

PART 1 – GENERAL

These standards and procedures apply to the Basic Materials and Methods for the design and installation of products, assemblies and equipment applicable to the mechanical work at SeaTac International Airport and surrounding facilities that are owned and maintained by the Aviation Division.

1.01 DESIGN CRITERIA

A. Mechanical Rooms, Mechanical Penthouses, Air Handler and Fan Rooms, Meter Rooms, Valve Rooms etc.:

1. Fan rooms delivering conditioned air to public spaces shall be located at or above nearest roof tops and have unobstructed air intake louvers facing away from the airfield (generally, Northeast).
2. Rooms shall be sized large enough to service all equipment without having to crawl under or to climb over adjacent equipment, piping, appurtenances, etc. Fan rooms shall have an adjacent free space equivalent in sizes to the largest air handler or installed fan. Multiple air handlers may share “three spaces” for every two (2) air handlers.
3. Rooms shall be provided with a domestic water hose bibb and 115 V duplex outlets spaced not more than 50 ft apart.
4. All mechanical rooms shall be located along exterior walls with large doors and easily removable panels designed to allow passage of largest piece of equipment. Where the rooms are not located on the ground level – a service elevator shall be provided to the same level of the mechanical rooms, with non-obstructed paths of sufficient structural strength to allow removal of largest pieces of equipment along the path.
5. All equipment in these rooms shall be “curb mounted” with 4” minimum height curb using embedded 2” primed and painted steel angle for forming top edges. Curb shall extend 6” minimum from edges of equipment mounted on it. These rooms shall be provided with an access door or removable panel large enough to remove and replace largest equipment contained therein.
6. Room floors shall be sloped to interior floor drains and coated with waterproof seal paint coating (50% solids minimum by weight, Low VOC, 2 mils min dry coverage) including non-skid media. Coating to be Sherwin Williams, Armorseal Floor Plex, Henkel Bigfoot Pedestrian, or approved equal.

7. Acoustical Criteria: In general, follow ASHRAE criteria to limit sound power levels to the spaces served to 40 dBA or less and to keep radiated SPL at the unit to less than 70 dBA at 3 feet unless project identifies a more stringent requirement.
8. Expansion joint guides and anchors should be coordinated in submittal to confirm compatibility.
9. All control panels shall be located on a common wall or standing structure with adequate clearance in front and without obstructing service access to other adjacent equipment, pipe, electrical panels, etc...
10. Per the Stormwater Management Manual, use of exposed zinc in any form for exterior application is not allowed. See latest edition of Stormwater Management Manual.

B. Utilities:

1. Route utilities supplied by Central Mechanical Plant through existing utilidor/tunnel systems.
2. Provide service header for service entering building with all valves, meters, strainers, pressure reducing valves, backflow preventers and major branch connections at the service header. Each building shall have an approved reduced pressure principal backflow preventer and a pressure-regulating valve on the entering potable water system. Service header shall include shutoff valves at each major branch connection with future extension capability.
3. Provide pressure gauges at all services entering building, at pressure reducing valves inlet and outlet, pump inlets and outlets and on equipment requiring pressure-confirming operation.
4. Provide metering devices for chilled, heating, steam, condensate, domestic water and natural gas for each building and/or tenant as directed by Port of Seattle and to meet Washington State Energy code requirements. Locate required tenant meters outside of tenant space in an accessible area. Meters shall be labeled to match the space they serve.
5. Provide approved cross connection devices as required by F&I Standards for each tenant located outside of tenant space in an accessible area. When the cross connection devices are provided with a drain connection, size the drain pipe three pipe size increments larger than device outlet and route to the nearest floor drain or connect to the building sanitary sewer system with approved air gap fitting.

