# TECHNICAL SPECIFICATIONS SECTIONS

## STATEMENT OF WORK

**"Installation of 2 HVAC Units at Jane Hahn Juvenile Hall and Installation of 2 HVAC Units at the Orland Administration Building"**

| Project # | Location | Proposed Equipment | Proposed Capacity |
|---|---|---|---|
| 1. | Jane Hahn Juvenile Hall (existing equipment – 5 ton SEER 7, installed in 1966) | (2) 5 ton HVAC SER 13 | 4.62 |
| 2. | Orland Administration Building (existing equipment – 5 ton SEER 9, installed in 1994) | (2) 5 ton HVAC SER 13 | 4.62 |

## GENERAL MECHANICAL PROVISIONS

### 1. WORK INCLUDED

Provide materials, labor, and equipment as indicated in the Bid documents and County Agreement, together with all incidental items not shown or specified, which are required by code and good practice to provide complete and operable systems.

### 2. COORDINATION

Coordinate all mechanical work with all other trade work required for "turn-key" installations. All electrical, plumbing, and crane work, shall be coordinated to provide a complete installation. Expense of changes required because of lack of supervision or coordination shall be borne by the Contractor. Contractor shall take care to coordinate all work to avoid disturbance to building occupants which must remain occupied throughout the construction period.

### 3. SITE VISIT

Examine the project site(s) and become familiar with job conditions affecting work. No additional allowance will be granted due to lack of information about existing conditions.

### 4. SUBMITTALS

Submittals are to have been furnished with Bid Form and shall include all information necessary for County to award the work to the single best responsible bidder.

### 5. CODES & INSPECTIONS

A. Codes, standards: Applicable codes and standards contained herein shall determine minimum requirements for materials, methods, and labor practices not otherwise stated herein.
B. Inspections: The Glenn County Inspection Divisions will perform all inspections. Allow 24-hour notice when calling for inspections.

### 6. OPERATING & MAINTENANCE DATA

Include the following information where applicable.

A. Nameplate directory listing of equipment with location, area served, control sequence, complete operating instructions and start-up instructions.
B. Valve directory listing with valve number, type, size, location, foundation, and normal position.
C. Manufacturer's printed operations and maintenance information.
D. Manufacturer's parts list.
E. Service and Dealer directory listing.
F. Service and lubrication schedule

## 7. INSTRUCTIONS

Instruct County's Buildings & Grounds Supervisor in the operation and maintenance of all systems. Operating and maintenance manuals shall be approved prior to installation.

## 8. COMPLETION

Operate system in County's presence to demonstrate that the system is complete and operating in conformance with these specifications. Assure that a final inspection is conducted of all work.

## 9. MATERIALS

All material shall be new, full weight, in first class condition and suitable for space provided. All similar materials shall be of one manufacturer.

## 10. ELECTRONIC EQUIPMENT

All equipment which requires electrical services of 50 amperes or more shall have lugs suitable for either copper or aluminum supply conductors. Provide time switches and interlocking devises as required for automatic control. All wiring and electrical work pertaining to mechanical system, shall be by the Contractor, unless specified otherwise.

## 11. CLEANING SYSTEMS

After all equipment, fixtures, pipes, and duct systems are installed, the system shall be thoroughly cleaned. Remove all stickers, tags and instruction from equipment or fixtures. Clean bowls or fixtures. Clean all piping systems prior to installation of insulation or painting.

## 12. AIR DISTRIBUTION SYSTEM

Remove all debris and dust from system before operation. Under no circumstances shall system be operated without filters. Replace filters used during construction with new filters. Repair or replace any discoloration or damage to system, building finish, or furnishings resulting from Contractor's failure to properly clean system.

## 13. ACCESS TO EQUIPMENT & ACCESSORIES

Install equipment with adequate access for service. Provide access doors where shown or required for access to valves, P-traps primers, cleanouts, dampers, motors, etc. Type, size, and location of access doors shall be coordinated with County, if applicable.

## 14. UTILITIES

Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

## 15. EXISITNG SITE CONDITIONS

Secure units in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

## 16. SECURE UNITS

Secure units in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

### 17. DUCT TESTING

Duct testing as required for each location, and the appropriate forms.

## SECTION 15050 – BASIC MECHANICAL MATERIALS AND METHODS

### GENERAL

SECTION INCLUDES

Electric motors.

Motor starters.

Valves and fittings.

Strainers.

Gauges.

Thermometers.

Access Doors.

Expansion loops.

Flexible connections.

Insulation.

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this Section.

This Section is a part of each Division 15 Section.

ADDITIONAL REQUIREMENTS

Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.

Make all temporary connections required to maintain services, including adequate heat and cooling, during the course of this Contract without additional cost to the Owner. The normal function of the building must not be interrupted; notify the Owner seven days in advance before disturbing any service.

REFERENCES

CSA – Canadian Standards Association International

ANSI - American National Standards Institute

ASTM - American Society for Testing and Materials

CCR - California Code of Regulations

Title 8 - Division of Industrial Safety, Subchapter 7; General Industry Safety Orders, Articles 31 through 36

NCPWB - National Certified Pipe Welding Bureau

CEC - California Electrical Code

NEMA - National Electrical Manufacturers' Association

NFPA - National Fire Protection Association

OSHA - Occupational Safety and Health Act

UL - Underwriters' Laboratories, Inc.

DRAWINGS

Examine all Drawings prior to bidding of work and report any discrepancies in writing to the Architect.

Visit the site of work and examine existing conditions in order to become familiar with the scope. Verify any dimensions shown on the plans at the site. Discrepancies shall be brought to the attention of the Architect. Failure to examine the site shall not constitute basis for claims for additional work because of lack of knowledge or location of hidden conditions that could affect the scope.

Drawings showing location of equipment, piping, ductwork, etc., are diagrammatic and job conditions will not always permit their installation in the location shown. The Mechanical Drawings show the general arrangement of all piping, ductwork, equipment, etc., and shall be followed as closely as existing conditions, actual building construction, and the work of other trades will permit.

The Architectural and Structural Drawings shall be considered a part of the work insofar as these Drawings furnish the Contractor with information relating to design and construction of the building. Architectural Drawings take precedence over Mechanical Drawings.

Because of the small scale of the Mechanical Drawing, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate the structural and finish conditions affecting the work and arrange work accordingly, providing such fittings, valves, and accessories as may be required to meet conditions. When job conditions do not permit installation of equipment, piping, ductwork, etc., in the locations shown, it shall be brought to the Architect's attention immediately and the relocation determined in a joint conference.

Contractor shall be responsible for the relocation of any items installed without first obtaining the Architect's approval. Remove and relocate such items at his own expense if so directed by the Architect.

Execute work mentioned in the Specifications and not shown on the Drawings, or vice versa, the same as if specifically mentioned in both.

REQUIREMENTS OF REGULATORY AGENCIES

The publications listed below form a part of this specification; comply with provisions of these publications except as otherwise shown or specified.

California Electrical Code, 2007

National Fire Protection Association

CAL-OSHA

California Code of Regulations, Title 24

Occupational Safety and Health Administration

California State Fire Marshal, Title 19 CCR

California Building Code, 2007

California Building Energy Efficiency Standards, 2005

California Fire Code, 2007

California Mechanical Code, 2007

California Plumbing Code, 2007

Other applicable state laws

Nothing in Drawings or specifications shall be construed to permit work not conforming to these codes. It is not the intent of Drawings or specifications to repeat the requirements of codes except where necessary for completeness or clarity.

Conform to State of California 2005 Building Energy Efficiency Standards for all systems, equipment, and construction.

When contract documents differ from governing codes, furnish and install larger size or higher standards called for without extra charge.

No material installed as part of this Work shall contain asbestos in any form.

Where material or equipment is specified to conform to standards such as American Society for Testing and Materials (ASTM), Underwriters' Laboratories, Inc. (UL), American National Standards Institute (ANSI) and the like, it shall be assumed that the most recent edition of the standard in effect at the time of bid shall be used.

FEES AND PERMITS

Obtain and pay for all permits and service required in installation of this work; arrange for required inspections and secure approvals from authorities having jurisdiction. In addition, comply with the requirements of Division 1.

Arrange for utility connections and pay charges incurred, including excess service charges, if any.

Prior to the start of construction, contact local gas company representative and coordinate location of gas meter and piping. In addition, coordinate time required for installation, in order to avoid delay to the project.

Obtain the first permits to operate any compressed air tanks that are required to be furnished under this work, pay all costs, and perform all tests required to obtain permits. Post permits under glass in a conspicuous place on or near the tanks, as required by these authorities.

UTILITY CONNECTIONS

Bear the cost of all construction related to utility services, from the point of connection shown on the Contract Documents. This includes any piping, excavation, backfill, meters, boxes, check valves, backflow prevention devices, general service valves, concrete work and the like, whether or not the work is performed by this contractor, the water/sanitation district or any other governmental agencies or assigns.

FRAMING, CUTTING AND PATCHING

Special framing, recesses, chases and backing for work of this Section, unless otherwise specified, is covered under other Sections. This contractor is responsible for proper placement of all pipe sleeves, hangers, and supports and location of openings for work of this Section.

This Contractor is responsible for proper placement of pipe sleeves, hangers, inserts, and supports for work.

Cutting, patching, and repairing of existing construction to permit installation of piping, etc. is responsibility of this Contractor. Repair or replace damage to existing work with skilled mechanics for each trade involved in first-class manner.

Cut existing construction in a neat and workmanlike manner by the use of a concrete saw. Use of pneumatic devices will not be allowed.

Core openings through existing construction as required for the passage of new piping and conduits. Cut holes of the minimum diameter to suit size of pipe installed and associated insulation. Coordinate with building structure, and obtain structural engineer's approval prior to coring through any existing construction.

MATERIAL LIST AND SUBSTITUTIONS

Provide submittal of all materials proposed for use as part of this project. Product names in the Specification and on Drawings are used as standards of quality. Furnish standard items on specified equipment at no extra cost to the contract regardless of disposition of submittal data; other materials or methods shall not be used unless approved in writing by the Architect. The Architect's review will be required even though "or equal" or synonymous terms are used. It is the responsibility of the Contractor to assume all costs incurred because of additional work and or changes required to incorporate the proposed substitute into the project, including possible extra compensation due to the Architect. Refer to Division 1 for complete instructions.

Substitutions will be interpreted to be all manufacturers other than those specifically listed by model or catalog number.

Partial or incomplete submittals will not be considered.

Only one request for substitution will be considered on each item of material or equipment. No substitutions will be considered thereafter.

Quantities are the Contractor's responsibility and will not be reviewed.

Provide materials of the same brand or manufacture throughout for each class of material or equipment wherever possible.

Identify each item by manufacturer, brand, trade name, number, size, rating or whatever other data is necessary to properly identify and review materials and equipment. Words "as specified" are not sufficient identification.

Identify each submittal item by reference to specification section number and paragraph in which item is specified, or Drawing and Detail number.

Organize submittals in same sequence as they appear in Specification Sections, articles or paragraphs.

Show physical arrangement, construction details, finishes, materials used in fabrications, provisions for piping entrance, access requirements for installation and maintenance, physical size, mechanical characteristics, foundation and support details, weight.

Submit shop drawings, performance curves, and other pertinent data, showing the size and capacity of the proposed materials.

Specifically indicate, by drawn detail or note, that equipment complies with each specifically stated requirement of the Contract Documents.

Drawings shall be drawn to scale and dimensioned (except piping diagrams not to scale). Drawings may be prepared by vendor but must be submitted as instruments of Contractor, thoroughly checked and stamped by Contractor before submission to Architect for review.

Catalog cuts and published material may be included in supplement scale drawings.

Review of submittals will be only for general conformance with the design concept and general compliance with the information given in the contract documents. It will not include review of quantities, dimensions, weights or gauges, fabrication processes, construction methods, coordination with the work of other trades, or construction safety precautions, all of which are the sole responsibility of the Contractor. Review of a specific item does not indicate acceptance of an assembly of which the item is a component. The Architect will not be required to review and shall not be responsible for any deviations from the contract documents not clearly noted by the Contractor.

Installation of reviewed substitution is Contractor's responsibility. Any mechanical, electrical, structural, or other changes required for installation of reviewed substituted equipment must be made without additional cost. Review by the Architect of the substituted equipment and/or dimensional Drawings does not waive these requirements.

Submit to Architect for review, within reasonable time after award of contract and in ample time to avoid delay of construction, Shop Drawings or submittals on all items of equipment and materials to be provided. Provide submittal in at least seven copies and in a complete package.

Shop Drawings and submittals shall include Specification Section, Paragraph number, and Drawing unit symbol or detail number for reference. Organize submittals into booklets for each specification section and submit in loose-leaf binders with index and whether it is a deviation from the specifications.

Provide coordinated layouts for HVAC Ductwork systems, in accordance with Specification Section 15800. Provide specific information of seismic bracing of ductwork and in-line equipment.

Provide specific details for design and installation of seismic bracing of ductwork systems, piping systems, plumbing and hydronic systems, including in-line equipment and all mechanical equipment. Indicate location of each seismic brace for review.

Furnish to the Inspector, upon request, complete installation instructions on all material and equipment before starting installation.

Have fire damper and fire smoke damper installation instructions available at the site during construction for use by the inspector.

Provide submittal information proving compliance with the requirements of NSF-61 for lead free faucets and bubblers. Faucets and bubblers installed after January 1, 2010 shall comply with the lead free requirements of the California Health and Safety Code Section 116875.

Pipe, pipe or plumbing fittings, fixtures, solder and flux installed after January 1, 2010 shall comply with the lead free requirements of the California Health and Safety Code Section 116875. Provide submittal information for products listed and labeled as complying with NSF 61, Annex G, or provide other evidence of compliance with the California Health and Safety Code Section 116875.

MAINTENANCE AND OPERATING INSTRUCTIONS

Instruct the Owner's authorized representatives in operation, adjustment, and maintenance of all mechanical equipment and systems. Provide three copies of certificate signed by Owner's representatives attesting to their having been instructed.

Furnish three complete sets of operating and maintenance instructions bound in a hardboard binder, and one compact disc containing complete operation and maintenance instructions in PDF format. Provide Table of Contents. Provide index tabs for each piece of equipment in the binder and disc. Start compiling the data upon approval of list of materials.

These sets shall incorporate the following:

Complete operating instructions for each item of heating, ventilating and air conditioning equipment.

Complete operating instructions for each item of plumbing equipment.

Complete operating instructions for each item of fire sprinkler system. Include an original manual of NFPA-25 in maintenance instructions for fire sprinkler system.

Test data and system balancing reports as specified.

Typewritten maintenance instructions for each item of equipment listing in detail the lubricants to be used, frequency of lubrication, inspections required, adjustment, etc.

Manufacturers' bulletins with parts numbers, instructions, etc., for each item of equipment properly stripped and assembled.

Temperature control diagrams and literature.

A complete list or schedule of all major valves giving the number of the valve, location and the rooms or area controlled by the valve. Identify each valve with a permanently attached metal tag stamped with number to match schedule. Post list in frame under plastic on wall in mechanical room or where directed.

Provide copies of check test and start reports for each piece of mechanical equipment provided as part of the Work.

Provide copies of Commissioning and Preliminary Operation Tests required as part of the Work.

Post service telephone numbers and/or addresses in an appropriate place as designated by the Architect.

SITE CONDITIONS

Information on the Drawings relative to existing conditions is approximate only. Deviations found necessary during progress of construction to conform to actual conditions as approved by the Architect shall be made without additional cost to the Owner. The Contractor shall be held responsible for any damage caused to existing services. Promptly notify the Architect if services are found which are not shown on the Drawings.

EXISTING MATERIALS

Remove existing equipment, piping, wiring, construction, etc., which interferes with work of this contract promptly return to service upon completion of work in the area. Replace items damaged by the contractor with new material to match existing.

Removed materials which will not be re-used and which are not claimed by the Owner shall become the property of the Contractor and shall be removed from the premises. Consult Owner before removing any material from the premises. Carefully remove materials claimed by the Owner to prevent damage and delivered on the site where required.

Existing piping and wiring which will not be reused and which are concealed in the building construction may be abandoned in place and all ends shall be capped or plugged. Remove all such piping and wiring that is exposed in Equipment Rooms or occupied spaces. Material shall be removed by the contractor, and removed from the premises. Disconnect power, water, gas, pump or any other active energy source from any piping or electrical service prior to its being abandoned in place.

Existing piping, ductwork, and equipment which is modified or altered as part of this work shall be brought up to the latest code requirements which apply.

WARRANTY

Refer to Division 1 for Warranty requirements, including when warranty is to become effective. Refer to specific items of equipment specified herein for warranty duration if different from that specified in Division 1.

Repair or replace any defective work, material, or part that may appear within the warranty period. This shall include damage by leaks.

