, with 1/2-inch NPS fitting and 2 self-sealing valve-type core inserts suitable for inserting a 1/8-inch OD probe assembly from a dial-type thermometer or pressure gauge. Core material shall be EPDM or neoprene. Test plug shall have gasketed and threaded cap with retention chain and body of length to extend beyond insulation.

PART 3 - EXECUTION

PIPE APPLICATIONS:

Heating Hot Water: Use steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.

Chilled Water: Use steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.

PIPING INSTALLATIONS:

Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

Install piping generally parallel to walls and column center-lines, unless shown otherwise on the Drawings. Space piping, including insulation, to provide one (1) inch minimum clearance between adjacent piping or other surface.

Slope water supply and return piping at a uniform grade of 1 inch in 40 feet upward in the direction of flow.

Install branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line.

Install unions in pipes 2 inch and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration producing equipment. Support piping so no weight bears on connector. Use retention rods and/or rings when recommended by the manufacturer.

Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blow down connection of strainers 2 inch and larger.

Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position.

Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the Drawings.

Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.

Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the Drawings.

Thermometer Wells: In pipes 2-1/2 inch and smaller increase the pipe size to provide free area equal to the upstream pipe area.

Threaded Joints: Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Align threads at point of assembly. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified). Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

PIPE WELDING:

All welding shall be performed by qualified and certified welders. Welders' qualifications/certification shall be current, i.e., not more than 12 months since issuance, and fully completed by a reputable source. Welders shall submit copy of certificate and driver's license to contractor for review, submit for review/approval to the engineer. Maintain copies of certificates/licenses onsite. Welders shall be qualified on the size pipe utilized for this project.

Unless otherwise specified, welding shall be performed using Shielded Metal Arc Welding (SMAW), otherwise referred to as "stick" welding.

Welds require preparation of surfaces, beveling, and multiple passes.

All welds shall be inspected. The engineer reserves the right to utilize any examination procedure listed in Chapter VI of ANSI/ASME B31.1 to verify integrity of any welds in question. If welds are found to be in

compliance, then testing costs shall be paid by the project. Otherwise, the contractor shall bear all related testing costs, weld/pipe replacement costs, additional engineering inspection or reporting costs, etc.

VALVE APPLICATIONS:

General Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated the following requirements apply:

Shut-off duty: use gate, ball, and butterfly valves.

Throttling duty: use globe and ball valves.

Install shut-off duty valves at supply connection to each piece of equipment, and elsewhere as indicated.

Install throttling duty valves as indicated.

Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.

Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

Install check valves on each pump discharge and elsewhere as required to control flow direction.

Install safety relief valves on hot water generators, boilers, and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe discharge to floor without valves. Comply with ASME Boiler and Pressure Vessel Code Section VIII, Division 1 for installation requirements.

Install pressure reducing valves on make-up water system, and elsewhere as required to regulate system pressure.

VALVE FEATURES

General: Provide valves with features indicated and where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ANSI B31.1.

Valve features specified or required shall comply with the following:

Flanged: Provide valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).

Threaded: Provide valve ends complying with ANSI B2.1.

Solder-Joint: Provide valve ends complying with ANSI B16.18.

Trim: Fabricate pressure-containing components of valve, including stems (shafts) and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing industry unless otherwise specified.

Non-Metallic Disc: Provide non-metallic material selected for service indicated in accordance with manufacturer’s published literature.

Renewable Seat: Design seat of valve with removable disc, and assemble valve so disc can be replaced when worn.

Extended Stem: Increase stem length by 2: minimum, to accommodate insulation applied over valve.

Mechanical Actuator: Provide factory fabricated gears, gear enclosure, external chain attachment and chain designed to provide mechanical advantage in operating valve for all valves 4" and larger that are mounted more than 7' 0" above the floor, or are otherwise difficult to operate regardless of height.

HYDRONIC SPECIALTIES INSTALLATION:

Install manual air vents at high points in the system, at heat transfer coils, and elsewhere as required for system air venting. Pipe air vent drains using ¼" soft copper and terminate at nearest safe waste. Support piping on 2' centers.