6. Hot Taps are never allowed unless approved by F&I. Connections to existing piping shall be accomplished using a “TEE” in all cases. Tapping Tees are not acceptable. Shut down service to be branched and weld flanges or fittings to the pipe and install a Tee fitting. Follow Mechanical system standards for material types etc.
7. Provide DDC System activated and controlled kitchen exhaust systems and other tenant exhaust systems. Controls shall be located outside Tenant space except emergency shutdown. Areas with smoke control shall comply with proper sequence of control to support the smoke control system.
8. Provide bypass connections (with isolation valves ball or butterfly), at major branches and fixture groups to maintain continuous services and allow for maintenance.
9. Provide valves to permit isolation of equipment and portions of the building piping systems (such as floor levels, restrooms, branch risers) for maintenance, alterations and repairs without shutdown of entire system.
10. Provide thermometers and portable instrument connections on supply and return side and at all locations where fluid mixing or heat transfer occurs.
11. Provide galvanized or manufactured pipe sleeves for all concrete, masonry and fire rated penetrations.
12. Provide floor drains or floor sinks with adjacent floor area sloped to drain. Install trap primers per Mechanical Standards. Entire floor shall be sloped, not only the area around the floor drain or floor sink.
13. Provide piano-hinged or four (4) cam lock hinged side access doors with proper access to all equipment requiring maintenance. Provide side access doors sized to allow the largest piece of equipment (fan, motor, coil, etc.) to be removed and replaced. Minimum access door size shall be 14-inch x 14-inch. Provide bottom access for fan replacement on mixing boxes and coil cleaning. Latches shall be galvanized sheet metal 14 gauge or heavier.
14. At all equipment connections (e.g. chillers, heating and cooling coils, heat exchangers, pumps, etc.), offset pipes and provide break-out flanges or couplings to allow removal of coils. Orient flanges or couplings such that branch piping does not conflict with equipment removal.
15. Perform pipe stress analysis on all piping systems. Provide design of the pipe supports, guides, and attachments based on the piping support forces calculated.

C. Vibration Isolation and Seismic Restraints:

1. Secure equipment, components and accessories in accordance with seismic and wind restraint requirements per code.
2. Provide vibration isolation for all rotating equipment.
3. Ductwork, piping and conduits shall be provided with seismic and wind restraints in accordance with SMACNA Seismic Restraint Manual and current IBC requirements.
4. Equipment shall be seismically restrained to resist lateral forces acting in any direction in accordance with International Building Code.
5. A professional Structural Engineer licensed in the State of Washington shall prepare seismic calculations with stamped and signed certification. If the licensed engineer determines that the applicable International Building Code does not require some of the equipment, ductwork, piping and conduit to be seismically or wind restrained, then submit a stamped and signed statement from the professional engineer to that effect.
6. Mechanical equipment, piping, ductwork and materials shall not be suspended or supported from other pipe, electrical conduit, ceiling systems or any non-structural member.
7. Vibration from rotating equipment to structure must be tested and commissioned.
8. Vibration isolators subjected to vibration must be secured in place with threadlocker adhesive or other means to minimize movement over time.
9. Provide a bonding strap from equipment to ground where vibration isolators interrupt the grounding path.

D. Spare/Extra Parts:

1. Spare and extra parts shall be identified for mechanical system and components (i.e., fan belts, filters, pump seals, fusible links, sprinkler heads, etc.). Spare and extra parts are not provided as part of the capital program; therefore, all capital projects cannot provide spare and extra parts. Include spare parts information in O&M manuals.
2. When a new or existing air handling unit is used during construction activities, temporary filters must be installed. One prefilter set and one bag filter set shall be installed and used during any time in construction that the fans are operated. A new set of filters (pre, bag, and final as applicable) must be installed just prior

to occupancy after systems have been cleaned and flushed when it has been determined by POS that it is acceptable.

E. Restroom floors/Kitchens/Sink/Areas/Wet Areas Above Grade:

1. All wet areas above grade shall have a waterproofing membrane installed. The entire restroom floor/kitchen area and all the “wet” serving areas (bars, soda dispensing machines, drink stations, walk-ins, refers, steamers, coffee bars, etc....) must be covered 100% and rolled up 4” along the shell or base walls. Counters, cabinets, built-ins, etc. shall be on top of the membrane. The membrane shall be coordinated with all penetrations and membrane extended up and sealed around pipe and appropriate fire seal applied as required. No pipe, conduit, drain, or other coring of waterproof membrane after installation will be accepted. Membrane shall be installed under plumbing wall studs or other means to protect plumbing penetrations from leaking as required. Office area, lunchrooms, or other locations where only one sink is installed for occasional use shall have the membrane installed under the sink base and extended 5’-0” in each direction or rolled up base walls 4” if wall is within 5’-0” range.
2. Waterproof anti-fracture membrane shall be 40 mil (mm) minimum thick, ASTM D412/D751 compliant for elongation, ASTM E492/C627 compliant for impact resistance/system performance, ASTM E96 compliant for moisture vapor transmission. Fabric reinforced laminate sheet with self-stick back and fully weldable or sealable seams. All joints and seams to be covered with 2” of overlap strip or be heat welded/thermoset welded. National Applied Construction Products Strataflex, Protecto Wrap AFM-WM, Compotite Composeal Gold, WR Meadows MEL-ROL Procon Membrane, or approved equal.