On failure to comply with the above warranty within a reasonable length of time after notification is given, the Architect shall have the repairs made at the Contractor's expense.

RECORD DRAWINGS

Refer to Division 1 requirement, Record Documents, for requirements governing Work specified herein.

Upon completion of the work and as a precedent to final payment, deliver to the Architect originals of all Drawings showing the work exactly as installed. Also deliver to the Architect one complete set of reproducible Drawings showing the work exactly as installed. Provide Contractor's signature, verifying the accuracy of Record Drawings.

Obtain the signature of the Inspector of Record for all Record Drawings.

DELIVERY AND STORAGE

All equipment, ducting and piping delivered to site shall be protected from the weather, humidity and temperature variations, dirt and dust and other contaminants.

COORDINATION

General:

Coordinate all of work in this Section with all of the Trades covered in other Sections of the Specifications to provide a complete, operable and sanitary installation of the highest quality workmanship.

Electrical Coordination:

Refer to the Electrical Drawings and Specifications, Division 16, for the service voltage and power feed wiring for equipment specified under this section. The Contractor has full responsibility for the following items of work:

Review the Electrical Drawings and Division 16 to verify that the electrical services provided are adequate and compatible with the equipment requirements.

If additional electrical services are required over and above what is indicated on the Electrical Drawings and in Division 16, such as more control interlock conductors, larger feeder, or separate 120 volt control power source, include the cost to furnish and install the additional electrical services as part of the bid.

Prior to proceeding with the installation of any additional electrical work, submit detailed drawings indicating the exact scope of additional electrical work for review.

Mechanical Coordination:

Arrange for pipe spaces, chases, slots and openings in building structure during progress of construction, to allow for mechanical installations.

Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames".

**PRODUCTS**

GENERAL

Materials or equipment of the same type shall be of the same brand wherever possible. All materials shall be new and in first class condition.

All sizes, capacities, and efficiency ratings shown are minimum, except that gas capacity is maximum available.

Refer to Division 15400 and 15800 for specific system piping materials.

ELECTRIC MOTORS

U.S. Motors, Century Electric, General Electric, Lincoln, Gould or equal. The minimum efficiencies shall be as defined by IEEE 112 Test Method B and NEMA MG1. Provide NEMA 3R enclosure where exposed to outdoors.

MOTOR STARTERS

Square D, Allen Bradley, or equal, in NEMA Type 1 enclosure, unless otherwise specified or required. Minimum starter size shall be Size 1. Provide NEMA 3R enclosure where exposed to outdoors.

Where three phase motors are provided for two-speed operation, provide two speed motor starters.

All three-phase starters shall have the following:

Provide magnetic motor starters for all equipment provided under the Mechanical Work. Starters shall be non-combination type. Provide part winding or reduced voltage start motors where shown or as hereinafter specified. Minimum size starter shall be Size 1.

Cover mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.

Three ambient compensated thermal overload.

Fused control transformer (for 120 or 24 volt service).

Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIR enclosures.

VALVES AND FITTINGS

Valves: Provide Nibco, Hammond, Milwaukee, Powell, Stockham, or equal, full line size.

Butterfly valves may be used in lieu of gate or globe valves for locations above grade. Valves shall conform the paragraph "Butterfly Valves".

Ball valves conforming to the paragraph "Ball Valves" may be used in lieu of gate valves for locations above grade.

Valves 2-1/2 inches and smaller in nonferrous water piping systems may be solder joint type with bronze body and trim. Provide gate or globe valves on inlet and outlet of each water heater or pump whether shown or not.

Gate Valves:

2-1/2 inches and less: Union bonnet, bronze body, rising stem, solid wedge, Class150, Hammond - IB648, Nibco - T-134, Milwaukee - 1151, Stockham - B-124, or equal.

Furnish valves in copper lines with adapters to suit the valve / line requirements.

3 inches and larger: Class 125, iron body, bronze mounted, bolted bonnet, non-rising stem, solid wedge, Hammond - IR-1138, Nibco - F619, Milwaukee F2882, Stockham - G-612, or equal.

Ball Valves:

Ball valves: Provide Class 150, full port, two piece, threaded type for pipe sizes 2 inch and smaller, flanged for larger valves, and Reinforced PTFE seal, 15 percent glass filled seal, Nibco T585-70, Milwaukee BA-400, Stockham S214BR, or equal.

Provide 3 piece bronze, threaded ball valve for compressed air services. Nibco Model T-595-Y, Milwaukee BA-300, or equal.

Ball Valves may be used in lieu of Gate Valves and Globe Valves for service 2-1/2 inches and less.

Underground Valves: Non-rising stem, bolted bonnet, solid wedge disk or resilient seat valves, certified AWWA C509, equipped with operating nuts, Mueller Series 2360, Nibco, or equal.

Underground valves 3 inches and smaller may be furnished with operating nuts or hand-wheels, and with Ring-Tite joint ends.

Furnish and deliver to Owner one wrench of each size required for operating underground valves.

Swing Check Valves: Bronze Valves: 125 or 150 psi, suitable for regrinding, Stockham B-345, Milwaukee 509, 510, Nibco T-433-B, or equal.

Butterfly Valves:

General: Tight closing, full lug type, with resilient seat suitable for minimum working pressure of 200 psig, bi-direction dead end service with down stream flange removed..

Seats suitable for 40 degree F for cold water service and 250 degrees F for hot water service. Seats shall cover inside surface of body and extend over body ends

Bodies: malleable iron or cast iron.

Discs: Bronze or stainless steel.

Stems or Shafts: Stainless steel. Install valves with stems horizontal.

Control Handles: Suitable for locking in any position or with 10 degree or 15 degree notched throttling plates to hold valve in selected position. Provide extended necks to compensate for insulation thickness. Provide gear operator for valves 5 inches and larger.

Manufacturer: Subject to compliance with requirements, provide butterfly valves of one of the following, or equal:

Demco Series "E" -3

Milwaukee CL Series

Nibco LD 2000

Stockham LG-512

Silent Check Valves (for use on pump discharge):

General, Provide Grinnell, Muessco, Bell and Gossett, Nibco/Scott, or equal, spring loaded check valves at pump discharge of all pumps.

2-1/2 inches and smaller: Nibco Model T-480, Grinnell 3615, Muessco #203BP, Milwaukee 548-T, or equal.

3 inches and larger: Nibco Model F910, Grinnell 503-580, Muessco #105AP Milwaukee Series 1400, or equal.

Calibrated Balance Valves (Symbol CBV): Provide globe style valves foil precision regulation and control rated 175 psi for sizes 2 ½ through 12" and rated 240psi for bronze sizes 2" and below. Each valve shall have two metering/test ports with internal check valves and protective caps. All valves must be equipped with visual position readout and concealed memory stops for repeatable regulation and control.

Bell & Gossett Circuit Setter Plus

Armstrong CBV

Flow Design Inc. Accusetter

Tour & Andersson

Circuit Sensor with butterfly valve above 3 inches.

Illinois Series 5000 through 2 inches.

Flow Control Valve: Automatic pressure compensating flow control valves shall be Griswold, Flow Design, Inc., or equal.

Gas Valve or Shut-off Valve above grade:

Provide Milwaukee BB2-100, Nibco Model GB-1, or equal, CSA listed, with tee handle for 2 inches and smaller.

Provide ReSun Model D-126, Key Port, or equal, CSA listed, rectangular port, full pipe area, 125 psi SWP, flanged ends. Provide T-Handle socket wrench and adapter fittings as required for operation of valves. Provide one package of spare lubricant sticks, sizes as required for valve sizes.

Provide valves same size as upstream piping. Make any reduction in size of gas piping down stream of shutoff valves.

For gas service below grade:

Lubricated plug cocks: ReSun Model D-126, Key Port, or equal, CSA listed, rectangular port, full pipe area, 125 psi SWP, flanged ends. Provide extended lubrication stem, arranged to allow for lubrication of the valve from grade. The extension must be constructed to allow for lubrication of the valve and for operation of the valve from grade. Provide T-Handle socket wrench and adapter fittings as required for operation of valves. Provide one package of spare lubricant sticks, sizes as required for valve sizes.

Provide flanged ends on valves installed below grade. Connect to polyethylene piping with flanges and stainless steel bolts.

Anchor each valve flange to valve box with welded angle iron, or provide vertical stiff leg, minimum 18 inches into earth.

Provide Central Double O Seal Transition Fittings, or equal, flanged style for connection between valve and piping system.

Wrap valve, flanges and exposed pipe with Pabco, or equal tape wrap, installed in accordance with requirements listed under "Pipe Protection".

Molded polyethylene body ball valve: Nordstrom Valves - Polyvalve II for sizes up to 2 inches, and Polyvalve for sizes 2 inches and larger, or equal.

Provide stub ends to match SDR of the piping, arranged for butt fusion welding. Provide valve body material to suit the adjacent piping system.

Provide wrench to suit the valve operator.

Seismic Gas Shut-Off Valve: Pacific Seismic Products, Inc., California model, or equal, high pressure style.

Air Vent Valves:

Provide Armstrong #1AV, Hoffman Model 78, Metraflex Model MV-15A, or equal, where automatic type air vent is shown. Install with shutoff valves or cocks and drain to a floor sink or drain.

At each high point of piping provide manual air vent connection at top of pipe. Provide ball valve within 18 inches of ceiling in accessible location, and extend drain line to allow convenient access.

JOINING MATERIALS

Refer to Division 15400 & 15800 piping sections for special joining materials not listed below.

Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated

Full-Face Type: For flat-face, Class 125, cast iron and cast bronze flanges.

Narrow-Face Type: For raised-face, Class 250, cast iron and steel flanges.

AWWA C111, rubber, flat face, 1/8-inch (3.2mm) thick, unless otherwise indicated; and full-face or ring type, unless other indicated.

Flange Bolts and Nuts: AWWA C111, carbon steel, unless otherwise indicated.

Plastic, Pipe-Flange Gasket, Bolts and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

Solder Filler Metals: ASTM B 32, lead free alloys. Include water-flushable flux according to ASTM B813.

Brazing Filler Metals: AWS A5.8, BCup-3 Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg-1, silver alloy for refrigerant piping, unless otherwise indicated.

Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

Solvent Cements for Joining Plastic Piping:

ABS Piping: ASTM D2235.

CPVC Piping: ASTM F493.

PVC Piping: ASTM D2564. Include primer according to ASTM F 656.

PVC to ABS Piping Transition: ASTM D3138.

STRAINERS

Charles M. Bailey #100A, Armstrong, Muessco, or equal, Fig. 11 "Y" pattern, 125 psi WP minimum, with monel screens with 20 square mesh for 2 inches and smaller and 3/64 inch perforations for 2-1/2 inches and larger. Install all strainers with a blow-off hose valve with hose adapter. Strainer shall have gasketed cover with straight thread.

GAUGES

Marsh "Series J U.S. Gage, Danton 800, or equal, with bronze bushed movement and front recalibration. Dials shall be white with black numerals, 3-1/2 inch dial face. Normal reading shall be at mid-scale. Provide a needle valve on each gauge connection. Supply a gauge piped with branch isolation valves across the inlet and outlet of each pump and where shown on the Drawings.

Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core {and gasketed cap}, on inlet and outlet of each coil, boiler, condenser, chiller and heat exchanger and where shown on Drawings.

THERMOMETERS

Marsh, Taylor, Palmer, or equal, 5 inch diameter bimetal dial, adjustable from face, with adjustable positioner, located to be easily read from normal personnel approach. Normal reading shall be at mid-scale.

Provide extension for insulation.

Provide thermometers with steel bulb chambers and brass separable sockets.

Thermometers for air temperature shall have 8 inch minimum stem.

Provide Ventlock, Durodyne, or equal thermometer test holes at each air conditioning unit, furnace, and make-up air unit, in mixed air and supply air, and at all locations shown or scheduled on the Drawings. Provide two portable thermometers, with sensing connection arranged to suit test connections.

Provide Pete's Plug II, Sisco P/T, or equal, test plug with Nordel core, on inlet and outlet of each coil, boiler, condenser, chiller and heat exchanger and provide two digital electronic test thermometers for each range of fluid temperature and where shown on Drawings.

ACCESS DOORS

Where floors, walls, or ceilings must be penetrated for access to mechanical equipment, provide access doors, 14 inch by 14 inch minimum size in usable opening. Where entrance of a serviceman may be required, provide 20 inch by 30 inch minimum usable opening. Locate access doors/panels for non-obstructed and easy reach.

All access doors less than 7'-0" above floors and exposed to public access shall have keyed locks.

Access doors shall match those supplied in Division 8 in all respects, except as noted herein.

Where panels are located on ducts or plenums, provide neoprene gaskets to prevent air leakage, and use frames to set door out to flush with insulation.

Provide insulated doors where located in internally insulated ducts or casings.

Do not locate access doors in highly visible public areas such as lobbies, waiting areas, and primary entrance areas. Coordinate with the Architect when access is required in these areas.

Where specific information or details relating to access panels different from the above is shown or given on the Drawings or other Divisions of work, then that information shall supersede this specification.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering access doors which may be incorporated in the work include Milcor, Karp, Nystrom, or Cesco, equal to the following:

Milcor

Style K (plaster)

Style DW (gypsum board)

Style M (Masonry)

Style "Fire Rated" where required

EXPANSION LOOPS

Piping in building expansion joints: Provide Metraflex "Metraloop", Unisource Mfg. Co. "V" connector, or equal, CSA listed for 4 inches of movement, in lines where piping crosses building expansion joints or seismic joints, between buildings, between buildings and canopies, and as indicated.

FLEXIBLE CONNECTIONS

Where indicated on Drawings, provide Metraflex Metrasphere, Style R, Mason Industries, or equal, Spherical Expansion Joints. Provide control units at each expansion joint, arranged to limit both expansion and compression.

Flexible joints at entry points to building shall be Barco Ductile iron, Advanced Thermal Systems, or equal, threaded style with stainless ball and mineral filled seal.

PIPE GUIDES

Where flexible connections are indicated on Drawings, provide Metraflex style IV, B-Line, or equal, pipe guides in locations recommended by manufacturer. Maximum spacing from flexible connection to first pipe guide is 4 pipe diameters, and maximum spacing from second pipe guide is 14 pipe diameters.

EQUIPMENT IDENTIFICATION

Identify each piece of equipment with a permanently attached engraved bakelite plate, 1/2 inch high white letters on black background.

Text of Signs: Provide identification of equipment unit number, and room or area served. Coordinate name of area served with final room names and numbers for the facility. In addition, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

PIPE IDENTIFICATION

Identify each piping system and indicate the direction of flow by means of Idento Bands (Idento Metal Products Co.), Seton, Inc., Marking Services Inc., Reef Industries, Inc., or equal, pipe markers. Apply the markings after all painting and cleaning of the piping and insulation is completed.

The legends and flow arrows shall conform to ASME A13.1.

The sizes of the lettering and flow arrows shall be as follows:

| Outside Diameter of Pipe or Covering (inclusive) | Minimum Length | |
|---|---|---|
| | Size of Letter | of Flow Arrow |
| 5/8" to 2" | 1/2" | 2-1/2" |
| 2-1/2" and Larger | 1" | 4" |

INSULATION WORK

General:

The term "piping" used herein includes pipe, air separators, valves, strainers and fittings.

Apply insulating cement to fittings, valves and strainers and trowel smooth to the thickness of adjacent covering. Cover with jacket to match piping. Extend covering on valves up to the bonnet. Leave strainer cleanout plugs accessible.

Provide pre-formed PVC valve and fitting covers.

Provide Calcium Silicate rigid insulation and sheet metal sleeve, 18 inch minimum length at each pipe hanger. Seal ends of insulation to make vapor tight with jacket.

Test insulation, jackets, lap-seal adhesives and pre-insulated flexible ductwork as a composite product and confirm flame spread of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with UL723, ASTM E84, or NFPA 255.

Clean thoroughly, test and have approved, all piping and equipment before installing insulation and/or covering.

Repair all damage to existing pipe and duct insulation whether or not caused during the work of this contract, to match existing adjacent insulation for thickness and finish, but conforming to flame spread and smoke ratings specified above.

Insulation of Piping:

Insulate domestic hot and tempered water with 1 inch thick 3-1/2# minimum density fiberglass with ASJ-SSL jacket for sizes up to and including 2 inches. For larger sizes, provide 1-1/2 inch thick 3-1/2# minimum density fiberglass insulation and ASJ-SSL jacket.

Insulate domestic hot water piping under slab on grade and cold water piping exposed to the weather with 3/4" thick Therma-Cel, Armaflex, or equal; seal water tight per manufacturer's directions.

Insulate horizontal, overhead rainwater leaders and condensate drains within the building envelope with 1 inch thick, 3-1/2# density fiberglass, with ASJ-SSL jacket.