Install automatic air vents at high points in the system, heat transfer coils, and elsewhere as required for system air venting.

Install pressure/temperature ports across cooling and heating coils, control valves that do not include these fittings, and as needed for proper testing, adjusting, and balancing.

Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

Use dielectric unions or flanges to isolate dissimilar materials.

FIELD QUALITY CONTROL

Preparation for testing: Coordinate tests with the engineer three days in advance and prepare hydronic piping in accordance with ASME B 31.9 and as follows:

Leave joints including welds uninsulated and exposed for examination during the test.

Flush system with clean water. Clean strainers.

Isolate equipment that is not to be subjected to the test pressure from the piping. If a valve is used to isolate the equipment, its closure shall be capable of sealing against the test pressure without damage to the valve. Flanged joints at which blinds are inserted to isolate equipment need not be tested.

Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing.

Examine system to see the equipment and parts that cannot withstand test pressures are properly isolated.

Subject piping system to a hydrostatic test pressure which at every point in the system is not less than 1.5 times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test.

After the hydrostatic test pressure has been applied for at least 15 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks. Document all tests by recording test area, setup, participants names, test pressure, duration, and final results.

FLUSHING AND CLEANING:

Water treatment will be provided by the owner’s water treatment contractor. Coordinate flushing and cleaning operation with owner's representative.

Flush entire water piping system. Remove, clean, and replace strainer screens.

Circulate cleaning solution for 4 hours if recommended by the water treatment contractor.

Final flush entire water piping system if cleaning operations were carried out. Remove, clean and replace strainer screens.

Close and fill system as soon as possible after final flushing to minimize corrosion.

END OF SECTION

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SECTION 23 31 13 - METAL AND FLEXIBLE DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

GENERAL CONDITIONS

The work described hereunder shall be installed in accordance with the "Mechanical General Conditions," Section 23 01 00.

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 air ductwork.

Smoke/fire dampers, air diffusers, and miscellaneous accessories.

Miscellaneous volume/control dampers.

Ventilation air ductwork.

Exhaust air ductwork.

RELATED WORK

Insulation is specified under Section 23 07 10.

QUALITY ASSURANCE:

Manufacture'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 electronic copies of brochures, technical data and/or shop drawings of the following, and as many additional copies as required for Contractor use:

Ductwork and materials

Mastics

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, lock forming quality; with G-90 zinc coating in accordance with ASTM A 525.

Single-Wall Spiral Round Duct: Round duct with mechanical fastening, spiral flat seams, complying with ASTM A527, with G-90 zinc coating in accordance with ASTM A 525.

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, hardware, etc. Dampers shall be airfoil 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".

Construct supply duct for 2” static pressure.

Construct return ducts for 2” negative static pressure.

Construct exhaust ducts for 1” negative static pressure and outside air ducts for 1” positive static pressure.

Construct rectangular taps with mitered fittings.

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 airtight 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.

Use single-wall spiral seam round duct where specified and/or as needed to accommodate existing conditions.

Duct sizes shown are internal dimensions. Maintain free area equivalence when making transitions or when transforming between round and/or rectangular duct.

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 existing structure, 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 approved UL listed details and accepted industry practice.

Hard Ceiling or Sidewall Connections: Provide insulated sheet metal boots sized to fit the grille size as indicated. Secure boot to ceiling structure. Boot insulation shall be semi-rigid 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 ten (10) feet extended length – use round spiral seam steel duct for longer runs. 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 3" wide sheet metal saddles. Wire gauge shall be per SMACNA and saddles shall have hemmed edges and corners. Support as needed to avoid kinks and flow obstructions.

END OF SECTION

SECTION 23 34 10 - FANS

PART 1 - GENERAL

GENERAL CONDITIONS

The work described hereunder shall be installed in accordance with the "Mechanical General Conditions," Section 23 01 00.