F. Heat Rejecting Equipment

1. Walk in coolers, freezers, ice bins or other heat rejecting equipment whose power input exceeds 15 amps at 120 VAC or 7.5 amps @208/240 VAC shall be provided with exterior remote condensing units.
2. No more than three pieces of heat rejecting equipment as outlined above is allowed for installation per zone inside the conditioned spaces of the Terminals. The designer is not released from the responsibility of calculating total space loads and providing adequate cooling and heating for the space.

G. Freeze Protection

1. Provide freeze protection for components subjected to freezing conditions, including but not limited to outdoor water pipes, potable water boxes, and air handling unit heating coils. Where heat trace tape is used, provide on a dedicated electrical circuit with power indicator light located in a visible location.

1.02 SUSTAINABLE MECHANICAL FEATURES

A. General:

Sustainable mechanical equipment and systems are indicated in the mechanical guidelines under the appropriate sections.

B. Owner Approval:

Discuss any sustainable equipment and systems not indicated in the mechanical guidelines during the beginning of the pre-design study or design phase.

C. Mechanical Features Not Allowed:

1. The following systems and equipment have been reviewed by POS and have been determined not acceptable:
 - a. Vacuum Waste System.
 - b. Waterless Urinals.
 - c. Instantaneous Domestic Hot Water System.
 - d. Displacement Ventilation System.
 - e. Natural Ventilation System.
 - f. Boiler Stack Economizer System.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All material, equipment and components shall be new.
- B. Plastic (ABS, CPVC, PE, PVC) shall not be used inside of buildings.
- C. Grooved end piping is not allowed on HVAC or plumbing systems, except on selected pumping assemblies (with prior approval by F&I).
- D. New piping shall not have any corrosion or rust when installed. Refinish any rusted or corroded piping at time of installation.

- E. All new equipment and components, including gaskets, shall be asbestos free.
- F. Fittings are required for all piping changes in direction and branch connections.

2.02 EQUIPMENT APPROVALS

- A. Electrically powered mechanical equipment and assemblies shall have the approval of and shall be labeled from one of the following agencies: Underwriters Laboratories (UL), Canadian Standards Association (CSA), or Electrical Testing Laboratories (ETL).
- B. ASME code stamp required on all pressure vessels and relief valves. Provide Certificate when required by the POS Insurance Company and State Boiler Inspector showing approval of the equipment and its installation. Contractor to arrange and pay for Pressure Vessel or Boiler Inspections prior to turnover.
- C. All materials, equipment, components and processes requiring approval from Washington State Department of Labor and Industries, or other nationally recognized testing agency, shall be labeled as approved in accordance with the provisions of the Washington Administrative Code.

2.03 PIPING AND VALVE IDENTIFICATION

- A. Manufacturers: Seton, M.S.I., Brady, or approved equal.
 - 1. Materials: Self Adhesive Vinyl or pre-coiled type with over coated UV resistant ink and heavy-duty vinyl similar to Seton model M3968.
 - 2. Ductwork located in mechanical rooms shall have 2" high letters identifying Supply Air, Exhaust Air, Return Air, Outside Air, Relief Air locate at air handlers and penetrations of mechanical rooms.
 - 3. All accessible utility service piping is to be coded with color banding tape.
 - 4. Piping in concealed spaces (ceiling and crawl spaces, plumbing chases, at access doors, etc.) must have the coding applied prior to concealment.
 - 5. Piping in mechanical rooms and spaces and other areas where exposed to view (boiler rooms, utility tunnels, fan rooms, pump rooms, etc.) must have the coding applied after painting.
 - 6. The 3-band color-coding system must relate the following information (reading downstream in direction of flow):
 - a. The character or degree of hazard of the medium contained.
 - b. The temperature level.