Insulate domestic cold water piping outside of insulation envelope in outside walls, vented attic spaces, and unheated spaces, including equipment rooms and below raised floor with 1 inch thick molded fiberglass, minimum density 3-1/2# per cubic foot, with ASJ-SSL jacket.

Exposed insulated piping within the building shall have a Zeston 2000 25/50, Proto Lo-Smoke, or equal, jacket and fitting cover installed over the insulation, applied per manufacturer's instructions. Verify suitability with manufacturer of insulation. Insulation with pre-applied polymer jacket may be substituted at Contractor's option.

Insulate condensate drain piping in freezer with 3/4 inch thick Therma-Cel, Armaflex, or equal. Seal water tight per manufacturer's directions. Install heat tape prior to insulation of piping, in accordance with manufacturer's directions.

Insulate all refrigerant suction piping and chilled water supply and return piping, including fittings, with 1 inch thick, 3-1/2 pound per cubic foot minimum density fiberglass with factory-applied ASJ-SSL jacket, or equal, 1-1/2 inches thick for chilled water pipes 6

inches and over and refrigerant piping 1-1/4 inches and larger. Insulate valves and irregular surfaces to match adjacent insulation and cover with two layers of Glasfab saturated in Foster's 30-36, 3M, or equal, carried 3 inches over the adjoining pipe insulation. Finish with a coat of Foster's 30-36, 3M, or equal. The 3 inch wide SSL end laps furnished with the insulation shall be adhered over the end joints. Seal entire surface of insulation vapor tight, including joints and ends of plastic fitting covers.

In lieu of the above, refrigerant suction piping, including fittings, may be insulated with nominal 3/4 inch thick Armacell LLC; AP Armaflex, or equal. Seal all joints with Armaflex 520 adhesive, or equal. Insulation exposed to the weather shall be finished with two coats of Armaflex white WB finish, or equal. Apply insulation in strict accordance with manufacturer's recommendations.

When equipment manufacturers' instructions indicate that refrigerant liquid piping be insulated, insulation thickness shall be as recommended by the manufacturer, and applied as described herein for refrigerant suction piping.

Urethane insulation will not be allowed above ground or on hot water piping.

On all insulated piping exposed to the weather apply .016 aluminum jacket (.014 for 12" and larger pipes) secured with 1/2 inch aluminum bands on 12 inch centers. Insulation shall be vapor tight before installing metal jacket. Cover fittings with glass cloth and two coats of Foster's 30-36, Zeston, or equal, plastic fitting covers. Insulation shall be vapor tight before applying metal jacket or plastic covers.

Insulate all heating hot water piping with 1-1/2 inch thick, 3-1/2# per cubic foot minimum density fiberglass with factory applied ASJ-SSL jacket.

Duct Insulation:

All duct insulation shall meet minimum R-value of R-8 at 3 inch thickness, 3/4 pound per cubic foot density for ductwork installed outside the building insulation envelope. For ductwork installed within the building insulation envelope, duct insulation shall have a minimum R-value of R-4.2 at 2 inch thickness, 3/4 pound per cubic foot density.

General: Insulation applied to the exterior surface of ducts located in buildings shall have a flame spread of not more than 25 and a smoke-developed rating of not more than 50 when tested as a composite installation including insulation, facing materials, tapes and adhesives as normally applied. Material exposed within ducts or plenum shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50.

Wrap all unlined concealed supply and return ducts with fiberglass duct wrap, manufactured as a blanket of glass fibers factory laminated to a reinforced foil/kraft vapor retarding facing. Provide 2 inch stapling and taping flange. Wrap insulation entirely around duct and secure with outward clinching staples on 6 inch centers. Provide mechanical fasteners at maximum 18 inch centers for all bottoms of duct which are greater than 24 inches. Lap all insulation joints 3 inches minimum. Insulate ducts installed tight against other work before hanging in place. Seal all seams, both longitudinal and transverse, and all staple and mechanical fastener penetrations of facing with scrim backed foil tape or recommended sealant, to provide a vapor tight installation.

On all ductwork exposed to weather field apply minimum 2 inches thick mineral-fiber board thermal insulation, glass fibers bonded with thermosetting resin. Comply with ASTM

C612, type IB without facing and with all service jacket with factory applied FRK-25 foil reinforced kraft paper. Aluminum jacket, 0.024 inch thickness sheets manufactured from aluminum alloy complying with ASTM B209, stucco embossed finish and having an integrally bonded moisture barrier over entire surface in contract with insulation.

Provide internal duct lining in accordance with specification section 15800.

**EXECUTION**

MECHANICAL DEMOLITION

Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

Disconnect, dismantle and remove mechanical systems, equipment, and components indicated to be removed. Coordinate with all other trades.

Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

Piping to Be Abandoned in Place: Drain piping and cap or plug piping to remain with same or compatible piping material. Refrigerant system must be evacuated per EPA requirements.

Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap remaining ducts with same or compatible ductwork material.

Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

Equipment to Be Removed: Drain down and cap remaining services and remove equipment.

Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

ELECTRICAL REQUIREMENTS

Provide adequate working space around electrical equipment in compliance with the California Electrical Code. Coordinate the Mechanical Work with the Electrical Work to comply.

Furnish necessary control diagrams and instructions for the controls. Before permitting operation of any equipment which is furnished, installed, or modified under this Section, review all associated electrical work, including overload protection devices, and assume complete responsibility for the correctness of the electrical connections and protective devices. Motors and control equipment shall conform to the Standards of the National Electrical Manufacturers' Association. All equipment and connections exposed to the weather shall be NEMA IIIR with

factory-wired strip heaters in each starter enclosure and temperature control panel where required to inhibit condensation.

All line voltage and low voltage wiring and conduit associated with the Temperature Control System are included in this Section. Wiring and conduit shall comply with Division 16.

Electric Motors:

All motors shall be rated for continuous operation at 115% of nameplate amperage but shall be selected to operate at less than nameplate amperage throughout the entire operating cycle. Motors found exceeding the nameplate amperage shall be promptly replaced at no cost to the Owner. Horsepower shown is minimum and shall be increased as necessary to comply with above requirements. Furnish motors with splash-proof or weatherproof housings, where required or recommended by the manufacturer. Match the nameplate voltage rating with the electrical service supplied. Check Electrical Drawings. Provide a transformer for each motor not wound specifically for system voltage.

Motor Starters:

Provide magnetic motor starters for all equipment provided under the Mechanical Work. Starters shall be non-combination type. Provide part-winding or reduced voltage start motors on all motors 50 – HP and larger, or where shown or as hereinafter specified. Minimum size starter shall be Size 1. All three-phase starters shall have the following:

Cover-mounted hand-off-automatic switch. Starters installed exposed in occupied spaces shall have key operated HOA switch.

Three ambient compensated thermal overload.

Fused control transformer (for 120 or 24 volt service).

Pilot lights, integral with the starters. Starters located outdoors shall be in NEMA IIIR enclosures.

Starters for single-phase motors shall have thermal overloads, Westinghouse Type MSTOLSLIP, Square D, or equal, toggle-operated with pilot light, NEMA I enclosure for starters located indoors, NEMA IIIR enclosure for starters located outdoors.

Provide OSHA label indicating the device starts automatically.

PIPING SYSTEM REQUIREMENTS

Drawing plans, schematic and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

PRIMING AND PAINTING

Perform all priming and painting on the equipment and materials as specified herein.

Priming:

Exposed ferrous metals, including piping, which are not galvanized or factory-finished shall be primed. Black steel pipe exposed to the weather shall be painted one coat of Rust-Oleum #1069 primer for black steel piping or Rust-Oleum #5260, Kelly Moore, or equal, primer for galvanized piping.

Metal surfaces of items to be jacketed or insulated except ductwork and piping shall be given two coats of primer unless furnished with equivalent factory finish. Items to be primed shall be properly cleaned by effective means free of rust, dirt, scale, grease and other deleterious matter and then primed with the best available grade of zinc rich primer. After erection or installation, all primed surfaces shall be properly cleaned of any foreign or deleterious matter that might impair proper bonding of subsequent paint coatings. Any abrasion or other damage to the shop or field prime coat shall be properly repaired and touched up with the same material used for the original priming.

Where equipment is provided with nameplate data, the nameplate should be masked off prior to painting. When painting is completed, remove masking material.

See Painting Section for detailed requirements.

EXCAVATING

Perform all excavating required for work of this Section. Provide the services of a pipe/cable locating service prior to excavating activities to determine location of existing utilities.

Unless shown otherwise, provide a minimum of 2'-6" cover above top of pipe to finished grade for all service piping, unless otherwise noted. Provide 3 foot minimum cover for fire mains. Trim trench bottom by hand or provide a 4 inch deep minimum bed of sand to provide a uniform grade and firm support throughout entire length of pipe. For all PVC pipe and for PE gas pipe, bed the pipe in 4 inch sand bed. Pipe bedding materials should be clean crushed rock, gravel or sand of which 100 percent will pass a 1 inch sieve. For pipes that are larger than 10 inches in diameter, at least 95 percent should pass a 3/4 inch sieve, and for pipes 10 inches in diameter or smaller, 100 percent should pass a 1/2 inch sieve. All other materials should have a minimum sand equivalent of 50. Only a small proportion of the native soils will meet these requirements without extensive processing; therefore, importation of pipe bedding materials should be anticipated. Pipe bedding materials shall be compacted in lifts not exceeding 6 inches in compacted thickness. Each lift shall be compacted to not less than 90 percent relative compaction at or above the optimum moisture content, in accordance with ASTM Specification D2940, except that bedding materials graded such that less than 100 percent will pass a No. 200 sieve shall be compacted in 6 inch lifts using a single pass of a flat-plate, vibratory compactor or vibratory drum. Pipe bedding materials should extend at least to the spring line.

Maintain all warning signs, barricades, flares, and red lanterns as required.

For all trenches 5 feet or more in depth, submit copy of permit detailed drawings showing shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trenches. Obtain a permit from the Division of Industrial Safety prior to beginning excavations. A copy of the permit shall be available at the site at all times.

BACKFILLING

Backfill shall comply with applicable provisions of DIVISION 2 of these Specifications.

Except under existing or proposed paved areas, walks, roads, or similar surfaces, backfill for other types of pipe shall be made using suitable excavated material or other approved material. Place backfill in 8 inch layers, measured before compaction, and compact with impact hammer to at least 90 percent relative compaction per ASTM D2940.

Backfill plastic pipe and insulated pipe with sand for a minimum distance of 12 inches above the top of the pipe. Compact using mechanical tamping equipment.

Entire backfill for excavations under existing or proposed pavements, walks, roads, or similar surfaces, under new slabs on grade, shall be made with clean sand compacted with mechanical tamping equipment vibrator to at least 90 percent relative compaction per ASTM D2940. Remove excess earth. Increase the minimum compaction within the uppermost two feet of backfill to 95 percent.

Replace or repair to its original condition all sod, concrete, asphalt paving, or other materials disturbed by the trenching operation. Repair within the guarantee period as required.

Thrust Blocks:

Provide concrete anchors or thrust blocks on all PVC and cast iron water lines in the ground. Install thrust blocks at all changes in direction and at all connections to the mains 1-1/2 inches and larger. Form thrust blocks by pouring concrete between the pipes and trench wall. They shall be adequate in size and placed to take all thrusts created by the maximum internal water pressure; sizing and placement shall be per manufacturer's recommendations and 2007 CPC (California Plumbing Code) and IAPMO installation standards.

Anchor piping to building construction.

Provide fire protection piping thrust blocks in accordance with the requirements of NFPA 24.

INSTALLATION OF PIPING AND DUCT SYSTEMS

At time of final connection, and prior to opening valve to allow pressurization of water and gas piping from existing systems, on site or off site, perform a pressure test to indicate static pressure of existing systems. If pressure on water piping is greater than 80 psi, or gas pressure is not as indicated on Contract Documents, inform Architect immediately. Do not allow piping systems to be pressurized without written consent of the Architect.

General:

All piping shall be concealed unless shown or otherwise directed. Allow sufficient space for ceiling panel removal.

Installation of piping shall be made with appropriate fittings. Bending of piping will not be accepted.

Install piping to permit application of insulation and to allow valve servicing.

Where piping or conduit is left exposed within a room, the same shall be run true to plumb, horizontal, or intended planes. Where possible, uniform margins are to be maintained between parallel lines and/or adjacent wall, floor, or ceiling surfaces.

Horizontal runs of pipes and/or electrical conduit suspended from ceilings shall provide for a maximum headroom clearance. The clearance shall not be less than 6'-6" without written approval from the Architect.

Minor changes in locations of equipment, piping, ducts, etc., from locations shown shall be made when directed by the Architect at no additional cost to the Owner providing such change is ordered before such items of work, or work directly connected to same are installed and providing no additional material is required.

Close ends of pipe immediately after installation. Leave closure in place until removal is necessary for completion of installation.

Each piping system shall be thoroughly flushed and proved clean before connection to equipment.

Pipe the discharge of each relief valve, air vent, backflow preventer, and similar device to floor sink or drain.

Install exposed polished or enameled connections with special care showing no tool marks or threads at fittings.

Install horizontal valves with valve stem above horizontal.

Use reducing fittings; bushings shall not be allowed. Use eccentric reducing fittings wherever necessary to provide free drainage of lines and passage of air.

Verify final equipment locations for roughing-in.

Service Markers: Mark the location of each plugged or capped pipe with a 4 inch round by 30 inch long concrete marker, set flush with finish grade. Provide 2-1/2 inch diameter engraved brass plate as part of monument marker.

Furnish and install anchors or thrust blocks on PVC water lines in the ground at all changes in direction of piping, and at all connections or branches from mains 1-1/2 inch and larger. Form anchors or thrust blocks by pouring concrete between pipe and trench wall. Thrust blocks shall be adequate size and so placed as to take thrusts created by maximum internal water pressure, all in accord with manufacturer's recommendations.

Sanitary Sewer and Storm Drain: Grade piping inside building uniformly 1/4 inch per foot if possible but not less than 1/8 inch per foot. Run piping as straight as possible. Make piping connections between building piping and outside service pipe with cast iron reducers or increasers. Slope sewers uniformly between given elevations where invert elevations are shown.

Provide Metraflex "Metraloop", Unisource Mfg. Co. "V" connector, or equal, CSA listed for 4 inches of movement, expansion loops in all piping passing through building expansion joints, anchor as recommended by manufacturer.

Where piping is installed in walls within one inch of the face of stud, provide a 16 gauge sheet metal shield plate on the face of the stud. The shield plate shall extend a minimum of 1-1/2 inches beyond the outside diameter of the pipe.

Sleeves:

Install AMI Products, Adjus-to-Crete, Pipeline Seal and Insulator, or equal, pipe sleeves of sufficient size to allow for free motion of pipe, 24 gauge galvanized steel. The space between pipe and sleeves through floor slabs on ground, through outside walls above or below grade, through roof, and other locations as directed shall be caulked with oakum and mastic and made watertight. The space between pipe and sleeve and between sleeve and slab or wall shall be sealed watertight.

At Contractor's option, Link-Seal, Metraflex Metraseal, or equal, casing seals may be used in lieu of caulking. Wrap pipes through slabs on grade with 1 inch thick fiberglass insulation to completely isolate the pipe from the concrete.

Floor, Wall, and Ceiling Plates:

Fit all pipes with or without insulation passing through walls, floors, or ceilings, and all hanger rods penetrating finished ceilings with chrome-plated or stainless escutcheon plates.

Firestopping:

Pack the annular space between the pipe sleeves and the pipe and between duct openings and ducts through all floors and walls with UL listed fire stop, and sealed at the ends. All pipe penetrations shall be UL listed, Hilti, 3M Pro-Set, or equal.

Install fire caulking behind mechanical services installed within fire rated walls, to maintain continuous rating of wall construction.

Provide SpecSeal Systems UL fire rated sleeve/coupling penetrators for each pipe penetration or fixture opening passing through floors, walls, partitions or floor/ceiling assemblies. All Penetrators shall comply with UL Fire Resistance Directory (Latest Edition), and in accordance with Chapter 7,CBC requirements.

Sleeve penetrators shall have a built in anchor ring for waterproofing and anchoring into concrete pours or use the special fit cored hole penetrator for cored holes.

Copper and steel piping shall have SpecSeal plugs on both sides of the penetrator to reduce noise and to provide waterproofing.

All above Systems to be installed in strict accordance with manufacturer's instructions.

Alternate firestopping systems are acceptable if approved equal. However, any deviation from the above specification requires the Contractor to be responsible for determining the suitability of the proposed products and their intended use, and the Contractor shall assume all risks and liabilities whatsoever in connection therewith.

Flashing:

Flashing for penetrations of metal or membrane roof for mechanical items such as flues, ducts, and pipes shall be coordinated with the roofing manufacturer and roofing installer for the specific roofing type. The work of this section shall include furnishing, layout, sizing, and coordination of penetrations required for the mechanical work.

