
DIVISION 23 – HEATING VENTILATING, AND AIR-CONDITIONING (HVAC)

23 0130.51 – HVAC AIR DUCT CLEANING

CLEANING

Comply with NADCA ACR 2006.

Systems and Components to Be Cleaned:

- Air terminal units

- Air devices for supply and return air

- Air-handling units:

 - Interior surfaces of the unit casing.

 - Coil surfaces compartment.

 - Condensate drain pans.

 - Fans, fan blades, and fan housings.

- Ductwork

- Filters and filter housings.

Particulate Collection:

- HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building.

- Control odors and mist vapors during the cleaning and restoration process

Duct Systems:

- Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).

- Create service openings as necessary to accommodate cleaning

Mechanical Cleaning Methodology:

- Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.

Cleaning Mineral-Fiber Insulation Components:

- Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.

Coil Cleaning:

Measure static-pressure differential across each coil and document before and after.

Antimicrobial Agents and Coatings:

Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

Requirement of Pleated Filters

Need to be clean and also provide a replacement set at completion of project.

23 0513 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

GENERAL MOTOR REQUIREMENTS

Comply with NEMA MG 1 unless otherwise indicated.

Comply with IEEE 841 for severe-duty motors.

23 0516 – EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

23 0533 – HEAT TRACING FOR HVAC PIPING

23 0548 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

23 0553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

GENERAL LABELLING

1. The contractor is to label the piping with text as to the loop function and loop medium. Similar as to what has normally been done for other buildings on campus (ex. Chilled Water Supply, Chilled Water Return, Glycol Hot Water Supply, etc.). In addition to the text labeling, if it is financially feasible within the project, please color code the exterior of the piping/insulation as to the process (ex. Steam, hot water, chilled water, domestic hot water, etc.).
2. Stencils – Black Paint
3. CHWR – Chilled Water Return
4. CHWS – Chilled Water Supply
5. STM-115 – 115 PSIG Steam
6. STM-60 – 60 PSIG Steam
7. STM-15 – 15 PSIG Steam

8. LP COND – Low Pressure Condensate Return
9. HP COND – High Pressure Condensate Return
10. HWR – Heating Water Return
11. HWS – Heating Water Supply
12. HWGLR – Heating Water Glycol Return
13. HWGLS – Heating Water Glycol Supply
14. HTRS – Heat Recovery Supply
15. HTRR – Heat Recovery Return
16. STORM – Storm Drain
17. DCW – Domestic Cold Water
18. DHW – Domestic Hot Water
19. DHWR – Domestic Hot Water Recirculation
20. GAS – Natural Gas
21. AIR – Compressed Air
22. OXYGEN – Oxygen
23. NITROGEN – Nitrogen
24. All building chillers are to be numbered sequentially.
25. All building cooling towers are to be numbered sequentially.
26. All building AHUs are to be numbered sequentially. Whether a unit is a MUA, H&V, RTU, etc. it shall be labeled as an AHU and numbered consecutively throughout the building. If the project is adding on to or renovating an existing building, the contractor needs to contact Facilities Management for the next available system number so each mechanical system in the building is numbered in consecutive sequence and without duplication.

- A. Valves shall be identified with a brass tag with brass ball-chain affixed to each valve indicating its enumeration and marked on the “As Built” as a legend which indicates what each numeral value serves accordingly. The legend will be provided to UND’s Preventative Maintenance Coordinator.
- B. Valves that are hidden from view behind ceiling tiles/access panels shall be indicated with color coded round stickers placed as near to the valve location as possible on the ceiling grid/panels. Color codes shall be as Follows:

- | | |
|----------------------|--------------------|
| 1. Dom Cold water: | Blue dot |
| 2. Dom Hot water: | Green dot |
| 3. Dom Hot recirc: | Green dot |
| 4. Natural Gas: | Yellow dot |
| 5. Compressed air: | Black dot |
| 6. Hot water heat: | Orange dot |
| 7. Steam/Condensate: | Gray or Silver dot |
| 8. Sprinkler: | Red dot |
| 9. Chilled water: | Purple dot |

- C. Piping Identification:

1. Contents and direction of flow on all piping (steam, gas, water, condensate, etc.) shall be identified by labeling.
 - a. Labels on piping up to 1-1/4" size shall be a minimum 1/2" high.
 - b. Labels on piping larger than 1-1/4" size or pipe covering shall be a minimum of 1" high.

Labels shall be applied at all points where pipes pass through walls, at each change of direction and on each 20 feet of straight lengths.

23 0593 – TESTING, ADJUSTING AND BALANCING FOR HVAC

GENERAL PROCEDURES FOR TESTING AND BALANCING

1. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing".
2. All hydronics need to be air balanced according to NEEB requirements.

23 0713 – DUCT INSULATION

A. INSULATION MATERIALS

1. Products shall not contain asbestos, lead, mercury, or mercury compounds.
2. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
5. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
6. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I, Type II with factory-applied vinyl jacket, Type III with factory-applied FSK jacket, Type III with factory-applied FSP jacket.
7. Mineral-Fiber Board Insulation: Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket or with factory-applied ASJ with factory-applied FSK jacket.
8. Mineral-Fiber, Pipe and Tank Insulation: Semi rigid board material with factory-applied ASJ or FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB.
9. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

FIRE-RATED INSULATION SYSTEMS

1. Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a [1] [2]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
2. Our preference is to have the exterior of the duct wrapped with minimum 1 ½” Owens Corning foil wrapped insulation. The interior of the duct should not be lined. (We have had problems with duct liner in the past. Duct liner holds dirt and is not good for maintaining indoor air quality. It also dries out over time and causes problems down the road. We have had problems with particles of the duct liner flaking off and getting into the air stream. No duct liner; only wrapped is the preference.