- c. The media or material contained.
 - d. The direction of flow.
7. The first (upstream) band is to be not less than three-fourths inch (3/4 inch) wide and is to indicate media (hazard) indicator consistent with all standard adopted color schemes as follows:
- | | | |
|--------|---|------------------------|
| Green | — | Safe Material |
| Yellow | — | Dangerous Material |
| Red | — | Fire Protection System |
| Blue | — | Protective Material |
| Purple | — | Valuable Material |
8. The second (middle) band is to be not less than three-quarters inch (3/4 inch) wide but the same width as the first and is to indicate “Temperature Range” and is to be spaced three-fourths inch (3/4 inch) from the first band.

Code Color	Temperature Range	Typical Systems	Range (°F)
Red	Very Hot	Heating Hot Water Supply Steam Condensate	Above 180°
Orange	Hot	Hot Water (domestic) Heating Hot Water Return Refrigerant Hot Gas	Below 180°
Yellow	Warm	Condenser Water Coil Condensate (Cooling) Refrigerant Liquid Supply	Less than 100°
Green	Cool	Cold Water (domestic) Well Water	50°
Blue	Cold	Chilled Water Return	Less than 60°
Purple	Very Cold	Chilled Water Supply Refrigerant Suction	Less than 53°

9. The third (downstream) band is to be not less than one and one-half inches (1-½ inch) wide or not less than twice the width of the preceding bands and is to indicate the “media” and “direction” and spaced three-fourths inch (¾ inch) from the preceding band.

Blue	—	Water
Brown	—	Soil or Waste
Aluminum	—	Vent
Red	—	Steam
Orange	—	Condensate
Purple	—	Refrigerant
Yellow	—	Fuel Oil
Green	—	Natural Gas
White	—	Air

10. When flow can be in either direction, a second one and one-half inch (1-½ inch) band is to follow the first band arranged to indicate the probable principal flow direction and located three-fourths inch (¾ inch) from the adjacent (i.e., four 4) bands are required on reversible-flow piping).

<u>BANDING SCHEDULE</u>				LEGEND:	
	WIDTH OF BAND				
	<u>3/4</u>	<u>3/4</u>	<u>1-½</u>		
Chilled Water (return)	G	B	B	<u>AL</u>	Aluminum
Chilled Water (supply)	G	P	B	<u>B</u>	Blue
Cold Water (domestic)	G	G	B	<u>BK</u>	Black
Compressed Air	G	G	W	<u>BR</u>	Brown
Condensate, Steam (inc. pumped)	Y	R	O	<u>G</u>	Green
Coil Condensate (Cooling)	G	B	BR	<u>O</u>	Orange
Condenser Water (return)	G	BK	B	<u>P</u>	Purple
Condenser Water (supply)	G	BR	B	<u>R</u>	Red
Fire Protection * See 11. Below				<u>Y</u>	Yellow
Fuel Oil (return)	Y	Y	Y	<u>W</u>	White
Fuel Oil (supply – pre heated)	Y	O	Y		
Fuel Oil (supply)	Y	G	Y		
Fuel Oil Vent	Y	Y	AL		
Generator Cooling Water (return)	O	O	B		
Generator Cooling Water (supply)	O	G	B		
Glycol Chilled Water (return)	Y	B	B		
Glycol Chilled Water (supply)	Y	P	B		
Grease Waste	G	O	BR		
Hot Water (domestic)	G	O	B		
Hot Water Heating (return) inc. glycol	Y	O	B		
Hot Water Heating (supply) inc. glycol	Y	R	B		
Hot Water, Circulating/ Tempered Water (domestic)	G	Y	B		
Natural Gas	Y	G	G		
Natural Gas Vent	Y	G	AL		
Non-Potable Water/Process Water	Y	G	B		
Rain Leader/Overflow Rain Leader	G	Y	BR		
Refrigerant Relief	Y	P	P		
Refrigerant Vent	Y	P	AL		
Refrigerant, Hot Gas (Freon)	P	O	P		
Refrigerant, Liquid Supply (Freon)	P	Y	P		
Refrigerant, Suction (Freon)	P	P	P		
Soda Dispenser Syrup	G	Y	Y		
Steam (high/low pressure)	Y	R	R		
Steam Vent	Y	O	AL		
Vent/Grease Vent/Foundation Vent/IWS Vent	G	G	AL		
Waste/Indirect Waste/Pumped Waste/IWS Waste	G	G	BR		
Well Water	Y	G	P		