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:

In-line Direct-Drive Cabinet Fans

RELATED WORK

Electrical wiring is specified in the Electrical Sections.

Control wiring is specified under other sections, provide any control devices as described on the schedule.

QUALITY ASSURANCE

Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA) approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA standards. All fans provided must be licensed to bear the Certified Ratings Seal.

WARRANTY

Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.

SUBMITTALS

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

Fans

Fan accessories/options, etc.

MAINTENANCE DATA:

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

DELIVERY, STORAGE AND HANDLING:

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

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

Comply with manufacturer's rigging and moving instructions for equipment unloading and moving to final location.

PART 2 - PRODUCTS

FAN SCHEDULE

Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage accessories as scheduled on the Drawings or specified hereafter.

Provide fan accessories as scheduled on the Drawings or required in these specifications.

IN-LINE DIRECT-DRIVE CABINET FANS

Provide in-line direct-drive cabinet centrifugal fans with forward curved dynamically balanced fan wheel and square galvanized steel housing with venturi throat inlet. The housing interior shall be lined with ½" thick acoustical insulation. The outlet duct collar shall include an aluminum backdraft damper and be adaptable to horizontal or vertical discharge. The access for wiring shall be external. The motor disconnect shall be internal and of the plug type. The motor shall be mounted on vibration isolators.

FAN ACCESSORIES

Provide fan accessories as scheduled on the Drawings or required in these specifications.

Wall caps shall include insect screens and backdraft dampers.

PART 3 - EXECUTION

Install fans in accordance with manufacturer's installation instructions.

Verify existing roof construction prior to compiling shop drawings for curbs and/or adapters.

Coordinate the installation with the controls' contractor.

Locate inline fans directly above a single lay-in tile for motor/fan access/replacement. Support fan from structure. Install flexible duct connectors to ductwork. Install axial restraints across flexible connector on fans with over ½ hp motors.

Ensure that fans are wired properly, with correct motor rotation, and includes electrical motor grounding.

Verify motor amperage and voltage.

Verify proper operation of backdraft dampers.

Verify control functions of fan.

END OF SECTION

SECTION 23 36 16 – VARIABLE AIR VOLUME AIR TERMINAL UNITS

PART 1 - GENERAL

GENERAL CONDITIONS

The work described hereunder shall be installed in accordance with the "Mechanical General Provisions," Section 23 01 00.

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:

Variable Air Volume Terminals

Controls (provided by others) shall be factory mounted

RELATED WORK

Electrical wiring is specified in the Electrical Sections.

QUALITY ASSURANCE

ARI certified performance.

Acceptable Manufacturers: Titus, Daikin, Carrier, Enviro-tec or Trane.

SUBMITTALS

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

Single Duct VAV boxes

MAINTENANCE DATA:

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

DELIVERY, STORAGE AND HANDLING:

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

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

Comply with manufacturer's rigging and moving instructions for equipment unloading and moving to final location.

PART 2 - PRODUCTS

BACTERIOLOGICAL LINER

All air terminal units shall be provided with a non-porous sealed bacteriological liner with foil facing or sheet metal.

The liner and insulation must meet the requirements of UL 181 and NFPA 90A.

The liner must meet bacteriological standards of ASTM C665 and ASTM C 1338. Liners made of Tedlar, Mylar, Silane or Alpha-Temp are not acceptable.

Insulation shall be 4-pound density with a 3.5 R value.

VARIABLE AIR VOLUME TERMINALS

Furnish and install single duct, variable volume terminals of the sizes and capacities shown in the plans.

Terminals shall have pressure-independent electronic control.

Factory installed controls will be provided by the Owner's Controls' contractor. Single duct VAV's will be provided to accept control voltage – no onboard transformer required. Fan Powered VAV's shall include control voltage transformer.

The terminal casing shall be 22-gauge galvanized steel, internally lined with dual density fiberglass insulation which complies with UL 181 and NFPA 90A. All exposed insulation edges shall be coated with NFPA 90A approved sealant to prevent erosion. Surfaces in contact with the supply air shall have foil or sheet metal facing. The casing shall be sealed to minimize leakage.