23 0716 – HVAC EQUIPMENT INSULATION

A. INSULATION MATERIALS

Comply with requirements in "Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.

Heat exchanger, chiller, loop piping and associated hydronic components shall be insulated with minimum 1 1/2” fiberglass insulation. Areas that are outside or susceptible to wear and tear from service access should be covered with aluminum or PVC chiller’s jacket to protect the integrity of the insulation. Valves, steam traps, condensate tanks, etc. that would need to be accessed for service are to have removable blankets installed.

23 0719 – HVAC PIPING INSULATION

A. Steam Heating Piping Insulation

1. All steam lines, steam condensate lines, and flash tanks shall be insulated with glass fiber pipe insulation in one piece molded section, 4 lb. nominal density, and of the following thickness:

Application	Pipe Size	Insulation Thickness
Steam lines (Low Pressure) 201°F - 250°F	2” and less	1-1/2”
	2-1/2” – 4”	2”
	5” – 6”	2-1/2”
	8” and over	3”
Steam lines (Medium	1” and less	1-1/2”
	1-1/4” – 2”	2”
	2-1/2” – 4”	2-1/2”

Pressure) 251°F - 305°F	5" – 6"	3"
	8" and over	3-1/2"
Steam lines (High Pressure) 306°F - 460°F	1" and less	2"
	1-1/4" – 2"	2-1/2"
	2-1/2" – 4"	3"
	5" – 6"	3-1/2"
	8" and over	4" total thickness
Condensate lines	1" and less	1"
	1-1/4" – 2"	1-1/2"
	2-1/2" and over	2"
Flash Tanks	All	2"

- B. Steam and condensate piping in areas prone to flooding, such as steam vaults, shall be piped using "Foam Glass" wrapped in a metal jacket.
- C. For High Temperature Equipment Insulation for equipment inside the building in conventional equipment rooms the following shall apply:
- All steam valves including control valves, expansion joints and the access end of strainers shall be covered with a custom fabricated insulation jacket secured around the fitting. Insulation Systems will be custom designed and engineered for each individual item which is not a standard product based on type of application, operating temperature, and environment. A close contour fit is essential for proper thermal performance and neat appearance.
 - Insulation Jacket shall be constructed of Teflon Impregnated Fiberglass Cloth with a minimum temperature rating to 500F and Dark Grey in color. Insulation shall be a minimum of one (1") Inch Thick.
 - Insulation jacket shall be secured to the fitting with stainless steel buckle and strap assembly, Grey color, Maximum Temperature Resistance 250°. Insulation Seams which do not tightly butt one another are Not Acceptable.
 - All reusable insulation blanket assemblies shall be labeled with laser label. The tagging systems will facilitate installation and reinstallation of all blankets and enable the manufacturer to provide replacements upon request by number assigned as imprinted on the label.

23 0800 – COMMISSIONING OF HVAC

23 0913 – INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

23 0923 – DIRECT-DIGITAL CONTROLS FOR HVAC

23 0943 – PNEUMATIC CONTROL SYSTEM FOR HVAC

23 0993 – SEQUENCE OF OPERATION FOR HVAC CONTROLS

23 1113 –FACILITY FUEL-OIL PIPING

SYSTEM DESCRIPTION

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.
 3. Fuel-Oil Valves: Comply with UL 842 and have service mark initials "WOG" permanently marked on valve body.
 4. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil piping.

PERFORMANCE REQUIREMENTS

1. Maximum Operating-Pressure Ratings: 3-psig (21-kPa) fuel-oil supply pressure at oil-fired appliances.

23 2113.33 –GROUND LOOP HEAT-PUMP PIPING

PIPES AND FITTINGS

1. Manufacturers:

Centennial Plastics, Inc.

Chevron-Phillips Chemical Company; Performance Pipe Division.

HORIZONTAL AND VERTICAL PIPING INSTALLATION

1. Separate trenches by 10 feet minimum unless otherwise indicated. Remove rocks in trenches that could contact pipe.
2. Backfill
3. Extend pipe from trench onto bottom of body of water at an elevation that is at least 12 inches below frost line. Seal membrane or impervious liner under body of water after installing piping.
4. Install HDPE piping in trenches according to ASTM D 2774 or ASTM F 645.
5. Clean HDPE pipe and fittings and make heat-fusion joints according to ASTM D 2657.

Minimize number of joints.

6. Purge, flush, and pressure test piping before backfilling trenches and boreholes.
7. Install continuous detectable warning tape for underground piping. Locate tape a minimum of 24 inches below finished grade, directly over piping.
8. Install HDPE piping in boreholes according to ASTM D 2774 or ASTM F 645.
9. Completely fill the borehole from bottom to top with backfill material.
10. Install the header piping 4 to 6 inches deep and install the horizontal piping from the header to the boreholes.
11. Extend the horizontal piping and connect to ground-loop heat-pump piping systems at outside face of building wall in locations and pipe sizes indicated.

23 2113 – HYDRONIC PIPING

COPPER TUBE AND FITTINGS

Drawn-Temper Copper Tubing: ASTM B 88, Type L ASTM B 88.

Annealed-Temper Copper Tubing: ASTM B 88, Type K.

DWV Copper Tubing: ASTM B 306, Type DWV.

Grooved, Mechanical-Joint, Wrought-Copper Fittings: ASME B16.22.

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

Anvil International, Inc.

Star Pipe Products.

Victaulic Company.

Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.