11. Fire Protection Sprinkler Mains: All fire mains and branch piping 2-1/2" diameter and larger shall be labeled on both sides of every wall or floor penetration and every 25 feet with a vinyl label. Labels shall have white lettering at least 1" in height on a red background. Labels shall indicate direction of flow, the riser name/number, and the words "FIRE SPRINKLER." Piping less than 2-1/2" diameter may be marked with vinyl label or have riser name, flow direction and "FIRE SPRINKLER" written on the pipe with a white paint pen. **Note system painting requirements in Sprinkler section.**
- B. For all valves provide numbered brass or laminated plastic tag specified to be connected to the valve with a brass jack chain. Tags must be at least 50 millimeters (2 inch) round or square, with stamped, black-filled lettering. In addition to numbers, tags will be lettered to indicate fluid carried through the valve [e.g., "CW"]. Numbers will be keyed to the mechanical construction drawings. (See also 08 General Provisions Mechanical ID System).

2.04 DIRECT DIGITAL CONTROL (DDC) SYSTEM

- A. Manufacturer: Siemens Building Technologies, Building Technologies Division (No Substitutions).
- B. Standard for all building control, smoke control and monitoring systems.
- C. Flow Metering shall be provided for all main services of Domestic and chilled water, steam and condensate.
- D. Variable Frequency Drives (VFD) shall be provided for all variable flow systems. Magnetic drives may be used with prior approval by F&I and when not prohibited by energy code.

2.05 AUTOMATIC FLOW CONTROL VALVES

- A. Manufacturer: Griswold Controls, Flow Control Industries Inc Delta-P, Custom Valve Concepts Kates, or approved equal.
- B. Supply-Side: Separate ball valve, strainer, and flow cartridge. Strainer selected from products listed below for strainers.
- C. P/T fittings, drain valve with hose bib adapter and cap. Ball valves shall be as selected from Section 200400 Valves.

- D. Return-Side: Separate ball valve, P/T fittings and manual air vent. Ball valves shall be as selected from Section 200400 Valves.
- E. Insulated Hoses - Hose materials shall be high quality polyethylene pipe insulation over a stainless steel braided inner core and withstand working pressure of 375 PSI (1/2"), 300 PSI (3/4", 1", 1-1/4") at 194°F and 300 PSI (1-1/2", 2") at 194°F.

2.06 PLUMBING BALANCING VALVES

- A. Manufacturers: Preso, Armstrong, DeZurik, or approved equal.
- B. Venturi type flow measurement unit with pressure/temperature readout valves. ASTM A48 Cast Iron Body or ASTM B584 Bronze Body, ASTM B584 Bronze Disc ANSI 125# flanges or threaded as required for application. 250 psi max working pressure. 225 deg F max working temperature. EPDM seat and Brass ASTM B283 stem. EPDM elastomer O-rings. Lead Free.
- C. Portable Meter: Differential pressure gage, two 12-foot hoses, complete with carrying case.

2.07 HYDRONIC BALANCE VALVES

- A. Manufacturers: Preso, Barco, DeZurik, or approved equal.
- B. Venturi type flow measurement unit with pressure/temperature readout valves and ball or plug valve. ASTM A126, 125# class body, (ASTM A216 for 250# class), Teflon or regenerative Teflon seats, ANSI B6.1 connections, rated for 250 psi, 250 deg F temp rating. 100% shut-off stainless steel ball or plug valve.
- C. Only use as pump balancing valve or at multiple coils on a single air handler. Plug type balancing valve only, schedule on drawings, remove balance handle and provide to Port of Seattle Boiler Room prior to completion.
- D. Portable Meter: Differential pressure gage, two 12-foot hoses, complete with carrying case.