The damper shall be heavy gauge metal, with its shaft rotating in Delrin self-lubricating bearings. The shaft shall be marked on the end to indicate the damper blade position. The terminal shall be designed for field conversion from normally open to normally closed, or vice versa, without relocating the actuator, changing parts or adding relays.

The damper shall have a built-in stop to prevent over stroking and shall seal against a closed-cell foam gasket, to limit close-off leakage.

PART 3 - EXECUTION

Install units in accordance with manufacturer's installation instructions.

Install units not more than 18" above ceilings to facilitate access via a ladder.

Support units from structure. Use electrical metal framing channel for bridging between structural members and all threaded rod for suspending units.

Install terminal units to ensure a minimum 24" clear access to all electrical and control components.

Duct unit with 24" of straight duct at least one size larger than box connection size, see detail on plans.

Provide and install ceiling access panels where necessary to access filters, electrical, control and other components requiring access.

Install inlet ductwork as straight as possible. See and comply with manufacturer's installation details.

Ensure units are wired properly, with correct motor rotation and that they operate properly.

Ensure duct connections are tight and sealed.

Coordinate control installation with controls contractor.

Prepare for Test & Balance as required by that Section.

END OF SECTION

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SECTION 23 73 10 – VARIABLE AIR VOLUME AIR HANDLING UNITS

PART 1 - GENERAL

GENERAL CONDITIONS

The work described hereunder shall be installed in accordance with the "Mechanical General Provisions," Section 23 01 00.

DESCRIPTION OF THE WORK

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

Provide and install air handling units including factory start-up and warranties per schedule and plans.

RELATED WORK

Electrical power wiring is specified in the Electrical Sections.

All utility connections, including power, control, drains, chilled water, heating hot water; are described elsewhere.

QUALITY ASSURANCE

Air Handling Units: Certify capacity, static pressure, fan speed, horsepower and selection procedures in accordance with ARI 430.

Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410.

Air-handling Unit Assembly: Shall have UL certification for safety, including use with electric heat. Units requiring electric connection shall be listed and classified by ETL and CSA as suitable for the purpose specified and indicated.

Air-handling Unit Assembly: Shall meet NFPA 90A requirements.

MANUFACTURER'S STANDARD CONSTRUCTION

Exception to these specifications: It is not the intent that any supplier is locked out based on the specifics of that manufacturer's standard construction. Bids will be considered that do not materially differ from the specification so long as construction items differing from this specification are highlighted in the bid submittal and the units will fit into the space without adversely affecting duct layout, maintenance space requirements, and original design intent. The engineer reserves the right to determine which units are acceptable.

SUBMITTALS

Submit to the Architect/Engineer for approval electronic of brochures, technical data and/or shop drawings and as many additional copies as required for Contractor use.

Performance data indicating nominal capacity, sound data in accordance with AMCA 300, performance curves per ARI, fan power required, entering & leaving water temperatures, flow rates, and pressure drops.

Submit product data: materials of construction and corrosion protection, required clearances, field connections, weight, motor data, specialties and accessories.

Submit installation instructions, including field-wiring diagrams, required utility connections and manufacturer's recommendations. Provide a list of components which will be shipped loose for field assembly. Identify any special handling and storage procedure necessary to protect the equipment prior to operation.

Provide O&M manuals: Include manufacturer's descriptive literature, wiring diagrams, start-up instructions, and maintenance procedures. Provide a schedule of recommended periodic inspection and preventive maintenance procedures. Provide a list of any spare parts recommended for start-up or on-site storage.

WARRANTY

Provide manufacturer's standard one-year full parts and labor warranty.

PART 2 - PRODUCTS

GENERAL

Provide double-walled air handling unit specifically designed for the intended service. The unit shall be factory fabricated, assembled and tested. Units shall ship fully assembled unless directed otherwise. The unit shall perform as indicated in the Schedule and shall be configured to include all components/sections indicated on the Drawings.