Furnish and install flashing and counterflashing in strict conformance with the requirements of the roofing manufacturer. Submit shop drawing details for review prior to installation.

Furnish and install counterflashing above each flashing required. Provide Stoneman, or equal, vandalproof top and flashing combination. Provide vandalproof top for each plumbing vent through roof. Elmdor/Stoneman Model 1540, 1550 or 1570.

Flues and ducts shall have 24 gauge galvanized sheet metal storm collar securely clamped to the flue above the flashing.

For all other types of roofing system, furnish and install around each pipe, where it passes through roof, a flashing and counterflashing. All flashing shall be made of four pound seamless sheet lead with 6 inch minimum skirt and steel reinforced boot. Counterflashing shall be cast iron. For vents, provide vandalproof top and flashing combination. Elmdor/Stoneman Model 1100-4, 1100-5 or 1100-7.

Where indicated on Drawings, provide Stoneman, or equal Stormtite Multi-Flash assemblies, sized for gas, condensate, electrical and control conduit. Elmdor/Stoneman Model 915.

Hangers and Supports:

General: Support all ductwork, equipment and piping so that it is firmly held in place by approved iron hangers and supports and special hangers as required. All components shall support weight of ductwork, equipment and pipe, fluid, and pipe insulation based on spacing between supports with minimum factor of safety of five based on ultimate strength of material used. Do not exceed manufacturer's load rating. Pipe attachments or hangers, of same size as pipe or tubing on which used, or nearest available. Rigidly fasten hose faucets, fixture stops, compressed air outlets, and similar items to the building construction. The Architect shall approve all hanger material before installation. Do not support piping or ductwork with plumbers' tape, wire rope, wood, or other makeshift devices. Where building structural members do not match piping and ductwork support spacing, provide all "bridging" support members as required firmly attached to building structural members in a fashion approved by the Structural Engineer.

Materials, design, and type numbers per Manufacturers' Standardization Society (MSS), Standard Practice (SP)-58.

All hanger components shall be provided by one manufacturer B-Line, Grinnell, Uni-Strut, Badger, or equal.

Vertical Piping: B-line #B3373 clamps attached to the pipe above each floor to rest on the floor. Provide with lead or Teflon liners on copper tubing. Provide additional support at base of cast iron risers and support at unsupported riser joints and horizontal offsets per 2007 Mason Industries Seismic Restraint Guidelines. Provide intermediate support for vertical piping, spaced at or within the following maximum limits:

| Pipe Diameter | Steel Fluid | Steel Vapor | Copper Fluid | Copper Vapor | CPVC & PVC |
|---|---|---|---|---|---|
| 1/2 - 1" | 12 | 6 | 12 | 6 | Base and Each Floor (Note 1) |
| 1-1/4 - 2" | 12 | Base and Each | 12 | 6 | Base and Each Floor |

| | | | | | |
|---|---|---|---|---|---|
| | | Floor | | | (Note 1) |
| 2-1/2 - 3" | 12 | Base and Each Floor | 12 | 10 | Base and Each Floor (Note 1) |
| Over 4" | 12 | Base and Each Floor | 12 | 10 | Base and Each Floor (Note 1) |

Note 1: Provide mid-story guides per IAPMO installation standard.

Individually Suspended Piping: B-Line B3690 J-Hanger or B3100 Clevis, complete with threaded rod, or equal. All hangers on supply and return piping handling heating hot water or steam shall have a swing connector at point of support.

| Pipe Size | Rod Size |
|---|---|
| 2" and Smaller | 3/8" |
| 2-1/2" to 3-1/2" | 1/2" |
| 4" to 5" | 5/8" |
| 6" | 3/4" |

Provide 3/8 inch rod for support of PVC and CPVC and provide continuous support.

Trapeze Suspension: B-Line 1-5/8 inch width channel in accordance with manufacturer's published load ratings. No deflection to exceed 1/180 of a span.

Trapeze Supporting Rods: Shall have a safety factor of five; securely anchor to building structure.

Pipe Clamps and Straps: B-Line B2000, B2400; isolate copper pipe with two thicknesses of 2 inches wide 10-mil polyvinyl tape. Where used for seismic support systems, provide B-Line B2400 series pipe straps.

Concrete Inserts: B-line B221 continuous insert or B2500 spot insert. Do not use actuated fasteners for support of overhead piping unless approved by Architect.

Above Roof: H frame made from Uni-Strut hot-dipped galvanized 1-5/8 inch single or double channel with P-2072A or P-2073A foot secured to roof and surrounded with waterproof roofed in sleeper. Secure to sleeper with lag screws, and secure sleeper to blocking under roof.

Steel Connectors: Beam clamps with retainers.

Support to Structure:

Wood Structure: Provide and install wood blocking as required to suit structure. Provide lag screws or through bolts with length to suit requirements, and with size (diameter) to match the size of hanger rods required.

Do not install Lag screws in tension without written review and acceptance by Structural Engineer.

| | | |
|---|---|---|
| Side Beam Angle Clip | B-Line B3062 | MSS Type 34 |
| Side Beam Angle Clip | B-Line B3060 | |
| Ceiling Flange | B-Line B3199 | |

Blocking for support of piping shall be not less than 2 inch thick for piping up to 2 inch size (water filled) or 3 inch size (vapor filled). Provide 3 inch blocking for piping up through 5 inch size, and 4 inch blocking for larger piping. Provide support for blocking in accordance with Structural Engineers requirements.

Where lag screws are used, length of screw shall be 1/2 inch less than the wood blocking. Pre-drill starter holes for each lag screw.

Steel Structure: Provide and install additional steel bracing as required to suit structure. Provide through bolts with length to suit requirements of the structural components. Burning or welding on any structural member may only be done if approved by the Architect.

Rubber Neoprene Pipe Isolators:

Pipe isolators shall comprise an internal rubber or neoprene material that isolates pipe from hanger and structure. Install at all piping located in acoustical walls. Refer to Architectural Drawings for location of acoustical walls.

Isolation material shall be either a rubber or neoprene material that prevents contact between the pipe and the structure. The rubber shall have between a 45 to 55 durometer rating and a minimum thickness of 1/2 inch.

Acceptable Suppliers:

Vertical runs: Acousto-Plumb or equal.

Horizontal runs: B-Line, Vibraclamp; Acousto-Plumb or equal.

Pipe hanger and support spacing: Locate hangers and supports at each change of direction, within one foot of elbow, and spaced at or within the following maximum limits. Note that spacing listed are recommended maximums; increased spacing requirements due to California Building Code requirements, CCR Title 24, or other regulations in force and applicable for this contract shall be adhered to.

| Pipe Diameter | Steel Fluid | Steel Vapor | Copper Fluid | Copper Vapor | CPVC & PVC |
|---|---|---|---|---|---|
| 1/2 - 1" | 6 | 6 | 5 | 6 | 3 |
| 1-1/4 - 2" | 7 | 10 | 6 | 6 | 4 |
| 2-1/2 - 3" | 10 | 10 | 10 | 10 | 4 |

| | | | | | |
|---|---|---|---|---|---|
| Over 4" | 10 | 10 | 10 | 10 | 4 |

For cast iron soil piping:

Support piping at every other joint for piping length of less than 4 feet.

For piping longer than 4 feet, provide support on each side of the coupling, within 18 inches of each joint.

Hanger shall not be installed on the coupling.

Provide support at each horizontal branch connection.

Provide swaybrace at 40 foot maximum spacing for all suspended pipe with no-hub joints, except where a lesser spacing is indicated in the 2007 Mason Industries Seismic Restraint Guidelines. Provide a brace on each side of a change in direction of 90 degrees or more. Brace riser joints at each floor and at 15 foot maximum intervals.

Provide continuous V channel support for all horizontal plastic piping.

Provide support for piping through roof, arranged to anchor piping solidly in place at the roof penetration.

Provide rigid insulation and a 12 inch long, 18 gauge galvanized sheet iron shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering.

Insulate copper tubing from ferrous materials and hangers with two thicknesses of 3 inch wide, 10 mil polyvinyl tape wrapped around pipe.

Provide a support or hanger close to each change of direction of pipe either horizontal or vertical and as near as possible to concentrated loads.

Suspend rods from concrete inserts with removable nuts where suspended from concrete decks. Power actuated inserts will not be allowed.

On chilled or combination hot and chilled water or refrigerant pipes, install the hangers on the outside of the pipe covering and not in contact with the pipe. Provide rigid insulation and a 12 inch long, 18 gauge galvanized sheet iron shield between the covering and the hanger whenever hangers are installed on the outside of the pipe covering.

PIPE JOINTS AND CONNECTIONS

Cutting: Cut pipe and tubing square, remove rough edges or burrs. Bevel plain ends of steel pipe.

Threaded Pipe: Make joints with Rectorseal #5, Permatex #1, or equal, thread lubricant; use no caulking of any kind; remake leaky joints with new materials.

Copper and Brass Pipe and Tubing (Except Control Piping): Make all joints with silver brazing alloy, Sil-Fos, or equal, 1100° F melting point or greater, minimum 5 percent silver content, ASTM B-260, except that domestic water piping 1-1/4 inches and smaller not buried in the ground or concrete and Type DWV plumbing piping may be made up with 95-5 tin-antimony, ASTM B-32,

Grade 5A, solder. Use lead free solder for all applications. Boss or saddle type fittings or mechanically extracted tube joints will not be allowed.

Cast Iron Soil Pipe:

No-Hub fittings shall be made with a torque wrench.

Hub joints shall be with Ty-Seal couplings.

Wrought iron, steel, or copper pipe shall have a ring or part of a coupling screwed on to form a spigot end if caulked into a joint.

Connect cast iron sewer piping to outside service pipe with cast iron or vitrified clay reducers or increasers as required. Caulking of smaller pipe into the larger without a reducer or increaser will not be permitted.

Clay Sewer Pipe: Joints in bell and spigot clay sewer pipe shall comply with ASTM C-425, made with an approved type of interlocking, resilient mechanical compression joint, formed on the pipe at the factory. Lubricate inside of bells and outside of spigots with a solution as recommended by the pipe manufacturer.

Welded Pipe:

Make up with oxyacetylene or electric arc process.

All welding shall conform to the American Standard Code for Power Piping ASME B-31.1. When requested by the Architect, furnish certification from an approved testing agency or National Certified Pipe Welding Bureau that the welders performing the work are qualified.

All line welds shall be of the single "V" butt type. Welds for flanges shall be of the fillet type.

Where the branch is two pipe sizes smaller than the main or smaller, Bonney Weldolets, Threadolets, Nibco, or equal, may be used in lieu of welding tees.

Polyethylene Pipe: Assemble with fusion joints in strict accordance with manufacturer's instructions.

Make joints in PVC water pipe with PVC couplings and rubber rings, Manville Ring-Tite, PW Pipe, or equal. Check final location of rubber rings with the couplings with gauge or as recommended by the manufacturer. Make joints between PVC pipe and cast iron pipe or fittings using cast iron or PVC adapter fittings, installed as recommended by the manufacturer. Ring-Tite PVC or cast iron pipe fittings may be used in lieu of standard fittings. Make connection to valves with cast iron adapters connected to the water pipe with PVC couplings.

Flexible Connections:

Furnish and install Thermo Tech., Inc. F/J/R, Metraflex, or equal, flexible couplings with limiter bolts on piping connections to all equipment mounted on anti-vibration bases, except fan coil units under 2000 cfm, on each connection to each base mounted pump and where shown. Couplings shall be suitable for pressure and type of service.

Flexible connections in refrigerant lines; Flexonic, Anaconda or equal, metal hose, full size.

Anchor piping securely on the system side of each flexible connection.

Remove scale, slag, dirt and debris from inside and outside of pipe before assembly.

GAS SHUT-OFF VALVES

Provide line size ball valve in gas line to each appliance.

Provide line size ball valve in gas line, to be used as emergency shut-off for science classrooms. Install valve in locking box where indicated on the drawings.

Provide line size electric solenoid gas valve in gas line to kitchen equipment (if not supplied with appliance) under Type 1 hood. Interlock with hood fire alarm system.

UNIONS AND FLANGES

Install Epco, Nibco, or equal, dielectric unions or flanges at points of connection between copper or brass piping or material and steel or cast iron pipe or material except in drain, waste, vent, or rainwater piping. Bushings or couplings shall not be used.

Install unions in piping NPS 2" and smaller, and flanges in piping NPS 2-1/2" and larger whether shown or not at each connection to all equipment and tanks, and at all connections to all automatic valves, such as temperature control valves.

Locate the unions for easy removal of the equipment, tank, or valve.

Do not install unions or flanges in refrigerant piping systems.

ACCESS DOOR

Furnish and install access doors wherever required whether shown or not for easy maintenance of mechanical systems; for example, at concealed valves, strainers, traps, cleanouts, dampers, motors, controls, operating equipment, etc. Access doors shall provide for complete removal and replacement of equipment.

CONCRETE WORK

Concrete work required for work of this Section shall be included under another section of the Specification, unless otherwise noted, including poured-in-place concrete work for installing precast manholes, catch basins, etc., and shall include reinforced concrete bases for pumps, tanks, compressors, fan units, boilers, unless the work is specifically indicated on the Drawings to be furnished under this Section.

Thrust blocks, underground anchors, and pads for cleanouts, valve access boxes and washer boxes are included under this Section of the Specification. Concrete shall be 3000 psi test minimum. Refer to Division 3 for concrete types.

PIPE PROTECTION

Wrap bare galvanized and black steel pipe buried in the ground and to 6" above grade, including piping in conduit, with one of the following, or equal:

Polyethylene Coating: Pressure sensitive polyethylene coating, "X-Tru-Coat" as manufactured by Pipe Line Service Corporation or "Green Line" wrap as manufactured by Roystron Products, or equal.

Field Joints and Fittings: Protecto Wrap #1170 tape as manufactured by Pipe Line Service Corporation, or Primer #200 tape by Roystron Products, or equal. Installation shall be as per manufacturer's recommendation and instructions.

Tape Wrap: Pressure-sensitive polyvinyl chloride tape, "Transtex #V-l0 or V-20", "Scotchwrap 50", Slipknot l00, Pabco, or equal, with continuous identification. Tape shall be a minimum of 20 mils thick for fittings and irregular surfaces, two wraps, 50 percent overlap, 40 mils total thickness. Tape shall be laminated with a suitable adhesive; widths as recommended by the manufacturer for the pipe size. Wrap straight lengths of piping with an approved wrapping machine.

Sleeve copper piping/tubing installed below slab with "Polywrap-C" polyethylene sleeve, as manufactured by Northtown Pipe Protection Products, or equal. Sleeve shall be a minimum of 6 mils thick, colored blue for domestic water piping and orange for other piping. Install sleeve per manufacturer's recommendations and instructions.

Sleeve copper piping/tubing installed outside building below grade with "Polywrap-C" polyethylene sleeve, as manufactured by Northtown Pipe Protection Products, or equal. Sleeve shall be a minimum of 6 mils thick, colored blue for domestic water piping. Install sleeve per manufacturer's recommendations and instructions.

Field Joints: Valves and Fittings: double wrap polyvinyl chloride tape as above. Provide at least two thicknesses of tape over the joint and extend a minimum of 4 inches over adjacent pipe covering. Build up with primer to match adjacent covering thickness. Width of tape of fittings shall not exceed 3 inches. Tape shall adhere tightly to all surfaces of the fittings without air pockets.

Cleaning: Clean all piping thoroughly before wrapping.

Inspection: Damaged or defective wraps shall be repaired as directed. No wrapped pipe shall be covered until approved by Architect.

Covering: No rocks or sharp edges shall be backfilled against the wrap. When backfilling with other than sand, protect wrap with an outer wrapping of Kraft paper; leave in place during backfill.

Testing: Test completed wrap of piping, including all epoxy painted piping with Tinker and Rasor Co. test machine (San Gabriel, CA - 818-287-5259), Pipeline Inspection Company (Houston, TX - 713-681-5837), or equal.

PIPE IDENTIFICATION

Provide temporary identification of each copper pipe installed, at the time of installation. Temporary identification shall be removed and replaced with permanent identification as part of the work.

Apply the legend and flow arrow at all valve locations; at all points where the piping enters or leaves a wall, partition, cluster of piping or similar obstruction; and at approximately 50'-0" intervals on pipe runs. Variations or changes in locations and spacing may be made with the approval of the Architect. There shall be at least one marking in each room. Markings shall be located for maximum visibility from expected personnel approach.

Wherever two or more pipes run parallel, the markings shall be supplied in the same relative location on each.

Each valve on non-potable water piping shall be labeled with a metal tag stamped "DANGER -- NON-POTABLE WATER" in 1/4 inch high letters.

Identify each piping system in science classroom areas, and indicate the direction of flow by means of pipe markers, Idento Metal Products Co., SETMARK, or equal, pipe markers at 10 foot maximum centers. Apply the markings after all painting and cleaning of the piping and insulation is completed.