Grooved-End-Tube Couplings: Rigid pattern unless otherwise indicated; gasketed fitting.

Ductile-iron housing with keys matching pipe and fitting grooves, pre-lubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

Copper or Bronze Pressure-Seal Fittings:

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

1) NIBCO INC.

Viega.

Housing: Copper.

O-Rings and Pipe Stops: EPDM.

Tools: Manufacturer's special tools.
Minimum 200-psig working-pressure rating at 250 deg F.

Wrought-Copper Unions: ASME B16.22.

STEEL PIPE AND FITTINGS

2. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes' spot faced as indicated in "Piping Applications" Article.

Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

Material Group: 1.1.

End Connections: Butt welding.

Facings: Raised face.

Grooved Mechanical-Joint Fittings and Couplings:

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

- 1) Anvil International, Inc.
Central Sprinkler Company.
Star Pipe Products.
Victaulic Company.

The hydronics loop and associated equipment will need to be clean. The hydronics loop will need to be air tested for leaks and then flushed. If new coils connected to the loop are ensured to be clean, they should be bypassed during the flushing process. After flushing, the loop will need to be tested by a third party (with sampling witnessed by the engineer or UND) before being accepted and connecting to the new coils. A copy of the report needs to be provided to UND.

Hydronics piping material shall be soldered, threaded or welded. Victaulic piping will be accepted only if it is warrantied for a minimum of 10 years (prefer 15 years). (We have had problems with grooved piping leaking in the past. Usually two things lead to leaks, improper material or improper installation). If the contractor installs Victaulic, they need to ensure they use the proper seals for the medium and the failure temperatures of the loop. The contractor needs to follow the manufacturer's installation process in

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order for Victaulic to warranty it. Most importantly, the contractor needs to have a trained installer and have it inspected by a Victaulic rep (see Victaulic's spec sections 3.01 B.1 and C.1 for specific details). If they follow the process in the Victaulic specification, then Victaulic will warranty it. For hydronic HVAC systems, Pro-Press or crimped connections are not to be used; we have had problems with those in the past. For under floor hydronic radiation heating systems, PEX or Kytech products are acceptable.

Each loop shall include a holding tank, pump, pot feeder, and valves to add fluid to the system and to drain the system. The relief for the overflow shall drain into the holding tank to keep all fluid within the system. Side stream filters shall be installed for chilled water, hot water, and heat pump loops. Spirotherm air eliminator vents shall be used on all loops where necessary

23 2114 – HYDRONIC SPECIALTIES

- A. Gate valves are preferred over butterfly valves where major portions of a hydronic system may need to be isolated, such as pumps. All valves used for isolation of systems, shut-offs or for servicing equipment shall be gate or ball valves. Butterfly valves are acceptable for balancing or flushing purposes.
- B. All hydronic valves 3" or smaller shall be ball-valves made of brass or better quality materials.
- C. All hydronic valves over 3" or steam valves shall be gate valves made of cast iron or better quality materials. Valve stems are to have grease zerks to lubricate the stem in order to open and close the valve easily. Butterfly valves or other types of valves could be considered for isolation if they can be demonstrated to have zero leakage. A 10-year warranty is preferred for valves.

23 2123 – HYDRONIC PUMPS

CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

Manufacturers:

Bell & Gossett; Div. of ITT Industries.
Armstrong.

Description: Factory assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1. 2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 125-psig minimum working pressure and a continuous water temperature of 200 degrees Fahrenheit.

Pump Construction:

- a. Casing: Radially split, cast iron, with threaded gage tapping's at inlet and outlet, and threaded companion-flange connections.

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Impeller: ASTM 8 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.

Pump Shaft: Steel, with copper-alloy shaft sleeve.

Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.

Packing Seal: Stuffing box, with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.

Pump Bearings: Permanently lubricated ball bearings.

Motor: Single speed, with permanently lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing.

Capacities and Characteristics:

- a. Reference Mechanical Schedule Sheet.

CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

1. Manufacturers:

- a. Bell & Gossett; Div. of ITT Industries.

Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rate pump for 125-psig minimum working pressure and a continuous water temperature of 225 °F.

PUMP CONSTRUCTION:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tapping's at inlet and outlet, and threaded companion-flange connections.

Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.

Pump Shaft: Steel, with copper-alloy shaft sleeve.

Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.

Pump Bearings: Permanently lubricated ball bearings.

Motor: Single speed, with permanently lubricated ball bearings, unless otherwise indicated; rigidly mounted to pump casing with integral pump support.

27. Circulating pumps shall be B&G (Bell and Gossett), Armstrong or other as approved by Facilities Management. Other pumps of equivalent quality will be considered, but no Taco or Dunham Bush pumps will be accepted due to previous maintenance problems with those brands.

28. Preference is to have variable frequency drives on pumps where feasible. See 'Variable Frequency Drives'.
29. Complete a hydronics balance of all hydronic systems, following NEBB regulations.
30. Circulating pumps shall be setup to have a lag pump for hot water, chilled water, condenser water, heat pump loop and whenever feasible for all other applicable systems. Add lead/lag control of the pumps through the automation system.
31. For heating glycol loops, 40% SR1 Dowtherm glycol shall be used and for chilled glycol loops 30% SR1 Dowtherm glycol shall be used, unless otherwise approved by Facilities Management. If the engineer calculates a higher percentage is recommended to prevent freeze-ups, please bring that forward to Facilities Management for approval. We try to keep our glycol systems consistent whenever possible.