2.08 RELIEF VALVES

- A. Manufacturers: Watts, Armstrong, Taco, or approved equal.
- B. ASME rated, brass or bronze body with brass and rubber, wetted, internal working parts, to suit system pressure and heat capacity.
- C. Relief valves shall be in accordance with ASME boiler and pressure vessels Section IV.

2.09 PRESSURE/TEMPERATURE (P/T) TEST PORTS

- A. Manufacturers: Peterson Equipment Company, Sisco, Omega, or approved equal.
- B. Brass construction, 1000 psig maximum working pressure, 1/4-inch NPT, with extension for insulated lines.

2.10 THERMOMETERS/PRESSURE GAGES

- A. Manufacturers: Trerice, Marsh, Palmer, Weiss, or approved equal.
- B. Thermometers: 7-inch scale or 9-inch scale for mounting above 7-feet above finished floor, cast aluminum case, separable brass socket, and extension socket for insulation.
- C. Pressure Gages: 4-1/2 inch diameter or 6-inch diameter for mounting 7-feet above finished floor, cast aluminum or steel case, glass lens, 1/4-inch connector. 1/4-inch brass or stainless steel isolation valve, 1/4-inch coiled siphons for steam applications. Provide liquid filled pressure gages for Pump applications.

2.11 EXPANSION TANKS

- A. Manufacturers: Amtrol, Wessels, Taco, or approved equal.
- B. Hydronic Systems: ASME construction pre-pressurized bladder or diaphragm type expansion tank, plugged fittings for vent and drain, capped fitting with valve and pressure gage for air charge connection.
- C. Potable Water Systems: Expansion tank shall be ASME designed and constructed, FDA approved and labeled for use on potable water systems.

2.12 AIR SEPARATORS

- A. Manufacturers: Amtrol, Wessels, Taco, or approved equal.
- B. ASME construction, tangential type with strainer, top air outlet and bottom blow-down connection, and same size as connecting pipe.

2.13 DIELECTRIC FITTINGS

- A. Manufacturers: Victaulic, EPCO, B & K, or approved equal.
- B. ASTM A53 electro zinc plated steel body with threaded end connections and NSF/FDA approved LTHS high temperature stabilized polyolefin polymer liner; suitable for 200 F and 300 psi. Isolation flanges with isolation bolt kits must be provided for piping over 2".

- C. Dielectric unions: Not Allowed.

2.14 STRAINERS

- A. Manufacturers: Hoffman, Sarco, Watts, or approved equal.
B. Wye-Pattern, cast-iron body or bronze, ASTM A126, flanged ends for 2-1/2 inch and larger, threaded connections for 2 inch and smaller, bolted cover, perforated (3/32-inch maximum size) Type 304 stainless-steel screen, and capped blow-down valve. Comply with valve section.

2.15 AIR VENT

- A. Manufacturers: Hoffman, Armstrong, Sarco, or approved equal.
B. Manual: Disc type with built in check valve.
C. Provide with isolation valve on inlet. Pipe to floor drain or sink.
D. Auto-Drains are not acceptable.

2.16 AIR ADMITTANCE VALVES

Not Allowed.

2.17 PIPE FLEXIBLE CONNECTORS

- A. Manufacturers: Flexonics (US Hose), Metraflex, Flex-Weld (Keflex), or approved equal.
B. Stainless steel bellows with woven, flexible, stainless steel or bronze, wire-reinforcing protective jacket; 150 psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 2-inch misalignment or motion any direction.
C. When greater than 150 psig is required, contact F&I or MUST.

2.18 PUMP SUCTION DIFFUSERS

- A. Manufacturer: Match to pump manufacturer.
B. Angle body type with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16-inch diameter openings for pump protection, permanent magnet within flow stream, removable for cleaning; orifice cylinder with mesh strainer, adjustable foot support.