SPECIAL SEISMIC REQUIREMENTS

Supports, anchorage and restraints for all piping, ductwork and equipment shall be an OSHPD pre-approved system such as ISAT, Badger, Mason, or equal. All pipes, ducts and equipment shall be seismically restrained in accordance with the requirements of the current edition of the California Building Code. System shall have a current OPA number and shall meet any additional requirements of the authority having jurisdiction. Provide all supporting documentation required by the reviewing authority and the Architect and Engineer. Provide layout drawings showing piping, ductwork and restraint locations.

In lieu of the above or for non-standard installations not covered in the above pre-approved systems, Contractor shall provide layout drawings showing piping, ductwork and restraint locations, and detail supports, attachments and restraints, and furnish supporting calculations and legible details with a stamp by a California registered structural engineer, in accordance with 2007 California Building Code for occupancies requiring DSA/DGS or OSHPD review and approval Contractor shall use Seismic Zone 4 unless noted or approved otherwise.

Bracing of Ducts: Specifically state how the bracing attachment to structure is to be accomplished. All in-line equipment must be braced independently of the ducts and in conformance with all applicable building codes. Identify all in-line equipment in ducts, regardless of duct size and note how the seismic bracing has been independently provided. Provide shop drawings indicating the location of all transverse and longitudinal seismic braces.

Bracing of piping: Specifically state how the bracing attachment to structure is accomplished. Provide shop drawings indicating all seismic restraints, including details of anchorage to the building. All in-line equipment must be braced independently of the piping and in conformance with all applicable building codes. Provide calculations to show that the pre-approval numbers have been correctly applied in accordance with general information notes of the pre-approval documentation.

Typical exclusions for Compliance with this requirement for ductwork and piping are:

Fuel piping less than 1 inch inside diameter.

All other piping less than 2-1/2 inches inside diameter (exclusion does not apply to fire sprinkler piping or medical gas piping including vacuum piping), or

All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the support of the hanger. Does not apply to trapeze assemblies.

All electrical conduit (that is included as part of Division 15) less than 2-1/2 inches diameter.

Brace cast iron and plastic piping at 1/2 of the spacing allowed for ductile material.

All rectangular air handling ducts less than six square feet in cross sectional area, or

All round air handling ducts less than 28 inches in diameter.

All ducts suspended by individual hangers 12 inches or less in length from the top of the duct to the bottom of the support of the hanger.

Additional Requirements: In addition to the above, conform to all state and local requirements.

Expansion Anchors in Hardened Concrete:

Qualification Tests: The allowable shear and withdrawal load shall be based on qualification tests of at least three (3) test specimens, using a factor of safety of five (5) on the average of the test values, or a factor of safety of four (4) on the lowest test value, whichever is lower. Until the test data for the various anchors can be evaluated, use not more than 80% of the allowable load listed in the ICBO Research Committee Recommendation for the specific anchor.

Installation: The anchors must be installed in accordance with the requirements given in ICBO Research Committee Recommendations for the specific anchor.

Limitations on Anchors in Withdrawal: Anchors acting in withdrawal shall not be used for major connections such as anchoring tilt-up walls, tie-downs, heavy continuously applied loads, frequent vibratory loads, etc.

Job Testing: Fifty percent of the anchors shall be load-tested on each job to twice the allowable capacity in tension, except that if the design load is less than 75 pounds; only one anchor in ten need be tested. If any anchor fails, all anchors must be tested. The load test shall be performed in the presence of the project inspector.

The load may be applied by any method that will effectively measure the tension in the anchor, such as direct pull with a hydraulic jack, a torque wrench calibrated using the specific anchor, calibrated spring-loading devices, etc. Anchors in which the torque is used to expand the anchor without applying tension to the bolt may not be verified with a torque wrench.

TESTS AND ADJUSTMENTS

Test the installations in accordance with the following requirements and all applicable codes:

Inspector of Record should witness all tests of piping systems.

Notify the Architect at least seven days in advance of any test.

Notify local fire department of time and date of all fire systems testing.

All piping shall be tested at completion of roughing-in, or at other times as directed by the Architect.

Furnish all necessary materials, test pumps, gases, instruments and labor required for testing.

Isolate from the system all equipment that may be damaged by test pressure.

Make connections to existing systems with flanged connection. During testing of the new work, provide a slip-in plate to restrict test pressure to new systems only. Remove plate and complete connection to existing system at completion of testing.

Inspector of record shall witness final connection to system.

Test Schedule: No loss in pressure or visible leaks shall show after four hours at the pressures indicated.

Testing of Sanitary Sewer, Drain, Vent, Storm Drain may be done in segments in order to limit pressure to within manufacturer's recommendations. Test to 10 feet above the highest point in the system.

| System Tested | Test Pressure PSI | Test With |
|---|---|---|
| Sanitary Sewer, Drain, Vent | 10 Ft. Hd. | Water |
| Storm Drain, Condensate Drains | 10 Ft. Hd. | Water |
| Domestic Water | 125 | Water |
| Natural Gas (PE) | 60 | Air & Non-corrosive Leak Test Fluid |
| Natural Gas (Steel) | 100 | Air & Non-corrosive Leak Test Fluid |
| Fire Sprinkler Piping | 200 lb. | Water |
| All Hot, Chilled, Combination, Condenser Water Piping | 125 | Water |

All piping, including underground, connected to the fire sprinkler system shall be tested and certified in accordance with NFPA requirements, except where the requirements listed in this section exceed the requirements of NFPA.

Non-corrosive leak test fluid shall be suitable for use with the piping material specified, and with the type of gas conveyed by the piping system.

Perform operational tests under simulated or actual service conditions, including one test of complete plumbing installation with all fixtures and other appliances connected, and one test of complete installation of 48 hours each for heating and cooling with all equipment connected and operating.

Should any material or work fail in any of these tests, it shall be immediately removed and replaced for new material, and portion of the work replaced shall again be tested by Contractor at his own expense.

Lubricate each item of equipment, including motors, before operation.

Testing, Evacuating, Charging and Lubrication of Refrigeration Systems:

Pressurize with dry nitrogen and/or refrigerant to 300 psig and test all joints with an electronic detector or halide torch. Release the pressure and attach a high vacuum pump.

Evacuate to 4 mm (4000 microns) and hold for 30 minutes. Break to 5 psig with dry nitrogen or R-22 and allow to remain in the system for ten minutes. Evacuate to 2 mm (2000 microns) and hold for 30 minutes. Use a mercury manometer or electronic vacuum gauge. Do not start timing until recommended vacuum range is reached.

At the end of the evacuation, if the system has been proved leak-free, charge with refrigerant and fill the crankcase to the oil level specified by the manufacturer. All refrigerant oil shall be delivered to the location in sealed containers.

Replenish for a period of one year without cost to the Owner all refrigerant and oil required to maintain the proper levels.

TRACER WIRES

Provide tracer wire for non-metallic gas and water pipe in ground outside of buildings. Use AWG #12 tracer wire with low density high molecular weight polyethylene insulation, and lay continuously on pipe so that it is not broken or stressed by backfilling operations. Secure wire to the piping with tape at 18 inch intervals. Solder all joints. Tracer wire insulation shall be colored yellow for gas piping, blue for water piping.

Terminals: Precast concrete box and cast iron locking traffic cover, Brooks 3TL, or equal; cover marked with name of service; 6 inches of loose gravel below box. Plastic terminal board with brass bolts; identify line direction with plastic tags. Test for continuity between terminals, after backfilling, in presence of Inspector.

Alternate: Use electronically detectable plastic tape with metallic core, Terra Tape D, manufactured by Reef Industries, Inc., Seton, Inc., Marking Services, Inc., or equal; tape 2 inches wide, continuously imprinted "CAUTION WATER (GAS, etc.) LINE BELOW". Install, with printed side up, directly over pipe, 18 inches below finish grade. Backfill material shall be as previously specified for the particular condition where pipe is installed, but avoid use of crushed rock or of earth with particles larger than l/2 inch within the top 12 inches of backfill. Take precautions to insure that tape is not damaged or misplaced during backfill operations. Terminal boxes not required.

OPERATION OF SYSTEMS

Do not operate any mechanical equipment for any purpose, temporary or permanent, until all of the following has been completed:

Complete all requirements listed under "Check, Test and Start Requirements."

Ductwork and piping has been properly cleaned. Piping systems should be flushed and treated prior to operation.

Filters, strainers etc. are in place.

Bearings have been lubricated, and alignment of rotating equipment has been checked.

Equipment has been run under observation, and is operating in a satisfactory manner.

Provide test and balance agency with one set of Contract Drawings, Specifications, Addenda, Change orders issued, applicable shop drawings and submittals and temperature control drawings.

Operate every fire damper, smoke damper, combination smoke and fire damper under normal operating conditions. Activate smoke detectors as required to operate the damper, stage fan, etc. Provide written confirmation that all systems operate in a satisfactory manner.

TEMPORARY HEAT

The General Contractor will provide for all temporary heat at such times as may be required or directed by the Architect and pay all fuel and energy costs incurred.

Temporary heating facilities proposed for use by the Contractor will be subject to review of the Architect. Prior to use of any equipment for temporary heat, install temporary filters on all return air inlets, to preclude dust and construction debris from entering the duct system. In addition, install filters in air handling units, and replace at the completion of temporary operation.

Filters used for temporary operation of systems shall be as specified for permanent filters specified herein.

Comply with Check, Test and Start Requirements for start-up of equipment prior to operation for temporary heat.

Heating Contractor shall complete the permanent heating system as soon as possible, thereby making it available for temporary heat. When available, the system may be used as required at the direction of the Architect after systems are properly prepared for use as specified elsewhere. Heating Contractor shall then be responsible for operating the system during periods required and the General Contractor shall pay the fuel and energy costs incurred. Operation of the heating system prior to the filing of "notice of completion" shall not change the Guarantee provisions in any way.

CHECK, TEST AND START REQUIREMENTS

An authorized representative of the equipment manufacturer shall perform check, test and start of each piece of mechanical equipment. Provide written certification from the manufacturer stating that the contractor is qualified to perform the check test and start of the equipment.

As part of the submittal process, provide records of certification of contractor's qualifications for start-up of each item of equipment. Provide a copy of each manufacturer's printed startup form to be used.

Check, test and start of equipment may be done by the manufacturer, using manufacturer's employees, for start-up of specific equipment.

Provide all personnel, test instruments, and equipment to properly perform the check, test and start work.

When work has been completed, provide copies of reports for review, prior to final observation of work.

Provide copies of the completed check, test and start report of each item of equipment, bound with the operating and maintenance instructions.

Upon completion of the work, provide a schedule of planned maintenance for each piece of equipment. Indicate frequency of service, recommended spare parts (including filters and lubricants), and methods for adjustment and alignment of all equipment components. Provide a copy of the schedule with each operating and maintenance manual. Provide a copy of certification from the

Owner's representative indicating that they have been properly instructed in maintenance requirements for the equipment installed.

COMMISSIONING AND PRELIMINARY OPERATIONAL TESTS

Prior to observation to determine final acceptance, put all mechanical systems into service and check that work required for that purpose has been done, including but not limited to the following condensed check list. Provide indexed report to tabulating the results of all work.

All equipment has been started, checked, lubricated and adjusted in accordance with the manufacturer's recommendations, including modulating power exhausts if present.

Correct rotation of motors and ratings of overload heaters are verified.

Specified filters are installed and spare filters have been turned over to Owner.

All manufacturers' certificates of start-up specified have been delivered to the Owner.

All equipment has been cleaned, and damaged painted finishes touched up.

Damaged fins on heat exchangers have been combed out.

Missing or damaged parts have been replaced.

Flushing and chemical treatment of piping systems has been completed and water treatment equipment, where specified, is in operation.

Equipment labels, pipe marker labels, ceiling markers and valve tags are installed.

Valve tag schedules, corrected control diagrams, sequence of operation lists and start-stop instructions have been posted.

Preliminary test and balance work is complete, and reports have been forwarded for review.

Automatic control set points are as designated and performance of controls checks out to agree with the sequence of operation.

Maintenance manuals have been delivered and instructions to the operating personnel have been made.

Prior to the observation to determine final acceptance, operate all mechanical systems as required to demonstrate that the installation and performance of these systems conform to the requirements of these specifications.

Operate and test all mechanical equipment and systems for a period of at least five consecutive 8 hour days to demonstrate the satisfactory overall operation of the project as a complete unit.

Include operation of heating and air conditioning equipment and systems for a period of not less than two 8 hour days at not less than 90 percent of full specified heating and cooling capacities in tests.

Commence tests after preliminary balancing and adjustments to equipment have been checked. Immediately before starting tests, install air filters and lubricate all running equipment. Notify the Architect at least seven calendar days in advance of starting the above tests.

Provide training and orientation of Owners operating staff in proper care and operation of all equipment, systems and control systems. Submit three copies of certificate, signed by the Owner's representative, attesting to their having been instructed.

During the test period, make final adjustments and balancing of equipment, systems controls, and circuits so that all are placed in first class operating condition.

Where Utility District rebates are applicable, demonstrate that the systems meet the rebate program requirements.

In addition to the requirements of paragraphs A and B above, the contractor shall also be responsible to complete all the Acceptance Requirements of the 2005 California Building Energy Efficiency Standards, including but not limited to Air Distribution Systems, Outside Air systems, Packaged HVAC Systems, VFD Systems, Hydronic system Controls, Space Conditioning Controls, Demand Control Ventilation and Air Economizers. Contractor shall perform all required acceptance tests and shall complete the appropriate "Certificates of Acceptance" and submit such certificates to the projects enforcement agency for approval by the agency and agency issuance for final occupancy permit.

Before handing over the system to Owner replace all filters with complete new set of filters.

Review of Contractor's Tests:

All tests made by the Contractor or manufacturers' representatives are subject to observation and review by the Owner. Provide timely notice prior to start of each test, in order to allow for observation of testing. Upon the completion of all tests, provide a letter to confirm that all testing has been successful.

Test Logs:

Maintain test logs listing the tests on all mechanical systems showing dates, items tested, inspectors' names, remarks on success or failure of the tests.

Preliminary Operation:

The Owner reserves the right to operate portions of the mechanical system on a preliminary basis without voiding the guarantee.

Operational Tests:

Before operational tests are performed, demonstrate that all systems and components are complete and fully charged with operating fluid and lubricants.

Systems shall be operable and capable of maintaining continuous uninterrupted operation during the operating and demonstration period. After all systems have been completely installed, connections made, and tests completed, operate the systems continuously for a period of five working days during the hours of a normal working day.

This period of continuous systems operation may be coordinated with the removal of Volatile Organic Compounds (VOCs) from the building prior to occupancy should the Owner decide to implement such a program.

Control systems shall be completely operable with settings properly calibrated and adjusted.

Rotating equipment shall be in dynamic balance and alignment.

If the system fails to operate continuously during the test period, the deficiencies shall be corrected and the entire test repeated.

Pre-Occupancy Building Purge:

Prior to occupancy, ventilate the building on 100% outside air, 100% exhaust for a continuous period determined by a qualified industrial hygienist (engaged by the Contractor) to reduce V.O.C's prior to occupancy.

Submit report by the industrial hygienist verifying satisfactory completion of the pre-occupancy purge.

*END OF SECTION 15050.*

**SECTION 15800 – HEATING, VENTILATING AND AIR CONDITIONING**

**GENERAL**

SECTION INCLUDES

Packaged and split heating ventilating and air conditioning sstems.

Fans.

Relief and intake vents.

Filters.

Dampers.

Ductwork.

Ductwork sealing and leak testing.

Air inlets and outlets.

RELATED DOCUMENTS

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

ADDITIONAL REQUIREMENTS

Furnish and install any incidental work not shown or specified which is necessary to provide a complete and workable system.

Coordinate all of work in this Section with all of the Trades covered in other Sections of the Specifications to provide a complete, operable and sanitary installation of the highest quality workmanship.

DESCRIPTION OF WORK

Work of this section includes, but is not necessarily limited to Heating, Ventilating and Air Conditioning work indicated on the drawings and described herein.

QUALITY ASSURANCE

Design Criteria:

All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture. All gas-fired equipment shall be UL, ETL or CSA listed.

Supply all equipment and accessories in accordance with requirements of all applicable national, state and local codes.

All items of a given type shall be the products of the same manufacturer.

Scheduled equipment performance is minimum capacity required.

Scheduled electrical capacity shall be considered as maximum available.

Scheduled gas BTU input shall be considered as the maximum available.

SUBMITTALS

Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, weights, furnished specialties and accessories; and installation and start-up instructions.

Roof Curb Data: Submit calculations for roof curbs supporting equipment weighing 400 pounds or more, proving compliance with the seismic requirements of the 2007 CBC. Calculations shall be stamped and signed by a State of California registered structural engineer.