23 2213 – STEAM AND CONDENSATE HEATING PIPING

- A. High pressure steam and condensate valves shall be Class 150 SWP cast steel and stamped for high pressure steam application.
 1. Flange valves OS & Y (required for 2" and larger, optional for 1-1/2" and smaller) shall be Crane, Velan or approved equal.
 2. Threaded valves 1-1/2" and smaller shall be 800# forged steel, rising stem, bolted bonnet
- B. Owner may require the Contractor to verify and assure the quality of all steam pipe welds by performing x-ray testing on 10 percent of all welded connections as determined by Owner.
 1. If failures are detected, Owner reserves right to have all welded connections inspected.
- C. Provide a clear access to all valves.
- D. Install pressure regulators with manual bypasses at mechanical entrances of high pressure steam distribution lines.
 1. Use parallel pressure reducing stations where large fluctuations in steam use is anticipated or where steam use is critical.
- E. Duplex electric condensate pumps with sight glass.
- F. Install drip traps before all thermostatic temperature regulating valves and pressure reducing valves, and at line's end.
- G. Install strainer upstream from all steam traps. Strainer to be fitted with manual blow-down valve.

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- H. Consult with the Owner concerning the installation of a tunnel or direct buried systems.
- I. High pressure steam valves shall be Class 150 cast steel and stamped for high-pressure steam application.
- J. Direct buried steam and condensate systems:
 - 1. Direct buried systems shall be supplied by Perma-Pipe.
 - 2. All steam pipe connections shall be welded; all welders must be certified.
- K. Cathodic protection should be installed where necessary to protect the steam distribution system from corrosion.
- L. Contractor shall verify and assure the quality of all steam pipe welds by performing x-ray or hydro testing of all welded connections. Verified by third party.
- M. Provide a clear access to shut-off valves.
- N. Install Spence Type "E", Boylston or Leslie pressure regulators with bypasses at mechanical entrances of high pressure distribution lines.
- O. Install Spence Type "E", Boylston or Leslie pressure regulators with bypasses at mechanical entrances of high pressure distribution lines. Use cascading or step pressure operated parallel pressure reducing stations where large fluctuation in steam use is anticipated. Individual PRV's for each item of equipment are not satisfactory. Pipe the reduced pressure steam from the reduced pressure header to the items of equipment, utilizing proportional pneumatic steam control valves that have positive shut-off, fail-to-open, temperature control of medium being heated. Condensate pumps shall be non-electric positive displacement pressure-powered pumps for larger applications. Provide removable insulating jacket for the pump tank and valves. Install drip traps before all thermostatic temperature regulating valves and pressure reducing valves, and at line's end.
Install removable insulated covers on steam reducing stations for maintenance. The removable cover should be able to be re-installed after repairs.

23 2214 –STEAM AND CONDENSATE HEATING SPECIALTIES

VALVES

Gate, Globe, Check, Ball, and Butterfly Valves:

Stop-Check Valves:

Manufacturers:

A.Y. McDonald Mfg. Co.
Cincinnati Valve Company.
Crane; Crane Energy Flow Solutions.
Jenkins Valves.

SAFETY VALVES

Bronze or Brass Safety Valves: ASME labeled.

Manufacturers:

Armstrong International, Inc.
Kunkle Valve.
Spirax Sarco, Inc.

Cast-Iron Safety Valves: ASME labeled.

Manufacturers:

Armstrong International, Inc.
Kunkle Valve.
Spirax Sarco, Inc.

PRESSURE-REDUCING VALVES

Manufacturers:

Boylston

Watts

Spence Engineering Company, Inc.

STEAM TRAPS

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

Armstrong International, Inc.
Velan
Gestra
Hoffman

THERMOSTATIC AIR VENTS AND VACUUM BREAKERS

Thermostatic Air Vents:

Manufacturers:

Armstrong International, Inc.

Barnes & Jones, Inc.
Dunham-Bush, Inc.
Hoffman Specialty.
Spirax Sarco, Inc.

Vacuum Breakers:

Manufacturers:

Armstrong International, Inc.
Dunham-Bush, Inc.
Hoffman Specialty.

23 2300 –REFRIGERANT PIPING

PERFORMANCE REQUIREMENTS

1. Line Test Pressure for Refrigerant R-134a
2. Refrigerant tubing shall be type “k” hard copper
3. Suction Lines for Air-Conditioning Applications: 115 psig.
4. Suction Lines for Heat-Pump Applications: 225 psig.
5. Hot-Gas and Liquid Lines: 225 psig.

6. Line Test Pressure for Refrigerant R-407C:

Suction Lines for Air-Conditioning Applications: 230 psig.

Suction lines for Heat pump applications 380 psig

Hot gas liquid lines: 380 psig

Line Test Pressure for Refrigerant R-410A:

Suction Lines for Air-Conditioning Applications: 300 psig.

Suction Lines for Heat-Pump Applications: 535 psig.

Hot-Gas and Liquid Lines: 535 psig.

23 2500 – HVAC WATER TREATMENT

Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or to the environment.

Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

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Specify dowtherm SRI (ethylene glycol) or dowfrost (propylene glycol) distilled or R/O water shall be used in closed loop heating systems

23 3100 –HVAC DUCTS AND CASINGS

SINGLE-WALL RECTANGULAR, ROUND, FLAT-OVAL DUCTS AND FITTINGS

General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

If necessary, sound attenuators are fine. Facilities Management is open to recommendations to improve HVAC affected acoustics

Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

DOUBLE-WALL RECTANGULAR, ROUND, FALT-OVAL DUCTS AND FITTINGS

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

McGill AirFlow LLC.

MKT Metal Manufacturing.

Linx Industries

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Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

Maximum Thermal Conductivity: **0.27 Btu x in./h x sq. ft. x deg F**

Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.