2.19 PIPE HANGERS

- A. Manufacturers: Rilco, Pipe Shield, PHD, Anvil, or approved equal.
- B. Conform to MSS SP-58, MSS SP-59 and ANSI B31.1
- C. MSS Type 1 or 43 (Adjustable Steel Clevis/Adjustable Roller) is preferred for all applications and service temperatures listed in MSS (-19 deg F to 750 deg F). MSS Type 7 (Adjustable band Hanger) or MSS Type 10 (Adjustable Swivel Ring Band Hanger) are allowed for piping size 1" and below. All grease waste pipe hangers to be rubber lined to protect stainless piping. All hangers for copper or other dissimilar metals must be coated with copper, rubber, or inserts used to protect piping. Any pipe over 6" requires MUST approval for hanger types. MSS Type 41 is preferred, but other MSS Types may be required depending on size and application, defer to MUST. Detailed design drawings on structural and mechanical plans are required for hangers over 6". Pipe clamps, U-bolts, Single rod offset, clamps, J-hangers, Split rings, Adjustable ring hangers, Split clamps, Wall hooks, and "J" Hook style supports are not allowed.
- D. Multiple pipe runs in parallel can be supported with MSS Type 59 (Trapeze) can be used for pipes up to 1-1/2". Pipes over 1-1/2" must be supported with supports that are detailed on design drawings on structural and mechanical plans. Pre-engineered strut systems are not allowed for piping over 1-1/2". If multiple pipe support is desired for economy, structural tube or channel with saddle supports or pipe rolls per MSS are preferred.
- E. MSS Type 21 (Center Beam Clamp) is the preferred method when attaching to beams, side beam clamps are to be avoided as much as possible. Beam C-clamps are not allowed. When welding, MSS Type 22 (Welded Beam Attachment) is preferred.
- F. Wall supports shall be strut for pipes to 1-1/2" and MSS type 31, 32, or 33 for pipes over 1-1/2".
- G. MSS type 8 (Riser Clamp) shall be utilized per MSS. Mount on strut. Do not support clamp from pipe sleeve or concrete.
- H. Threaded rod to be sized per MSS-SP-58 and 69 Table 4, double nuts installed under hanger and threaded rod cut to extend no more than 3 threads below hanger.
- I. Hanger spacing shall be per MSS-SP-58 and 69 Table 3.
- J. Hanger inserts shall be fiberglass, calcium silicate, or high-density foam as required by application, size and service temperature. Insulation protection shields must be provided and engineered per MSS-SP-58 and 69 Table 5. For insulated piping below 32 degrees (PC Air Piping) the shields must incorporate high density foam inserts (Polyisocyanurate, foam glass, etc. refer to (200700)). The support/inserts

shall allow for maintaining vapor barrier integrity. In addition, the inserts and protective shield or other clamping devices (to outside of insulation) must be designed specifically for the application for temperature and product (not per Table 5, see notes in table) and exert enough clamping force to assure that the support will move axially with the pipe and will not slip under the design conditions. Show drawings and submittal may require custom inserts at specific lengths and calculated shields or pipe clamps that are designed specifically for material compressive strength and possible point loading. Refer to MSS-SP-58 and MSS-SP-69 and manufacturers recommendations.

- K. For point load applications (type 31, 32, 33, 41, 44, and 45 hangers) shield thicknesses and length must be increased per MSS-SP-58 and designed specifically for system operating temperature (20°F for PC Air Piping)
- L. Horizontal movement shall not exceed 4° and shall be considered when designing hangers. If floors/roofs above support vibrating or vehicle equipment, designer shall calculate and design seismic supports and spring supports into the construction documents. Spring supports shall be selected per MSS-SP-58 and 69 Table 2. Specific slides and guides must comply with MSS-SP-58 and 69. Connections to pipe attachments shall be outside of the pipe insulation so that movement of the pipe does not cause damage to the insulation. Hangers, supports, and guides shall not be applied directly to horizontal piping for piping applications below 32°F (PC Air Piping).
- M. Pipe guides and anchor for piping application must be considered. The following criteria shall be considered in the selection of low temperature pre-insulated pipe supports:
 - 1. Vertical, lateral and axial support design load limits.
 - 2. Vertical, lateral, and axial support design travel limits.
 - 3. Temperature of the pipe support, at the pipe surface, and ambient conditions.
 - 4. All test or pre-operational loads that may be exceeded normal operating conditions.
 - 5. Any dimensional clearances needed during installation and operation must be specified.
 - 6. All loading and displacements caused by seismic, hydraulic surge, or other disturbances.
 - 7. Temperature at the support steel.