Engineering Data: Submit fan curves and sound power level data for each fan unit. Data shall be at the scheduled capacity. Data shall include the name of the rating agency or independent laboratory.

Maintenance Data: Submit maintenance data and parts list for each piece of equipment, control, and accessory; including "trouble-shooting" maintenance guide.

Include this data in maintenance manuals.

Record Drawings: At project close-out, submit Record Drawings of installed ductwork, duct accessories, and outlets and inlets in accordance with requirements of Division 1.

COORDINATED LAYOUT

Coordinated layouts are required to amplify, expand and coordinate the information contained in the Contract Documents.

Provide minimum 1/4 inch equals one foot scaled coordination drawings showing plan and pertinent section or elevation views of all piping, ductwork and electrical systems. Drawings shall be on vellum or sepia mylar, reproducible and the work represented shall be fully coordinated with the structure, other disciplines, and with all finishes. Drawings shall all be presented on a single size sheet. Contractor may use either size D (24 inch x 36 inch) or E (36 inch x 42 inch). Drawings graphics shall fully comply with A.I.A. Architectural Graphic Standards and ANSI Y14. Drawings may be hand drawn or computer generated using AutoCad or "Quick Pen". All drawings shall have title block, key plan, north arrow and sufficient grid lines to provide cross-reference to the design drawings.

Provide a stamp or title block on each drawing with locations for signatures from all contractors involved, including but not limited to the General, HVAC, Plumbing, Fire Protection, and Electrical Contractors. Include statement for signature that the contractor has reviewed the coordination drawings in detail and has coordinated the work of his trade.

Show on drawings the intended elevation of all ductwork in accordance with the following example.

B.O.D. = 9'-0"

OFFSET UP 6"

B.O.D. = 9'-6"

Highlight, encircle or otherwise indicate deviations from the Contract Documents on the coordinated layouts. Architect will not be responsible for "finding" changes or deviations to the original Contract Documents.

Since scale of contract drawings is small and all offsets and fittings are not shown, contractor shall make allowances in bid for additional coordination time, detailing, fittings, offsets, hangers and the like to achieve a fully coordinated installation. If changes in duct size are required, equivalent area shall be maintained and the aspect ratio shall not be in excess of 2 to 1 unless approved by the engineer. Drawings shall be submitted for review prior to fabrication and installation. Drawings may be submitted in packages representing at least one quarter of the building ductwork.

Check routing on all ductwork before fabricating. Report any discrepancies to Architect. No extra cost will be allowed for failure to conform to above.

It shall be responsibility of the General Contractor to insure that the Heating, Ventilating and Air Conditioning Contractor coordinates all of his work with all other trades, including mechanical and electrical trades, so that complete job is neat and in conformity with plans and specifications.

Where computer aided drafting has been used for the Contract Documents, the Drawing files may be made available. Upon request by the contractor, the files will be made available at a price of **$50** per drawing, with a minimum of $200.00 per request.

REFERENCES

AABC - Associated Air Balance Council

AFBMA - Anti Friction Bearing Manufacturer's Association

CSA – Canadian Standards Association International

AMCA - Air Moving and Control Association Inc.

Standard 210 - Laboratory Methods of Testing Fans

ANSI - American National Standards Institute

ARI - Air-Conditioning and Refrigeration Institute

ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers

ASME - American Society of Mechanical Engineers

ASTM - American Society of Testing and Materials

CCR - California Code of Regulations

CSFM - California State Fire Marshal

NIST - National Institute of Standards and Technology

NEMA - National Electrical Manufacturer's Association

NFPA - National Fire Protection Association

OSHA - Occupational Safety and Health Act

SMACNA - Duct Manuals

CBC - California Building Code

UL - Underwriters' Laboratories, Inc.

CMC - California Mechanical Code

CPC - California Plumbing Code

CEC - California Electrical Code

**PRODUCTS**

GAS FIRED EQUIPMENT

All gas-fired equipment shall be listed for use as a gas appliance.

All units shall comply with the Nox requirements of the Air Quality Management District (AQMD) in which they are to be installed.

PIPE AND FITTINGS

Refrigeration Piping: Refrigeration gas and liquid piping shall be Type "L" hard drawn copper tubing with wrought copper fittings. All joints shall be brazed with Sil-fos. Relief valve discharge piping shall be full size of relief discharge. Furnish and install Superior, Sporlan, Alco, Henry, or equal, stop valves, solenoid valves, adjustable thermal expansion valves, sight glass, flexible connection, charging valve, and drier with valve bypass in the liquid lines and Superior DFN shell and cartridge suction line filter sized 2-1/2 times tonnage.

AIR CONDITIONING UNIT,

Provide factory assembled single packaged outdoor rooftop mounted, electrically controlled electric cooling and heating unit, rated in accordance with ARI Standards 210/240 or 340/360, and UL listed and labeled, classified in accordance with UL 1995. Provide refrigerant charge R-410A, all internal wiring, piping, controls, and special features required prior to field startup. Design unit to conform to the following:

ASHRAE 15.

ASHRAE 90.1.

Insulation, adhesive, and all materials exposed to air stream shall meet NFPA 90A requirements for flame spread and smoke generation.

Unit casing shall be capable of withstanding 500-hour salt spray exposure per ASTM B117 (scribed specimen).

UL tested and certified

Unit shall be rated in accordance with ARI sound standards 270.

Unit shall be UL tested and certified in accordance with ANSI Z21.47 Standards as a total package.

Roof curb shall be designed to conform to NRCA Standards.

Unit shall be manufactured in a facility registered to ISO 9001:2000.

Unit shall be Energy Star qualified.

Cabinet:

Provide galvanized steel unit cabinet, bonderized and coated with a baked enamel finish.

All airstream interior surfaces shall be insulated with a minimum 1/2 inch thick, 1 lb density cleanable insulation. Heat compartment for optional electric heater shall be insulated with minimum 1/2 inch thick, 1 lb. density foil-faced insulation.

Cabinet panels shall be removable. Provide access panels for the filter, compressors, evaporator fan, and control box. Each external hinged access panel shall be insulated, with insulation encapsulated with panel or with sealed edges.

Return air filters shall be accessible through a dedicated tooless removable access panel.

Fork lift slots shall be provided in unit base rail. Base rail shall be minimum 16 gauge.

Unit shall have a factory-installed internally sloped condensate drain pan, providing minimum 3/4 in.-14 NPT connections for both horizontal and alternate vertical drain configuration. See Drawings for drain configuration. Pan shall be removable for cleaning and maintenance. All drain pans shall conform to ASHRAE 62 self-draining provisions.

Unit shall have standard side and alternate field or factory installed thru-the-bottom power and control wiring connection capability.

Unit shall be field or factory convertible to horizontal air discharge.

Fans:

Centrifugal supply air blower (evaporator fan) shall have permanently lubricated bearings. Provide belt-driven double inlet fan wheel, centrifugal type with forward curved blades and adjustable sheaves. Fan wheel shall be steel, with corrosion resistant finish, dynamically balanced.

Evaporator-fan motors shall be continuous operation, open drip-proof, and thermally protected. Bearings shall be sealed, permanently lubricated ball-bearing type.

Condenser fans shall be of the direct-driven propeller type, with corrosion-resistant aluminum blades. Fans shall be dynamically balanced and discharge air upwards. Condenser-fan motors shall be totally enclosed and thermally protected.

Compressor:

Fully hermetic, scroll type with internal high-pressure and temperature protection. Furnish with crankcase heater when normally supplied as standard equipment for model size scheduled on Drawings.

Factory installed rubber shock mounted and internally spring mounted for vibration isolation.

Compressor Anti-Recycle Timer: Compressor shall be prevented from restarting for a minimum of five minutes after shutdown, with manufacturers installed compressor cycle delay.

Compressor shall have a five year warranty.

Coils:

Standard evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless internally finned copper tubes with all joints brazed.

Condenser coils shall be single slab, single pass design. Single slab, 2 pass design may be utilized when supplied as standard equipment for unit size as scheduled on the Drawings.

Coils shall be leak tested at minimum 150 psig and pressure tested at minimum 450 psig.

Refrigerant Components:

Each refrigerant circuit shall include:

Fixed orifice metering device.

Solid core refrigerant filter driers with pressure ports.

Refrigerant pressure gage ports and connections on suction, and discharge lines.

Suction line accumulator.

Reversing valve.

Filter Section:

Standard filter section shall consist of factory-installed 2-in. thick, 30% efficiency disposable fiberglass.

Filter section shall use standard size filters.

Optional MERV-8 pleated filters of commercially available sizes shall be available.

Controls:

Unit shall be complete with self-contained low voltage fuse protected control circuit. See Section 15900, if included, and equipment schedule, sequence of operation and control diagram on Drawings for additional requirements.

Provide electro-mechanical controls with 24V thermostat interface or provide microprocessor controls when third party direct digital controls with an Energy Management System will be provided.

Provide electro-mechanical controls with 24V thermostat interface or provide microprocessor controls for stand-alone thermostat operation.

Provide microprocessor controls for single zone VAV or displacement type units for stand-alone operation. Units shall have factory mounted supply fan variable frequency drives.

Provide microprocessor controls with BACnet or LON interface for single zone VAV or displacement type units when third party direct digital controls with an Energy Management System will be provided. Units shall have factory mounted supply fan variable frequency drives.

Electro-mechanical controls shall include the following, as a minimum:

Provide compressor minimum off time (5 minutes).

Economizer control.

Time delay relay.

Integrated adjustable defrost cycle.

Microprocessor controls shall be ASHRAE 62 compliant and include the following, as a minimum:

User diagnostic interface.

Unit control with standard suction pressure transducers and condensing temperature thermistors.

Shall provide a 5° F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.

Service run test capability.

Shall accept input from a CO2 sensor (indoor) and provide demand ventilation control.

Provide compressor minimum off time (5 minutes).

Service diagnostic mode.

Economizer control.

Time delay relay.

Integrated adjustable defrost cycle.

Safeties:

Unit shall incorporate a solid-state compressor lockout that provides optional reset capability at the space thermostat, should any of the following safety devices trip and shut off compressor:

Compressor lockout protection provided for either internal or external overload.

Low-pressure protection.

Freeze protection (evaporator coil).

High-pressure protection (high pressure switch or internal).

Compressor reverse rotation protection.

Loss of charge protection.

Start assist on singe-phase units.

Supply-air sensor shall be located in the unit and detect both heating and cooling operation.

Phase Protection: Provide unit-mounted "SymCom" Motor Saver three phase voltage monitor, model 201A or equal, adjustable voltage range for each unit, install per manufacturer's recommendations, mount in NEMA 3R enclosure if exposed to the weather.

Units shall provide the following features:

Low voltage fault trip and reset.

Voltage unbalance/phasing fault trip and reset.

High voltage fault trip and reset.

Transient Protection (Internal).

Automatic restart.

Provide each unit with 600V socket, "SymCom" model OT08

Operating Characteristics:

Unit shall be capable of starting and running at 115° F ambient outdoor temperature per maximum load criteria of ARI Standards 210/240 or 340/360.

Unit with microprocessor or electro-mechanical controls shall operate in cooling down to an outdoor ambient temperature of 25° F.

Unit shall be provided with fan time delay to prevent cold air delivery in heating mode.

Electrical Requirements:

All unit power wiring shall enter unit cabinet at a single location — standard side or alternate bottom. See Drawing Schedule for thru-the-bottom power wiring requirement.

Motors:

Compressor motors shall be cooled by refrigerant gas passing through motor windings and shall have line break thermal and current overload protection.

Evaporator fan motor shall have permanently lubricated, sealed bearings and inherent automatic-reset thermal overload protection or manual reset calibrated circuit breakers.

Totally enclosed condenser-fan motor shall have permanently lubricated, sealed bearings, and inherent automatic-reset thermal overload protection.

Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following, or equal:

Carrier Corporation.

Trane Inc.

Provide the following additional features and equipment:

Roof Curb: formed 14 gauge galvanized steel with wood nailer strip and capable of supporting entire unit weight. Provide 3 inch wide bottom flange.

Provide heavy-duty 18 gauge expanded metal coil guard grille to protect all surfaces of the condensing coil. Coil guard to by Micrometl, Canfab, or equal.

Modulating Power Exhaust Economizer: Micrometl, Canfab, or equal. Integrated type capable of simultaneous economizer and compressor operation.

Provide self-contained outdoor rooftop system, mounted directly to the return air compartment of the HVAC packaged equipment. Provide differential dry bulb economizer control system and a factory programmed, fully programmable variable frequency drive package controlled by a differential pressure transmitter, mounted directly to the return air compartment of the HVAC packaged equipment. Design the system to continuously maintain space pressure, and provide capability of introducing up to 100 percent outdoor air.

Provide hinged cabinet access doors and include latches to provide a tool-less entry for servicing.

Provide door lock on the power exhaust cabinet to meet ETL safety requirements.

Outdoor air intake dampers shall be low leak not to exceed 3 percent at 1 inch wg pressure differential and include stainless steel side seal and neoprene edge seal. Arrange dampers to close upon loss of power.

Provide belt driven exhaust blowers, double inlet, forward-curved centrifugal type. Provide gravity backdraft damper at fan outlet.

Provide fully programmable factory programmed variable frequency drive (VFD) package for each fan, driven by 4 to 20 mA signal from a differential pressure transmitter. Pressure transmitters shall measure 0 - 0.1 in wg. Install room sensor tubing with sensor tube termination installed within the room.

Where direct digital controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls required to make the system fully operational.

Where stand-alone controls are utilized, provide Belimo, or equal, damper actuator, complete with spring return and all controls, including logic module, required to make the system fully operational.

RELIEF AND INTAKE VENTS

Galvanized steel housing with 1/2 inch mesh screen, counterbalanced backdraft damper and matching prefabricated curb. Omit backdraft damper on intake vents. Provide pitched roof curb for relief vents, and install with backdraft damper level.

Provide prime coat of paint for all roof-mounted air intakes and relief vents.

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

Greenheck Fan Corporation.

Lauren Cook Company.

PennBarry.

American Coolair Corporation.

FILTERS

Provide Farr 30/30, Echo Air E-35, or equal, disposable pleated media type, for all units. Provide 25-30 percent efficiency per ASHRAE test standard. Provide 1 inch thick for furnace units and 2 inch thick for all other units.

Filer bank as per drawing schedule

Air filters shall be a State Fire Marshal approved and listed type. Preformed filters having combustible framing shall be tested as a complete assembly.

Air filters in all occupancies shall be Class 2 or better, as defined in the test method above.

Air filters shall be accessible for cleaning or replacement.

Air filters shall be SFM listed.

Temporary Filters:

Install new temporary filters in all units that have filter systems installed. Temporary filters shall match the permanent filters that are specified for the units. Replace filters as needed, in accordance with manufacturer's directions, in order to provide protection for the unit prior to occupancy by the Owner.

If air handling units are operated during construction of the project, install temporary filters directly over each return air inlet. Filters shall match the permanent filters that are specified for the units. Select size of filter to completely cover the frame of the return air inlet, and tape filters firmly in place to eliminate any construction debris from entering the duct system or unit. Remove the temporary filters upon completion of the work, and repair all damaged paintwork.

Spare Filters:

Furnish two new, complete sets of filter cartridges for each filter bank on completion and acceptance of the work. Install one set of filters in units (prior to final air balance) and leave the remaining filters in location designated by the Owner.

FILTER GAUGE

Furnish and install for each bank of air filters including air conditioning units, heating and ventilating units and fan units, except individual room units, a magnehelic air filter gauge.

Provide 0 to 1 inch range for pre-filter systems, with a permanent red line to indicate change out pressure.

Provide 0 to 2 inch range for final filter systems, with a permanent red line to indicate change out pressure.

DAMPERS

Backdraft Dampers: Ruskin CBD2, counterbalanced, Nailer Industries, or equal.

Manual Air and Balance Dampers: Provide dampers of single blade type or multi-blade type constructed in accordance with SMACNA, "HVAC Duct Construction Standards," except as noted herein.

Rectangular Ductwork:

Single damper blades may be used in ducts up to 10 inches in height. Dampers shall be 16 gauge minimum. Provide self-locking regulators, equal to Ventlok 641. Provide end bearings equal to Ventlok 607 at each damper. Provide continuous solid 3/8 inch square shafts.

Multiple blade dampers shall be equal to Ruskin CD35 Standard Control Damper. Maximum width for multiple damper blades for use in rectangular duct shall not exceed 6 inches.

Where duct velocity may be expected to exceed 1500 fpm, provide Ruskin CD-50, or equal, low leakage dampers with airfoil blades.

Round Ductwork:

Single damper blades may be used in ducts up to 12 inches in diameter. Provide multiple blade opposed blade dampers, with connected linkage, for ductwork larger than 12 inches in diameter.