Coat insulation with antimicrobial coating.

Cover insulation with polyester film complying with UL 181, Class 1.

Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

Maximum Thermal Conductivity: **[0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K)]**
<Insert conductivity> at 75 deg F (24 deg C) mean temperature.

Inner Duct: Minimum 0.028-inch [**perforated galvanized sheet steel having 3/32-inch diameter perforations, with overall open area of 23 percent solid sheet steel.**

Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

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Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

GENERAL CASING FABRICATION REQUIREMENTS

General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 9, "Equipment and Casings," for acceptable materials, material thicknesses, and casing construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

Exterior Surface Galvanized Coating Designation: **G60, Z180, G90, Z275.**

Interior Surface Galvanized Coating Designation:

Sections Not Exposed to Moisture: **G60 Z180) [G90 (Z275)].**

Sections Housing and Downstream from Cooling Coil and Humidifiers: [**G90 (Z275)].**

Stainless Steel: ASTM A 480/A 480M, [**Type 304**] [**Type 316**], and having a [**No. 2D**] <Insert **finish**> finish.

Sealing Requirement: SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class A. Seal all seams, joints, connections, and abutments to building.

Penetrations: Seal all penetrations airtight. Cover with escutcheons and gaskets, or fill with suitable compound so there is no exposed insulation. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping." Provide shaft seals where fan shafts penetrate casing.

Access Doors: Fabricate access doors according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 9-15, "Casing Access Doors - 2-inch wg (500 Pa)," and Figure 9-16, "Casing Access Doors - 3-10-inch wg (750-2500 Pa)"; and according to pressure class of the plenum or casing section in which access doors are to be installed.

Condensate Drain Pans: Formed sections of **Type 304, stainless-steel sheet G90, Z275 coated, galvanized sheet steel** complying with requirements in ASHRAE 62.1. Pans shall extend a minimum of 12 inches (300 mm) past coil.

23 3300 –AIR DUCT ACCESSORIES

All Ahu's shall have insulated airfoil aluminum ultra-low leak dampers
If necessary, sound attenuators are fine. Facilities Management is open to recommendations to improve HVAC affected acoustics.

23 3319 –DUCT SILENCERS

If necessary, sound attenuators are fine. Facilities Management is open to recommendations to improve HVAC affected acoustics.

23 3413 – AXIAL HVAC FANS

23 3416 – CENTRIFUGAL HVAC FANS

23 3423 – HVAC POWER VENTILATORS

UTILITY SET FANS

Manufacturers:

Aerovent; a division of Twin City Fan Companies, Ltd.
Carnes Company.
Loren Cook Company.
Peerless Blowers.

CENTRIFUGAL ROOF VENTILATORS

Manufacturers:

Acme Engineering & Manufacturing Corp.
Aerovent; a division of Twin City Fan Companies, Ltd.
Carnes Company.
Greenheck Fan Corporation.
Loren Cook Company.
PennBarry.

AXIAL ROOF VENTILATORS

Manufacturers:

Acme Engineering & Manufacturing Corp.
Aerovent; a division of Twin City Fan Companies, Ltd.
Broan-NuTone LLC.
Carnes Company.
Greenheck Fan Corporation.
Loren Cook Company.

UPBLAST PROPELLER ROOF EXHAUST FANS

Manufacturers:

Acme Engineering & Manufacturing Corp.
Aerovent; a division of Twin City Fan Companies, Ltd.
Carnes Company.
Greenheck Fan Corporation.
Loren Cook Company.

CENTRIFUGAL WALL VENTILATORS

Manufacturers:

Acme Engineering & Manufacturing Corp.
Aerovent; a division of Twin City Fan Companies, Ltd.
Broan-NuTone LLC.
Carnes Company.
Greenheck Fan Corporation.
Loren Cook Company.

CEILING-MOUNTED VENTILATORS

Manufacturers:

Broan-NuTone LLC.
Carnes Company.
Greenheck Fan Corporation.
JencoFan.
Loren Cook Company.

IN-LINE CENTRIFUGAL FANS

Manufacturers:

Acme Engineering & Manufacturing Corp.
Carnes Company.
FloAire.
Greenheck Fan Corporation.
JencoFan.
Loren Cook Company.

PROPELLER FANS

Manufacturers:

Acme Engineering & Manufacturing Corp.
Airmaster Fan Company.
Broan-NuTone LLC.
Carnes Company.
Chicago Blower Corporation.
Cincinnati Fan.

23 3433 – AIR CURTAINS

AIR-CURTAIN UNIT

Manufacturers:

Air Economy Corporation.
Cambridge Engineering, Inc.
Fantech.
Loren Cook Company.
Marley Engineered Products.
Mars Air Doors; Mars Air Systems.
Mestek, Inc.
Powered Aire, Inc.

23 3514 – DUST COLLECTIONS

23 3516 – ENGINE EXHAUST SYSTEMS

23 3600 – AIR TERMINAL UNITS

Any new VAVs shall be blade type Titus, Trane or Price. VAVs shall have reheats and access panels on the inlet side of the reheat coil with enough room to access the coil to clean it. Isolation valves need to be installed to isolate reheat coils. Facilities Management prefers VAVs in equipment rooms when possible, especially for laboratories and critical areas. VAVs shall be numbered consecutively within the building

All Ahu's shall have insulated airfoil aluminum ultra-low leak dampers.

All actuators shall be electronic.

23 3700 – AIR OUTLETS AND INLETS

23 3813 – COMMERCIAL-KITCHEN HOODS

TYPE I EXHAUST HOOD FABRICATION

1. Manufacturers:

Captive-Aire Systems.