CASING

Unit shall be constructed of galvanized steel casing panels with 2" thick polyurethane foam filled insulation. Coils shall be removable without cutting any panels.

Top or side lugs shall be provided for supporting the unit.

Base rails of 6" height shall be provided to support the cabinet.

Construct unit casing exterior panels of G90 galvanized steel.

The unit shall have a complete double wall internal liner of G60 galvanized steel.

Side panels shall be easily removable from both sides of unit for access to unit and shall seal against a full perimeter automotive style neoprene gasket to ensure a tight seal.

The panel retention system shall comply with UL 1995 which states all moving parts (for example, fan blades, blower wheels, pulleys, and belts) that, if accidentally contacted, could cause bodily injury, shall be guarded against accidental contact by an enclosure requiring tools for removal.

Accessibility options shall be as follows:

a. Hinged double-wall access door with quarter-turn latch on fan side with removable access panel(s) on the other side.
b. Hinged double-wall access doors on access sides.
c. Removable double-wall access panels on opposite side of hinged door.
d. Hinged double-wall access door to filter with quarter-turn latch.

Fan supports, structural members, panels, or flooring shall not be welded, unless aluminum, stainless steel, or other corrosion-resistant material is used. Painted welds on unit exterior steel or galvanized steel are not acceptable.

All sections shall be double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.

Access Doors: Access doors shall be one piece, double-wall construction with insulation sealed between the inner and outer panels. Panel assemblies shall not carry an R-value of less than 13.

Cooling Coil Drain Pans: Drain pans for cooling coils shall be stainless steel construction. The pan shall be sloped in four (4) directions toward the drain fitting. Drain pan shall have recessed bottom drain connections. Drain pan shall allow no standing water and comply with ASHRAE Standard 62.

Heating Coil Drain Pans: Provide anti-microbial galvanized steel double-sloped drain pan with drain fitting.

Finish: Galvanized or Manufacturer standard paint

FANS

Provide direct-drive plenum fan. Fan assemblies including fan, motor and sheaves shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports. Manufacturer must ensure maximum fan RPM is below the first critical speed.

Fan and motor assembly shall be mounted on vibration isolators inside cabinetry.

Units shall be certified in accordance with the central station air handling unit's certification program, which is based on AHRI Standard 430.

BEARINGS AND DRIVES

Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards, L-50 life at 200,000 hours heavy-duty pillow block type, self-aligning, grease lubricated ball bearings, with lubrication fittings. Provide extended grease lines to drive/access side of unit casing, for all fan bearings, rigidly attached for easy service access.

Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

V-Belt drives shall be adjustable cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed.

Fixed and adjustable pitch motor sheaves shall be provided.

Final RPM is obtained with sheaves set at mid-position and rated motor horsepower.

Contractor to furnish fixed sheaves at final RPM as determined by balancing contractor.

MOTORS AND DRIVES

Units shall have internal motor and drives and shall be provided with a full-size removable service door on the drive side of the fan(s).

All three-phase motors shall have a ± 10% voltage utilization range and a 1.15 minimum service factor. Motor shall be compliant with EPACT where applicable.

Fan motors shall be heavy duty, premium efficiency, open drip proof (ODP) with Class F insulation. Motor shall be rated for VFD inverter duty and labeled accordingly.

COILS

All coil sections shall be provided with drain pans for condensate removal and cleaning operations. The drain pan shall extend under the complete coil and coil-access section.

Water Coils

All coils shall be enclosed in an insulated coil section. Coil headers and U-bends shall not be exposed.

Coil connections shall be MPT and constructed of bronze or suitable dielectric fitting/coupling.

Coils shall be counter flow design, constructed of copper tubes, aluminum plate fins, copper header and nozzles, stainless steel tube sheet and coil casing.

Coils shall be leak tested to 320-psig air pressure under water.

Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall be mounted in the unit casing to be accessible for service and can be removed from the unit either through the side or top. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 410.