Damper blades for round ductwork shall be 20 gauge steel for ducts up to 12 inches diameter and 16 gauge steel for dampers larger than 12 inches damper. Provide self-locking regulators, equal to Ventlok 641, Durodyne, or equal for operation of dampers. Provide end bearings equal to Ventlok 607 and provide continuous solid 3/8 inch square shafts.

Where ductwork is externally insulated, provide self-locking regulators equal to Ventlok 644, Durodyne, or equal for rectangular ductwork, and Ventlok 637, Durodyne, or equal for round ducts.

Fire Dampers and Combination Smoke-Fire Dampers:

Fire dampers and combination fir smoke dampers shall be listed and approved by the California State Fire Marshal. Installation shall conform to the manufacturer's UL approved installation instructions.

Fire dampers shall be UL 555 classified and labeled as dynamic fire dampers approved for wall and floor installation. They shall ship from the manufacturer as an assembly with a minimum 20-gauge factory installed sleeve. Sleeve length shall suit the requirements of the wall construction. Each dynamic fire damper/sleeve assembly shall ship complete with factory "roll formed" one-piece angles with pre-punched holes for easy installation. Dynamic fire dampers for vertical installation must consist of a single section on sizes up to 33" x 36" and a single section on sizes up to 24" x 24" for horizontal installation. 1-1/2 hour dynamic fire dampers shall be Ruskin DIBD20, Pottorff. 3 hour dynamic fire dampers shall b Ruskin DIBD230, Pottorff.

Fire dampers for high pressure/velocity systems where velocities exceed 2000 fpm and/or 4" w.g. pressure fire damper shall be Ruskin FD60 or equal by Pottorff.

Combination fire/smoke dampers. Dampers shall be UL classified and labeled as Leakage Class I Smoke Dampers in accordance with the latest version of UL 555S. Dampers shall be warranted to be free from defects in material and workmanship for a period of 5 years after date of shipment. Damper/actuator assembly shall be tested to full open and full close at minimum 2000 fpm 250° F heated air and 4" w.g. with airflow in both directions. (Specified select: 250° / 350°, 2000 fpm/3000 fpm). Each damper shall be equipped with EZ reset "controlled closure" quick detect heat actuated release device to prevent duct and HVAC component damage resulting from instantaneous damper closure. Release device shall be EFL type and shall allow easy reset from outside the sleeve after moderate temperature exposure. (Replacement type fusible links not acceptable.)

Two position combination fire smoke dampers shall be equipped with one or more factory installed, direct coupled, 120 volt, single phase, electric actuator for energize open – fail close operation. Dampers with multiple actuators shall be factory wired with single point connection at the EFL heat release devise for connection to poser. Damper actuator shall include minimum one-year energized hold open (no cycles) and spring return (fail) close reliability. Damper/actuator shall include minimum 20,000 full open-full close cycle performances.

Modulating combination fire smoke dampers shall be equipped with one or more factory installed contact for modulating signal connection. Damper/actuator shall include minimum 100,000 full open-full close cycle performances with spring return (fail) close on loss of power.

Round combination fire smoke dampers up to 24" diameter shall be true round type with minimum 2- gauge minimum galvanized designed for lowest pressure drop and noise performance. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame. Blade seals shall be silicone edge designed to withstand 450° F and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Each damper shall be equipped with a factory-installed sleeve of 17" minimum length and factory "roll formed" one-piece angles with pre-punched holes for easy installation. Dampers shall be Ruskin FSD60 or equal by Pottorff.

Round (larger than 24" diameter) or rectangular combination fire smoke dampers shall include roll-formed structural hat channel frame, reinforced at the corners, formed from a single piece of minimum 16 gauge equivalent thickness formed from single piece galvanized steel. Bearings shall be stainless steel turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450° F and galvanized steel mechanically locked in to the blade edge (adhesive type seals are not acceptable). Each damper shall be equipped with a factory-installed sleeve of 17" minimum length and factory "roll formed" one-piece angles with pre-punched holes for easy installation. Dampers shall be Ruskin FSD60 or equal by Pottorff.

3-hour rated combination fire smoke dampers shall be Ruskin model FSD60-3 or equal by Pottorff.

All FSD60 type dampers shall be AMCA licensed and shall bear the AMCA Seal for Air Performance. AMCA certified testing shall verify pressure drop does not exceed .03" w.g. at a face velocity of 1,000 fpm on a 24" x 24" damper.

Wall type fire/smoke damper:

Combination fire/smoke dampers for use in the wall of exit corridors shall be classified and labeled as Leakage Class II Smoke Dampers in accordance with the latest version of UL 555S. Dampers shall meet the requirements for combination fire/smoke dampers in paragraph 3 above except AMCA certified testing shall verify pressure drop does not exceed .07" w.g. at a face velocity of 1,000 fpm on a 24" x 24" damper and blades shall be single skin galvanized steel 10 gauge minimum with 3 longitudinal grooves for reinforcement. Dampers shall be Ruskin FSD36 or equal by Pottorff.

Front access combination fire/smoke dampers shall meet all the requirements for combination fire/smoke dampers in paragraph 3 above except pressure drop requirement. In addition the dampers shall be constructed so that actuators and all accessories are accessible from the grille side. Actuators and accessories shall be housed within an integral cabinet on the side of the damper frame and shall not be installed in the air stream in front of the damper. The damper sleeve shall be minimum 14" and flanged to accept a steel framed grille. The sleeve shall be covered with fire resistant material. Dampers shall be Ruskin FSD60FA or equal by Pottorff.

Fusible links shall have temperature rating approximately 50° F above normal maximum operating temperature of the heat producing appliance.

If project requires re-openable fire/smoke dampers, provide Ruskin 165 ° F / 350° F TS150, NCA or equal. The TS150 firestat replaces the EFL and allows the damper to be re-opened from remote location up to 350 ° F. TS150 shall include full open and full closed damper position contacts for interface with remote position indication panel.

Each fire/smoke damper shall be quipped with "controlled closure" quick detect heat actuated release device to prevent duct and HVAC component damage. Release device shall allow easy reset after moderate temperature rise outside the sleeve. Heat release device shall be the Ruskin EFL, NCA or equal.

Unless the system is using a validation control system (see section 15820), each fire/smoke damper shall be equipped with a control panel including blade position indicator lights and a key operated switch. The panel cover shall be oversized for flush mount into the wall or ceiling and shall have a brushed look. Control panel shall be Ruskin MCP2, or equal by Pottorff.

Fusible links shall have temperature rating approximately 50 degrees F. above normal maximum operating temperature of the heat producing appliance.

Where required to suit the size of damper required, provide manufacturers standard UL Classified mullions, arranged to support multiple dampers. Assembly shall be minimum of 16 gauge galvanized steel, complete with all accessory caps and framing members

required for installation. Provide independent motor and operator as required for each individual damper, arranged to suit UL Classification requirements.

Manufacturer's instructions shall be made available to the inspection authorities.

All actuators used for smoke dampers or combination fire/smoke dampers shall have a cycle time requirement of no more frequently than every twelve months and shall be rated for continuous "0n" duty and shall be provided with internal spring return. Actuators shall be equipped with pilot light, remote key test switch, end switch and circuitry to activate pilot light on remote key (test) switch located in corridor ceiling adjacent to damper. Electric motors shall be Invensys MA-250, MA-253, Honeywell H2000, or equal.

TEMPERATURE CONTROL SYSTEM

Refer to Section 15900.

DUCTWORK

Construct and install all sheet metal ductwork in accordance with the 2007 California Mechanical Code for 2 inches static pressure for supply air, and 2 inches minimum for return and exhaust air unless otherwise noted on Drawings.

Construct and install all sheet metal ductwork in accordance with the 2007 California Mechanical Code for 4 inches static pressure upstream of AIR SUPPLY boxes and 2 inches minimum downstream of AIR boxes for supply air, and 2 inches minimum for return and exhaust air unless otherwise noted on Drawings.

Where not in conflict with the California Mechanical Code, construct and install all sheet metal ductwork in accordance with SMACNA HVAC Duct Construction Standards (Metal and Flexible). Where applicable for HVAC work, construct and install sheet metal work in accordance with SMACNA Architectural Sheet Metal Manual.

Provide variations in duct size, and additional duct fittings as required to clear obstructions and maintain clearances as approved by the Architect at no extra cost to the Owner.

Gauges, joints and bracing shall be in accordance with the 2007 California Mechanical Code.

Provide beading or cross breaking for all ductwork inside building. Provide cross breaking for ductwork exposed to weather.

At the contractor's option, ductwork may be fabricated using the Ductmate, Nexus, Quickduct, Transverse Duct Connection (TDC), Pyramid-Loc duct connection systems, or equal. Fabricate in strict conformance with manufacturer's written installation instructions and in accordance with California Mechanical Code.

Seal flanged ends with pressure sensitive high density, closed cell neoprene or polyethylene tape gasket, Thermo 440, or equal.

Provide metal clips for duct connections, except at breakaway connections for fire dampers and fire smoke dampers. Provide corner clips at each corner of duct, through bolted, at all locations except at breakaway connections for fire dampers and fire smoke dampers. Where used on locations exposed to weather, provide continuous metal clip at top and sides of duct, with 1 inch overhang for top side.

Design and installation standards:

SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) for all work in this section.

ASHRAE Standards: Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE) recommendations, 1985 edition, for all work in this section.

NFPA Compliance: Comply with ANSI/NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," and ANSI/NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

California Mechanical Code 2007 edition.

ADC Test Code FD 72-RI, Flexible Air Duct Test Code.

NFPA 90-A, Standard for the Installation of Air Conditioning and Ventilating Systems, latest edition.

Fabricate all ductwork with sheet metal. Fiberglass ductwork will not be accepted for use on this project.

Duct sizes indicated are external sizes.

Galvanized Sheet Steel: Lock-forming quality, ASTM A924 and ASTM A653, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

Provide mill certification for galvanized material at request of the IOR.

Seal airtight all joints and seams, including standing seams and manufactured joints and seams, of all supply, return and exhaust ducts except those exposed in the conditioned space. Provide one part, non-sag, solvent release and curing polymerized butyl sealant, formulated with a minimum of 75 percent solids.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct sealant which may be incorporated in the work include the following, or equal:

Design Polymetrics Model DB1010

Polymer Adhesive Sealant Systems Inc – Airseal #11

United Sheet Metal

Seal airtight and watertight all joints and seams of all ductwork exposed to the weather with 6 ounce canvas bonded with MEI Eco-Tack adhesive; cover the canvas with a heavy coat of Foster's 56-10, United McGill, or equal, no dilution.

Pressure-sensitive tapes or single part sealant not acceptable.

Where seams are exposed to weather, paint seams with aluminum paint. Provide cross broken ductwork, and insure that the ductwork will shed water. Beading of duct work will not be considered.

Provide sheet metal angle frame at all duct penetrations to wall, floor, roof, or ceiling.

Rectangular Duct Fabrication:

Shop fabricate ductwork of gauges and reinforcement complying with the more stringent of the following standards, except as noted herein.

SMACNA HVAC Duct Construction Standards

California Mechanical Code

Fabricate ducts with minimum duct gauges as follows:

| Duct Dimension | Minimum Gauge | Joint Reinforcement Per CMC |
|---|---|---|
| up through 12" | 26 | Not Required |
| 13" through 18" | 24 | Not Required |
| 19" through 30" | 24 | C/4 |
| 31" through 42" | 22 | E/4 |
| 43" through 54" | 22 | F/2 |
| 55" through 60" | 20 | G/4 |
| 61" through 84" | 20 | I/2 |
| 85" through 96" | 20 | J/2 |
| Over 96" | 18 | K/2 |

Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Fabricate to include single thickness turning vane in elbows where space does not permit the above radius or where square elbows are shown. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers. Turning vanes shall be E-Z Rail II, Durodyne, or equal

Fabricate round supply connections at rectangular, plenum type fittings using spin-in type fittings, complete with extractor and volume control damper. Refer to Paragraph "DAMPERS" for damper requirements.

Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations. On ducts with flat seams, provide standard reinforcing on inside of duct. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.

Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.

Provide 20 gauge minimum for ductwork exposed within occupied spaces.

Rectangular Internally insulated Duct:

Provide internal duct lining where indicated on the Drawings, with a minimum of 10'-0" length in each direction from the fan, fan casing, or unit casing. Line all transfer ducts.

Where ductwork is exposed to weather or outside the building insulation envelope, provide 2 inch thick, 1-1/2 pound density internal lining with matte facing, with an R-Value of 8.0 minimum.

Where ductwork is within the building insulation envelope, lining shall be 1" thick, 1-1/2 pound density, with R-value of 4.2 minimum.

Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.

Provide 20 gauge minimum for ductwork exposed within occupied spaces.

Cement duct liner in place with nonflammable, non-hardening duct adhesive. Seal all raw edges of insulation inside ductwork with adhesive, including longitudinal liner edges.

Provide metal nosing at all locations where liner is preceded by unlined metal.

Where installed exposed in the conditioned space, duct shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value – R-4.2).

Provide sheet metal weld pins and washers or clinch pins and washers on all ductwork on 12 inch intervals with the first row within 3 inches of the leading edge of each piece of insulation and within 4 inches of corners. No use of adhesive mounted pins will be considered.

Install clinched pin fasteners with properly adjusted automatic fastening equipment. Manual installation will not be considered.

Install weld pins with properly adjusted automatic fastening equipment. Installation shall not damage the galvanized coating on the outside of the duct.

All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.

Manufacturer: Subject to compliance with requirements, manufacturers offering duct liners and adhesives include the following, or equal.

| Manufacturer: | Product: |
|---|---|
| Owens-Corning Fiberglas Corp. | Aeroflex Plus |
| Johns Manville | Linacoustic |
| CertainTeed Corporation | ToughGard |
| Fosters Adhesive | 85-462 |

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

Round Ductwork Fabrication:

Spiral lock seam prefabricated factory-build round and oval duct and fittings shall be used wherever possible. Shop fabricated ducts shall be used only where rectangular shaped ducts are shown on plans or where transitions and special fittings cannot be prefabricated by factory. Provide couplings to join each length of duct.

Fabricate duct fittings to match adjoining ducts and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1.5 times associated duct width. Provide two-piece, die-stamped, 45-degree to 90-degree elbows for sizes up to 12 inches; five-piece, 90-degree elbows for sizes 12 inches and above; conical tees; and conical laterals. All reducers shall be placed after a tap has been made on the duct main. Reducers shall be long-taper style.

Round Ductwork: Construct of galvanized sheet steel complying with ANSI/ASTM A 653 by the following methods and in minimum gauges listed.

| Diameter | Minimum Gauge | Method of Manufacturer |
|---|---|---|
| Up to 14" | 26 | Spiral Lockseam |
| 15" to 23" | 24 | Spiral Lockseam |
| 24" to 36" | 22 | Spiral Lockseam |
| 37" to 50" | 20 | Spiral Lockseam |
| 51" to 60" | 18 | Spiral Lockseam |
| Over 60" | 14 | Longitudinal Seam |

Provide locked seams for spiral duct; fusion welded butt seam for longitudinal seam duct.

Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams at exposed ducts. Provide spot weld bonded seams at concealed ducts.

| Diameter | Minimum Gauge |
|---|---|
| 3" to 36" | 20 |
| 38" to 50" | 18 |
| Over 50" | 16 |

Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.

Provide 20 gauge minimum for ductwork exposed within occupied spaces.

Round Internally Insulated Duct and Fittings: Where ductwork is exposed to weather or outside the building insulation envelope, construct with outer pressure shell, 2 inch thick (Minimum R-value = R-8) insulation layer, and perforated inner liner. Where ductwork is within the building insulation envelope, construct with outer pressure shell, 1 inch thick (minimum R-value = R4.2) insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ANSI/ASTM A 653, of spiral lockseam construction (use longitudinal seam for over 59 inches), in minimum gauges listed in table below. Where installed exposed in the conditioned space: duct and fitting outer pressure shell shall be minimum 20 gauge with 1 inch insulation layer (minimum R-value = R-4.2).

| Nominal Duct Diameter | Outer Shell | Inner Liner |
|---|---|---|
| 3" TO 12" | 26 gauge | 24 gauge |
| 13" TO 24" | 24 gauge | 24 gauge |
| 25" to 34" | 22 gauge | 24 gauge |
| 35" to 48" | 20 gauge | 24 gauge |
| 49" to 58" | 18 gauge | 24 gauge |
| Over 59" | 16 gauge | 20 gauge |

Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams of outer shell at exposed ducts. Provide spot weld bonded seams at concealed ducts.

| Nominal Duct Diameter | Outer Shell | Inner Liner |
|---|---|---|
| 3" to 34" | 20 gauge | 24 gauge |
| 36" to 48" | 18 gauge | 24 gauge |
| Over 48" | 16 gauge | 24 gauge |

Inner Liner: Perforate with 3/32 inch holes for 22 percent open area. Provide metal spacers welded in position to maintain spacing and concentricity.