Greenheck Fan Corporation.

TYPE II EXHAUST HOOD FABRICATION

1. Manufacturers:

Captive-Aire Systems.

Greenheck Fan Corporation.

23 4000 – HVAC AIR CLEANING DEVICES

23 5100 – BREECHINGS, CHIMNEYS AND STACKS

23 5213 – ELECTRIC BOILERS

MANUFACTURERS

Manufacturers: Steam/Hot Water

Cleaver-Brooks.

Fulton Boiler Works, Inc.

Lochinvar, LLC.

Precision Boilers, LLC.

PVI Industries, LLC.

23 5216 – CONDENSING BOILERS

23 5223 – CAST IRON BOILERS

23 5233.13 – FINNED WATER TUBE BOILERS

23 5233.16 – STEEL WATER TUBE BOILERS

23 5239.13 – SCOTCH MARINE BOILERS

23 5400 – FURNACES

23 5533 – FUEL FIRED UNIT HEATERS

23 5613.13 – HEATING SOLAR FLAT PLATE COLLECTORS

23 5700 – HEAT EXCHANGERS FOR HVAC

All building heat exchangers (convertors) are to be numbered sequentially.

Building heating systems shall all be hydronic. No steam direct AHU coils, reheat coils, radiation, etc. will be accepted.

Heat exchangers shall be specified as Bell and Gossett (B&G), Weil McLain, or Rheem.

Tube and shell or plate to plate heat exchangers/convertors will be accepted.

23 6100 – REFRIGERANT COMPRESSORS

**23 6213 – PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND
CONDENSER UNITS**

23 6313 – AIR COOLED REFRIGERANT CONDENSERS

MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Trane, York, or Daikin

23 6413 – ABSORPTION WATER CHILLERS

Absorption Chillers will not be accepted

23 6416 – CENTRIFUGAL WATER CHILLERS

1. Normally buildings are setup to house their own chiller or DX systems. If a chiller is installed, the following applies.
2. Trane, York, McQuay, or Carrier chillers are preferred.
3. It is recommended to have chillers bid separately by the mechanical contractor and reviewed by Facilities Management so they can be reviewed per product quality, cost assessment, energy savings/efficiency, maintenance, performance, noise, etc.

(1) Trane, York, or Daikin.

(2) It is recommended to have chillers bid separately by the mechanical contractor and reviewed by Facilities Management so they can be reviewed per product quality, cost assessment, energy savings/efficiency, maintenance, performance, noise, etc.

(3) The installation of a new chiller shall include a refrigerant detection system per code. The Freon Type will be 410A or 134A and a Trane TruSense SD or Bacharach HGM 30 detector. The alarm from this system will need to alarm via BACnet to the existing Facilities Management front-end automation system (Honeywell EBI).

(4) The chiller should be specified with a two year warranty, inclusive of parts and service. Facilities would prefer a five year service warranty on the chiller but, this should be bid as an alternate on the chiller bid to see if it is feasible within the project.

23 6423 – SCROLL WATER CHILLERS

A. WATER COOLED CHILLER:

1. Factory Test: Chiller shall be pressure-tested, evacuated and fully charged with refrigerant and oil, and shall be factory operational run tested with water flowing through the vessels.

Trane, York, or Daikin.

It is recommended to have chillers bid separately by the mechanical contractor and reviewed by Facilities Management so they can be reviewed per product quality, cost assessment, energy savings/efficiency, maintenance, performance, noise, etc.

The installation of a new chiller shall include a refrigerant detection system per code. The Freon Type will be 410A or 134A and a Trane TruSense SD or Bacharach HGM 30 detector. The alarm from this system will need to alarm via BACnet to the existing Facilities Management front-end automation system (Honeywell EBI).

The chiller should be specified with a two year warranty, inclusive of parts and service.

Facilities would prefer a five year service warranty on the chiller but, this should be bid as an alternate on the chiller bid to see if it is feasible within the project.

2.

Chiller manufacturer shall have a factory trained and supported service office that is within a 100 mile radius of the site.

Warranty: Manufacturer shall Warrant all equipment and material of its manufacture against defects in workmanship and material for a period of 2 years from date of initial start-up.

Unit shall be delivered to job site fully assembled, and charged with refrigerant and oil by the

Manufacturer.

Unit shall be stored and handled per Manufacturer's instructions.

Unit and its accessories shall be protected from the weather and dirt exposure during shipment.

During shipment, a covering shall be provided over vulnerable components. Nozzles and open ends shall be fitted with plastic enclosures.

General: Install and commission, as shown on the schedules and plans, factory assembled, charged, and tested water-cooled scroll compressor chiller(s) as specified herein.

Chiller shall be designed, selected, and constructed using a refrigerant with Flammability rating of "1", as defined by ANSI/ASH RAE STANDARD - 34 Number Designation and Safety Classification of Refrigerants.

Chiller shall include, but is not limited to: a complete system with not less than two refrigerant circuits, scroll compressors, direct expansion type.

Evaporator, water-cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and Operating controls including capacity controller, control center, motor starting components, and special features as specified herein or required for safe, automatic operation.