FILTERS

Provide factory fabricated filter section of the same construction and finish as unit casing with filter guides and hinged, removable double-wall access doors.

Provide flat pre-filter section to accommodate two-inch thick 30% efficient filters. Provide a final filter section to accommodate four-inch-thick MERV 11 filters. Filters shall be removable from one side of the filter section.

Provide two sets of pleated media equal to FARR 30-30.

ACCESS SECTIONS

Access shall be supplied as shown on the plans. Access doors shall be provided on one side of each section.

ADDITIONAL SECTIONS

If scheduled, include energy recovery wheel.

Access section shall be provided for access between components.

Energy recovery wheel shall be constructed of corrugated synthetic fibrous media, with a desiccant intimately bound and uniformly and permanently dispersed throughout the matrix structure of the media. Rotors with desiccants coated bonded, or synthesized onto the media are not acceptable due to delaminating or erosion of the desiccant material. Media shall be synthetic to provide corrosion resistance and resistance against attack from laboratory chemicals present in pharmaceutical, hospital, etc. environments as well as attack from external outdoor air conditions. Face flatness of the wheel shall be maximized in order to minimize wear on inner seal surfaces and to minimize cross leakage. Rotor shall be constructed of alternating layers of flat and corrugated media. Wheel layers should be uniform in construction forming uniform aperture sizes for airflow. Wheel construction shall be fluted or formed honeycomb geometry so as to eliminate internal wheel bypass. Wheel layers that can be separated or spread apart by airflow

are unacceptable due to the possibility of channeling and performance degradation.

Desiccant Material: The desiccant material shall be a molecular sieve, and specifically a 4A or smaller molecular sieve to minimize cross contamination. Wheel Media Support System: The wheel frames shall consist of evenly spaced steel spokes, galvanized steel outer band and rigid center hub. The wheel construction should allow for post fabrication wheel alignment. Wheel Seals: The wheel seals shall be full contact nylon brush seals or equivalent. Seals should be easily adjustable. Wheel cassette: Cassettes shall be fabricated of heavy duty reinforced galvanized steel or welded structural box tubing. Cassettes shall have a built-in adjustable purge section minimizing cross contamination of supply air as shown on unit schedule. Bearings shall be inboard, zero maintenance, permanently sealed roller bearings, or alternatively, external flanged or pillow block bearings. Drive systems shall consist of fractional horsepower AC drive motors with multi-link drive belts.

Certification: The wheel shall be AHRI certified by the energy recovery wheel supplier to AHRI Standard 1060 and must bear the AHRI certification stamp. The wheel shall be listed or recognized by UL or equivalent.

PART 3 EXECUTION

AIR HANDLING UNIT DELIVERY AND SETTING

Protect units on site from physical damage and internal access. Handle carefully to avoid damage to components, enclosures, and finish. Protect coils.

Entire installation shall be in accordance with the applicable requirements of the manufacturer.

Support unit on ½" thick neoprene isolation pads located below base rails on 2' centers or as required by manufacturer. Locate units in space to facilitate maintenance, duct and piping layouts, and to comply with the manufacturer's access requirements.

PIPING

Install coil piping, valves, flexible pipe connections, etc. Support piping so no weight bears on coil headers. See plans.

Install condensate piping and terminate in the nearest hub drain, see plans.

DUCTWORK

Install ductwork per plans. Space ducts to allow for insulation. Route ductwork as high as possible to optimize ceiling heights. Coordinate installation with other trades.

CONTROLS

Install controls per plans.

START-UP

Vacuum and wet wipe interior or unit.

Remove shipping restraints at fan assembly.

Install new air filters, lubricate bearings, verify condensate is properly trapped, piping configuration is

correct, belts aligned and tensioned, all shipping braces have been removed, and fan has been test-run under observation.

Test controls, motor rotation, zone dampers, safeties, etc. prior to startup.

Perform startup per the manufacturer’s recommendations.

END OF SECTION