Ducts exposed in the conditioned space shall be free of dents and blemishes and be mounted tight against adjacent surface with flat hangers. Remove all fabrication labels from ductwork.

Provide 20 gauge minimum for ductwork exposed within occupied spaces.

All ductwork, adhesives, lining, sealant, flex duct and the like shall have a flame spread of 25 or less and developed smoke rating of 50 or less when tested in accordance with one of the following test methods: NFPA 255, ASTM E84, or UL 723.

Optional Ducts and Fittings: At Installer's option, provided that certified tests by manufacturer show that rigidity and performance is equivalent to SMACNA and/or ASHRAE standard gauge ductwork, provide ducts and fittings as follows:

Ducts: Construct of manufacturer's standard gauge, with spiral lock seam and intermediate standing rib.

Available Manufacturers: Subject to compliance with requirements, manufacturers offering factory fabricated ductwork which may be incorporated in the work include the following, or equal:

Sheet Metal Div., McGill AirFlow, LLC., Acousti-k27

Semco Duct and Acoustical Products, Inc.

Air Systems Manufacturing, Inc. - Las Vegas

Miscellaneous Ductwork Materials:

Duct Joints: Install duct sealers, pop rivets or sheet metal screws at each fitting and joint. Duct sealer shall be fire retardant. Sheet metal screw for joints shall be minimum #10 size galvanized.

Duct Access: Provide hinged access door in rectangular ducts for access to fire dampers, control equipment, etc. Access door size shall be duct diameter wide by duct diameter high for all ducts under 24 inches. Ducts over 24 inches in diameter shall have 24-inch by 18-inch access doors. Minimum size access doors shall be 6 inches by 6 inches.

Provide hinged style access doors for round ductwork, NCA Manufacturing, Inc., Model AD-RD-87, Pottorff Series 60, or equal. Access doors shall be 16 gauge galvanized steel with continuous piano hinge. Locks shall be plated steel strike and catch. Provide 1" x 3/8" Polyethylene "Perma Stik" gasket all around door.

Flexible Ducts:

Provide exterior reinforced laminated vapor barrier, fiberglass insulation, (minimum R-value = R-8.0 for ductwork installed outside the building insulation envelope; minimum R-value = R-6.0 for ductwork installed within the building insulation envelope), encapsulated spring steel wire Helix and impervious, smooth, non-perforated interior vinyl liner. Individual lengths of flexible ducts shall contain factory fabricated steel connection collars.

Factory made air ducts shall be approved for the use intended and shall conform to the requirements of UMC Standard 6-1, 6-5 and UL 181. Each portion of a factory-made air duct system shall be identified by the manufacturer with a label or other suitable identification indicating compliance with UMC Standard No. 6-5 and its class designation. These ducts shall be UL listed Class 1, 25/50 smoke and flame spread and shall be installed in accordance with the terms of their listing. Factory-made air ducts shall have the following minimum R-values: R-8.0 for ductwork installed outside the building insulation envelope, R-6.0 for ductwork installed within the building insulation envelope.

Flexible ductwork shall be maximum of 8 feet long, and shall be extended to the fullest possible length, in order to minimize pressure drop in the duct.

Ducts shall be U.L. approved and tested and meet Class requirements of NFPA 90A, and comply with UMC Standards 6-2 & 6-5. Make bends to maintain R/W-1.5.

Flexible ducts shall be selected for minimum of 6 inch positive static pressure and minimum of 1 inch negative static pressure.

Make connections to rigid duct and units with Panduit style draw band at inner liner material, and a second draw band over the outer vapor barrier material.

Subject to compliance with requirements, manufacturers offering Flexible Ducts which may be incorporated in the work include the following, or equal:

Cal Flex Model 2PMJ (Minimum R-6)

ThermaFlex Model M KC (Minimum R-6)

Provide Ventlon flexible connections on inlet and outlet of AC Unit, air handler and exhaust fans. Provide galvanized weather hood over flexible connections exposed to the weather.

AIR INLETS AND OUTLETS

Except as otherwise indicated, provide manufacturer's standard outlets and inlets where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

Ceiling, wall or floor Compatibility: Provide outlets with border styles that are compatible with adjacent ceiling, wall or floor systems, and that are specifically manufactured to fit into ceiling, wall or floor module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems that will contain each type of air outlet and inlet.

Refer to Schedule on Mechanical Drawings for details of inlets and outlets to be used.

**EXECUTION**

ROOF MOUNTED EQUIPMENT

Mount and anchor equipment in strict compliance with drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.

Examine rough-in for roof mounted equipment to verify actual locations of piping and duct connections prior to final equipment installation.

Verify that piping to be installed adjacent to roof mounted equipment allows service and maintenance.

Verify that gas piping will be installed with sufficient clearance for burner removal and service.

Install ducts to termination at top of roof curb and install heavy duty rubber gaskets on supply and return openings and on full perimeter of curb, or as required for an airtight installation, prior to setting unit on curb

Cover roof inside roof mounted air conditioning unit with 2" thick, 3 pound density fiberglass insulating board.

Connect supply and return air ducts to horizontal discharge roof mounted equipment with flexible duct connectors specified elsewhere in these Specifications.

Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

EQUIPMENT START-UP

Initial start-up of the systems and pumps shall be under the direct supervision of the Contractor.

Equipment start-up shall not be performed until the piping systems have been flushed and treated and the initial water flow balance has been completed.

It shall be the responsibility of the Contractor to assemble and supervise a start-up team consisting of Controls, Chiller Start-Up Technician and Test and Balance Contractor; all to work in concert to assure that the systems are started, balanced and operate in accordance with the design.

After start-up is complete, instruct the Owner's personnel in the operation and maintenance of the systems. Obtain from the Owner's representative a signed memo certifying that instruction has been received.

ANTI-VIBRATION BASES AND HANGERS

Isolate all ventilating and air conditioning equipment connections including conduit, piping, drains, etc., so that equipment will operate under continuous demand without objectionable vibration.

Support all air conditioning units, all fans, and all pumps of 5 HP and over on anti-vibration bases or hangers. Other equipment shall be supported on anti-vibration bases, pads, or hangers, as shown on the drawings or specified with the equipment. Individual fans shall have integral fan and motor bases, spring-type unless noted. High velocity fans - unguided stable springs with 2" deflection.

Selection of the bases or supporting units shall be in accordance with the vibration eliminator manufacturer's recommendations. Minimum static deflection shall be 1-1/2 inches or as marked on the drawings.

The equipment manufacturer shall furnish the weight of equipment at each point of support.

FILTERS

Mount filters in airtight frames furnished by the filter manufacturer, and install in accordance with manufacturer's recommendations.

Identify each filter access door with 1/2 inch high minimum stenciled letters.

Provide temporary filters for all fans that are operated during construction; after all construction dirt has been removed from the building install new filters at no additional cost to the Owner. In addition to temporary filters at filter location, provide temporary filters on all duct openings which will operate under a negative pressure.

Filters used for temporary operation shall be the same as permanent filters for the application. Filters used for duct openings may be 1 inch thick pleated media disposable type.

INSTALLATION OF DUCTWORK

Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum of joints. Align ductwork accurately at connections within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true to shape and

to prevent buckling. Where possible, install ductwork to clear construction by 1/4 inch minimum, except at air inlets and outlets. Where ductwork will not clear construction, secure duct firmly to eliminate noise in the system.

Applicable Leakage Classes:

| Pressure Class | Leakage Class | |
|---|---|---|
| | Round Duct | Rectangular Duct |
| 2" W.G. or less | 12 | 12 |
| 4" W.G. or greater | 3 | 6 |

Install concrete inserts for support of ductwork in coordination with formwork as required to avoid delays in work.

Upper connection of support to wood structure shall be with wood screws or lag screws in shear fastened in the upper one half of the wood structural member. Fasteners shall conform to the following schedule:

| | |
|---|---|
| For ducts with P/2=30" | #10 x 1-1/2" wood screw |
| For ducts with P/2=72" | 1/4" x 1-1/2" lag screw |
| For ducts with P/2 over 73" | 3/8" x 1-1/2" lag screw |

Upper connection in tension to wood shall not be used unless absolutely necessary. Where deemed necessary the contractor shall submit calculations to show the size fastener and penetration required to support loads in tension from wood in accordance with the following schedule:

| | |
|---|---|
| For ducts with P/2=30" | 260 pounds per hanger |
| For ducts with P/2=72" | 320 pounds per hanger |
| For ducts with P/2=96" | 460 pounds per hanger |
| For duct with P/2 larger than 120" | NOT ALLOWED |

Where ducts pass through interior partitions and exterior walls, conceal space between construction opening and duct or duct plus insulation with sheet metal flanges of same gauge as duct. Overlap opening on four sides by at least 1-1/2 inches.

Upper connection to manufactured truss construction must comply with truss manufacturers published requirements and Structural Engineers requirements.

Support ductwork in manner complying with SMACNA "HVAC Duct Construction Standards," hangers and supports sections. Where special hanging of ductwork is detailed or shown on Drawings, Drawings shall be followed. Angles shall be attached to overhead construction in a manner so as to allow a minimum of 2 inches of movement in all directions with no bending or sagging of the angle.

Except where modified in individual paragraphs of this Section, provide hanger support with minimum 18 gauge straps, 1 inch wide. Fold duct strap over at bottom of duct.

Install duct supports to rectangular ducts with sheet metal screws. Provide one screw at top of duct and one screw into strap at bottom of duct.

Installation of Flexible Ductwork:

Provide flexible ducts with supports at 30 inch centers with 2 inch wide, 26 gauge steel hanger collar attached to the structure with an approved duct hanger. Installation shall minimize sharp radius turns or offsets.

Supports shall be in accordance with UMC Standard 6-5.

Make connection to duct with spin-in fittings, with air scoop and balance damper.

Paint inside of ducts, visible through grille, dull black.

Where ductwork is installed in finished areas of buildings that do not have ceilings, paint ductwork, support hangers, and air inlets and outlets to match adjacent architectural surfaces, or as directed by Architect.

DUCTWORK SEALING AND LEAK TESTING

New Construction: All duct systems (supply return, outside air intake, and exhaust), except those exposed in the conditioned space, shall be sealed and leak tested to a leakage rate not to exceed 6 % of the fan flow of the system. The leakage rate shall be confirmed through field verification and diagnostic testing in accordance with the procedures set forth in the 2005 California Building Energy Efficiency Standards Non-Residential ACM Manual. Contractor shall also complete the Acceptance Requirements in the standards for duct sealing/leak testing. Refer to section 15050 for further information on Acceptance Requirements.

Retrofit Construction, including alterations to existing duct system or space conditioning equipment: All duct systems (supply, return, outside air intake and exhaust), except those exposed in the conditioned space, shall be sealed and leak tested in strict conformance with the requirements of section 149 of the 2005 California Building Energy Efficiency Standards. See drawings for extent of this work and leakage rate requirements. The leakage rate shall be confirmed through field verification and diagnostic testing in accordance with the procedures set forth in the 2005 California Building Energy Efficiency Standards Non-Residential ACM Manual. Contractor shall also complete the Acceptance Requirements in the standards for duct sealing/leak testing. Refer to Section 15050 for further information on Acceptance Requirements.

CLEANING AND PROTECTION

Refer to section 15880 for cleaning of new and existing ductwork

Clean ductwork internally of dust and debris. Clean external surfaces of foreign substances that might cause corrosive deterioration of metal or where ductwork is to be painted.

Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.

Temporary Closure: At ends of ducts that are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering that will prevent entrance of dust and debris until connections are to be completed.

At completion of work, check internal lining for small cuts, tears, or abrasions. Repair all damage with fire retardant adhesive.

DAMPERS

All dampers automatically controlled by damper motors are specified under "Temperature Control System" except those specified with items of equipment.

Provide opposed blade manual air dampers at each branch duct connection and at locations indicated on the drawings and where necessary to control air flow for balancing system. Provide an opposed blade balancing damper in each zone supply duct. Provide an access panel or Ventlok flush type damper regulator on ceiling or wall for each concealed damper.

Install fusible link fire dampers full size of duct at points where shown or required.

Provide 18 inch x 12 inch minimum hinged access doors in ductwork and furring for easy access to each fire damper; insulated access doors in insulated ducts. Label access doors with 1/2 inch high red letters.

Provide Ventlok Series 100, Durodyne, or equal access doors with hardware for convenient access to all automatic dampers and other components of the system, insulated type in insulated ducts. Provide Ventlok #202 for light duty up to 2 inch thick doors, #260 heavy-duty up to 2 inch thick doors and #310 heavy-duty for greater than 2 inch thick doors. Provide #260 hinges on all hinged and personnel access doors; include gasketing.

AIR INLETS AND OUTLETS

Provide all air inlets and outlets with gaskets and install so that there will be no streaking of the walls or ceilings due to leakage. Duct connection to outlet on exposed duct shall be full size of outer perimeter of outlet flange.

Unless otherwise indicated on Drawings, provide rectangular plenum on top of each diffuser and ceiling return for connection to ductwork. Line plenum with internal insulation as indicated for lined ductwork. Size plenum to allow full opening into air terminal.

Ceiling-mounted air terminals or services installed in T-Bar type ceiling systems shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity as the main runners.

Terminals or services weighing not more than 56 pounds shall have two No. 12 gauge hangers connected from the terminal or service to the structure above. These wires may be slack.

Support terminals or services weighing more than 56 pounds directly from the structure above by approved hangers. Provide 4 taut 12 gauge wires each, attached to the fixture and to the structure above. The 4 taut 12 gauge wires, including their attachment to the structure above must be capable of supporting 4 times the weight of the unit.

Secure air inlets and outlets to main runners of ceiling suspension system with two #8 sheet metal screws at opposing corners.

Furnish all air inlets and outlets with a baked prime coat unless otherwise noted. Provide off-white baked enamel finish on ceiling-mounted air inlets and outlets. Paint exposed mounting screws to match the material being secured.

Air inlets and outlets shall match all qualities of these specified including appearance, throw, noise level, adjustability, etc.

FANS

Each ceiling-mounted fan shall have variable speed switch and integral backdraft damper. Mount variable speed switch within fan housing. Mark final balance point on variable speed switch.

Provide access doors for fans or motors mounted in ductwork.

Mount all fans as detailed on Drawings and in compliance with CBC standards.

Fan motors mounted in air-stream to be totally enclosed.

Completely line supply, return or exhaust fan cabinets with 1 inch thick, 3/4 pound density acoustic insulation securely cemented in place.

Roof fans shall be mounted level.

Provide heavy-duty rubber gasket between exhaust fan mounting flange and roof curb, or as required for an airtight installation.

Label fume hood fans with sign "CAUTION - HAZARDOUS EXHAUST".

RELIEF VENTS

Install relief vents to provide a level mounting for backdraft damper.

TEMPERATURE CONTROL SYSTEM

General: Must comply with the requirements of Title 24 control and set back requirements.

Provide thermostats where indicated on drawings. All wiring shall be in conduit. Provide all relays, transformers and the like to render the control system complete and fully operable. All control conduit to be rigid steel type.

TESTING AND BALANCING

Obtain the service of an independent test and balance agency that specializes in, and whose business is limited to, testing and balancing of air conditioning systems. Balance agency shall be a member of Associated Air Balance Council (AABC). Coordinate testing and balancing agency work with work of other trades.

Testing and balancing agency, as a part of its contract, shall act as authorized inspection agency and shall report any discrepancies or items not installed in accordance with Contract Drawings and/or Specifications pertaining to air and water distribution, and exhaust systems.

Balance report shall be signed by the Contractor, attesting that all reported deficiencies have been corrected. Balance reports containing uncorrected deficiencies will be rejected.

Test economizer cycle for each air system.

Adjust control systems to provide correct operation.

Adjust relief air dampers as required to provide 100 percent relief in economizer mode, and confirm satisfactory operation of all backdraft dampers.

Provide, as part of air balance report, final settings of each economizer control, and total air flow through relief air hood.

ACCEPTANCE REQUIREMENTS

In addition to the testing and balancing requirements specified in the previous section, the contractor shall also be responsible to complete all the Acceptance Requirements of the 2005 California Building Energy Efficiency Standards. Refer to Section 15050 for further information on Acceptance Requirements.

EQUIPMENT MOUNTING

Mount and anchor equipment in strict compliance with drawings details. Alternate anchorage methods will not be considered for roof mounted equipment.

*END OF SECTION 15800.*

**END OF MECHANICAL TEHCNICAL SPECIFICATIONS**

# PROJECT SITE

# LOCATION MAP

"Jane Hahn Juvenile Hall" located at
306 N. Villa Avenue, Willows, CA 95988

# PROJECT SITE

# LOCATION MAP

"Orland Administration Building" located at
821 East South Street, Orland, CA 95963