Compressors: Shall be four hermetic scroll type including:

- a. Refrigerant flow through the compressor with 100% suction cooled motor.
- b. Compliant design for radial and axial flow
- c. Large suction side free volume and oil sump to provide liquid handling capability.
- d. Compressor crankcase heaters to provide extra liquid migration protection.
- e. Annular discharge check valve and reverse vent assembly to provide low pressure drop, silent shutdown and reverse rotation protection.
- f. Initial Oil charge.
- g. Oil Level sight glass.
- h. Vibration isolator mounts for compressors.
- i. Brazed-type connections for fully hermetic refrigerant circuits.
- j. Microprocessor controlled, Factory installed Across-the-line type compressor motor starters
- k. Each refrigerant circuit shall include: liquid line shutoff valve with charging port, low side pressure relief device, filter-drier, solenoid valve, discharge service

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valve, system high pressure relief device, sight glass with moisture indicator, expansion valves, and flexible, closed-cell foam insulated suction line.

EVAPORATOR

1. Evaporator shall be a direct expansion shell and tube construction, dual circuit heat exchanger capable of refrigerant working pressure of 450 PSIG (3103 kPa) and liquid side pressure of 150 psig (1034 kPa).

Evaporator shall be covered with 3/4" (19mm), flexible, closed-cell insulation, thermal conductivity of 0.26k ([BTU/HR-Ft²-°F]/in.) maximum. Water nozzles shall be insulated by Contractor after pipe installation.

Heat exchangers shall be ASME pressure vessel code certified.

Installing contractor must include accommodations in the chilled water piping to allow proper drainage and venting of the heat exchanger.

The water connections shall be fully accessible with flanged connection points.

CONDENSER

1. Condenser shall be a cleanable thru-tube construction with removable heads and integral sub cooling. Heat exchanger shall be capable of a refrigerant side working pressure of 560 PSIG (45 bar) and liquid side pressure of 150 psig (1034 kPa).

The condenser shall be equipped with relief valves and be capable of holding the full refrigerant charge for pump down.

The water connections shall be fully accessible with flanged connection points.

General: Automatic start, stop, operating, and protection sequences across the range of scheduled conditions and transients.

Microprocessor Enclosure: NEMA 1(IP32) powder painted steel cabinet with hinged, latched, and gasket sealed door.

Microprocessor Control Center:

1. Automatic control of com pressor start/stop, anti-coincidence and anti -recycle timers, automatic pump down on shutdown, evaporator pump, and unit alarm contacts. Automatic reset to normal chiller operation after power failure.

Software stored in non-volatile memory, with programmed set points retained in lithium battery backed real time clock (RTC) memory for minimum 5 years.

Forty-character liquid crystal display, numeric data in English (or Metric) units. Sealed keypad with sections for Set points, Display/Print, Entry, Unit Options & clock, and On/Off Switch. Display descriptions and membrane keypad graphics shown in English language.

Programmable Set points (within Manufacturer limits): display language; chilled liquid temperature setpoint and range, remote reset temperature range, set daily schedule/holiday for start/ stop, manual override for servicing, number of compressors, low liquid temperature cutout, low suction pressure cutout, high discharge pressure cutout, anti-recycle timer (compressor start cycle time), and anti-

coincident timer (delay compressor starts).

Display Data: Return and leaving evaporator liquid temperatures, low leaving liquid temperature cutout setting, low ambient temperature cutout setting, English or metric data, suction pressure cutout setting, each system suction pressure, discharge pressure, liquid temperature reset via a 4- 20milliamp or 0- 10 VDC input, anti-recycle timer status for each compressor, anti-coincident system start timer condition, compressor run status, no cooling load condition, day, date and time, dally start/ stop times, holiday status, automatic or manual system lead/lag control, lead system definition, compressor starts/operating hours (each), status of hot gas valves (if supplied), run permissive status, number of compressors running, liquid solenoid valve status, load & unload timer status, water pump status.

System Safeties: Shall cause individual compressor systems to perform auto shut down; manual reset required after the third trip in 90 minutes. Includes: high discharge pressure, low suction pressure, high pressure switch, and motor protector. Compressor motor protector shall protect against damage due to high input current or thermal overload of windings.

Unit Safeties: Shall be automatic reset and can use compressors to shut down if low ambient, low leaving chilled liquid temperature, under voltage, and flow switch operation. Contractor shall provide flow switch installation and wiring per chiller manufacturer requirements.

Alarm Contacts: Low ambient, low leaving chilled liquid temperature, low voltage, low battery, and (per compressor circuit): high discharge pressure, and low suction pressure.

BAS/EMS Temperature Reset: Chiller to accept 4 to 20mA, 0 to 10 VDC, input to reset the leaving chilled liquid temperature.

Pressure Transducers and Readout Capability

1. Discharge Pressure Transducers: Permits unit to sense and display discharge pressure.
Suction Pressure Transducers: Permits unit to sense and display suction pressure.

Manufacturer shall provide any controls not listed above, necessary for automatic chiller operation. Mechanical Contractor shall provide field control wiring necessary to interface sensors to the chiller control system

23 6426 – ROTARY-SCREW WATER CHILLERS

Trane, York, or Daikin.

It is recommended to have chillers bid separately by the mechanical contractor and reviewed by Facilities Management so they can be reviewed per product quality, cost assessment, energy savings/efficiency, maintenance, performance, noise, etc.

The installation of a new chiller shall include a refrigerant detection system per code. The Freon Type will be 410A or 134A and a Trane TruSense SD or Bacharach HGM 30

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detector. The alarm from this system will need to alarm via BACnet to the existing Facilities Management front-end automation system (Honeywell EBI).

The chiller should be specified with a two-year warranty, inclusive of parts and service.

Facilities would prefer a five-year service warranty on the chiller but, this should be bid as an alternate on the chiller bid to see if it is feasible within the project.