- N. Seismic and wind/snow design for exterior piping shall be calculated in submittals and shop drawings and be provided by a Structural Engineer licensed in the State of Washington and include design utilizing rod stiffeners, seismic braces or cable, etc. in accordance with MSS-SP-127, MSS-SP-58, and MSS-SP-69.
- O. All pipe supports shall be scheduled on drawings.

2.20 VIBRATION ISOLATION

- A. Manufacturers: Mason, Amber Booth, Kinetics, Metraflex, Pipe Technology Products, Bergen Power, or approved equal.
- B. Equipment: Vibration isolation springs with seismic restraints and bases to match equipment provided.
- C. Refer to paragraph 2.19 L, M, and N above for pipe vibration isolation information.

2.21 MOTOR STARTERS

To be specified when provided by mechanical equipment manufacturer. Other starters to be coordinated and provided under Electrical Specifications.

2.22 MECHANICAL PIPE PENETRATIONS

- A. Manufacturers: Hubbard Enterprises/Holdrite; Hydro Preseal or equal to the following:
 - 1. Cast in place watertight device for protecting penetrating pipes, conduits etc. from expansion and contraction of concrete. Factory assembled for use in cast in place concrete floors and walls and consisting of two outer sleeves and a one-piece radial extended flange type water stop gasket, with mid body seal for employment and sealing to concrete slab providing a continuous water seal extending to the penetrating pipe or conduit.
 - 2. Outer Sleeves attached to the mid body seal forming an area with which to attach the device to the structural reinforcing rod to hold the sleeve positioned in the wall.
 - 3. Water stop mid-body seal: Flexible polymer seal with radial extended flange, consisting of one to three concentric rings which lock into concrete maintaining a seal over time, as the concrete contracts from the sleeve.

- B. ASTM A53, Standard weight (Schedule 40), Grade B, electric resistance welded or seamless, black steel sleeve.
 - 1. Mechanical Sleeve Seals shall be made of a series of modular interlocking molded synthetic EPDM or nitrile rubber rated from -40°F to 200°F temperatures. Links to be fabricated with heavy duty plastic or metal plates. Links shall be connected with corrosion resistant nuts and bolts conforming to ASTM B633. Seal shall completely fill annular space and withstand 40 feet of head of water or 20 psi minimum resistance when torqued and in final position. Metraflex Metraseal, Link Seal, APS Innerlynx, BWM Pipesal or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install dielectric fittings wherever joining dissimilar metals.
- B. Install piping to allow application of insulation plus 1" clearance around insulation.
- C. Banding applied outside of buildings or service tunnels must be applied by painting directly on metal surface of Pipe Jacket.
- D. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and material in relationship with other systems, installations, and building components. Show space requirements for installation and access. Dimensions will be shown on drawings indicating clearances, distances, and elevations of different systems to ensure mechanical systems can be installed with proper maintenance access. Drawings must be shown for planned piping layout including valve stem movement and specialty locations, clearances for maintaining insulation, service clearance, disassembly for component replacement, support details, other systems installed in proximity of mechanical installation, exterior wall and foundation penetrations, fire rated wall and floor penetrations, sizes and locations of concrete pads and all equipment bases, scheduling, sequencing, phasing, movement, and positioning of large equipment into building during construction, fire risers, floor plans, elevations, and details to indicate installation.
- E. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and layouts of piping

systems were used to size pipe, calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, unless deviations to layout are approved on coordination/shop drawings.

3.02 DEMOLITION

- F. Demolition of existing services shall be back to the nearest main. Provide shut-off valves or duct caps. Stubs must be no longer than 12". Contact the Boiler Room 206-787-5476 for termination of pneumatic tubing. Contractor not to demolish any pneumatics without coordination with Boiler Room.

3.03 MECHANICAL PIPE PENETRATION SEALS

- G. Fire protection piping shall be identified using three-color band system as in Section 2.03 as well as being labeled with sprinkler riser # sticker on all piping 3" and larger.
- H. Install sleeves in new concrete floors or new walls. Extend pipe sleeves a minimum of 2-inches above floor or beyond wall. Use waterproof fire seal caulk or pipe seal as approved by Airport Building Department. Pipe riser clamps shall be supported off floor and not pipe sleeves. Where fire ratings are not required, provide mechanical pipe penetration seals for existing core drilled floors/walls.

END OF SECTION