23 6429 – MODULAR WATER CHILLERS

A. MANUFACTURERS

1. Multistack LLC: www.multistack.com
2. The chilled water system has been designed based on specific capacities and characteristics of equipment scheduled
3. When substitution of a different manufacturer or model number is desired, submit sufficient information to demonstrate to Architect that the substitute will have the same or better performance as that specified AND that the related equipment in the system will perform acceptably with the substitute
4. If the related equipment must be modified to perform acceptably with the substitute, the entity proposing the substitution is responsible for all additional costs due to re-design and provision of different related equipment

CHILLERS

1. Chillers: Factory assemble and test module consisting of compressor(s), compressor motor(s), evaporator, condenser, enclosure, refrigeration circuits(s) and specialties, interconnecting piping, water circuit isolation valves, starters, and microprocessor-based controls.
 - a. Rating: AHRI 550/590.
Safety: UL 1995 and ASHRAE STD 15.
Machinery Sound Testing: AHRI 575.
Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
Construction & Testing: ASME (BPV VIII, 1) if applicable for construction type
Energy Efficiency: ASHRAE Std 90.1.
 - 1) Less than or equal to 0.65 kW per ton at full load and 0.61 kW per ton at NPLV with condenser water kept constant at 75 deg. F entering.

Enclosures:

- 1) Frame:

Heavy gage steel.
Factory painted finish.

Steel Chiller Cabinets:

- a) Factory baked on enamel finish.

Electrical Equipment: NEMA 250 or UL 1995 as applicable.

Motors: UL 984. See Section 23 0513 for additional requirements.

Power Phase Monitor:

- 1) Provide power phase monitor on the incoming power supply to the chiller. This device shall prevent the chiller from operating during periods when the incoming power is unsuitable for proper operation. Provide protection against low voltage (brown-out), phase rotation, loss of phase, and phase imbalance.

COMPRESSORS AND EVAPORATOR

1. Compressors: Hermetic scroll type.

- a. Module: Fully hermetic with two, direct drive compressors, adequate valve types and specialties required for operation and servicing in accordance with manufacturer's recommendations.

Vibration Control: Factory installed internal rubber-in-shear isolators.

Oil Lubrication System: Initial oil charge, oil pump, oil level sight glass, and oil charging valve.

Capacity Reduction System: Compressor staging with duty cycling based on run time. Motor 3600 RPM suction gas-cooled, with overload protection.

Evaporator: Brazed plate type.

- a. Plate Material: 316 stainless steel.
Refrigerant Working-Side Pressure Rating: 650 psig minimum.
Water Working-Side Pressure Rating: 150 psig minimum.
Provide with flanged connections.
Insulation for all cold surfaces.

- 1) Insulation is factory installed on evaporator, connections, and suction piping. 0.75 inches minimum thick, closed cell, expanded polyvinyl chloride, polyurethane, or Armaflex 1 1 insulation with a maximum k value of 0.28.

Provide factory installed vents and water drain connections on evaporator.

Provide factory installed fittings for temperature control sensors on evaporator.

Evaporator inlet water heater shall incorporate a built-in 30-mesh in-line strainer

WATER-COOLED CONDENSER

1. Provide brazed plate type.
 - a. Refrigerant Working-Side Pressure Rating: 600 psig minimum.
Water Working-Side Pressure Rating: 150 psig minimum.
Provide with flanged connections.
Provide factory installed vents and water drain connections on condenser.
Provide factory installed fittings for temperature control sensors on condenser.
Condenser inlet shall incorporate a 30 mesh strainer.

REFRIGERATION CIRCUITS

1. Provide two independent refrigeration circuits with one compressor per circuit.
 - a. Provide liquid line shut-off valve, filter-drier, thermal expansion valve, refrigerant relief device, and compressor discharge check valve for each independent circuit.

INTEGRATED MICROPROCESSOR BASED DOC CONTROLS PACKAGE

1. Pre-wire, assemble, factory mount, and test operating and safety control system consisting of a digital display or gauges, on-auto-off switch, motor starting contactors, disconnect switches, power and control wiring. Provide controls, monitoring, programmable set-points, alarms, and BAS as defined below:
 - a. Automatic Adjustable Operating Controls:
 - 1) Temperature of chilled water leaving chiller.
Number of compressor circuits required to operate based on set-points and system load.
Compressor short-cycling prevention.
Lead/lag operation for compressors. New lead compressor selected every 24 hours to equalize run time.
Automatic reset on power source failure.
Load limiting.

Normal Operation Monitoring and Open Cover-less Displays:

- 1) Hours of operation.
Suction and discharge refrigerant pressures.
Automatic diagnostics.
Number of starts.
On/off compressor status.
Entering and leaving chilled water temperatures.
Status of operation.
Compressor winding temperature.
Suction temperature.

Oil pressure.

Set-Points:

- 1) Leaving chilled water temperature.
Date/time.

Automatic Chiller Shut-Down Safety Controls and Alarm:

- 1) Automatic Reset:
 - a) Chilled water flow interlock.
Voltage protection (over/under).
Phase reversal protection.

Manual Reset:

- 1) Low suction pressure.
High motor winding temperature.
Low chilled water temperature.
Low chilled water flow.
High condenser refrigerant discharge pressure.
Motor current overload and phase loss.
Low oil flow.

Remote Alarm: Activate remote, audible bell upon safety shutdown of chiller.
Building Automation System (BAS) Communications via BACnet IP:

- 1) Minimum Data Transmission to BAS:
 - a) All system operating conditions.
Capacity control information.
Safety shutdown conditions.

Minimum Operating Commands from BAS:

- a) Remote unit start/stop.
Remote chilled water reset.

23 6513 – FORCED DRAFT COOLING TOWERS

Towers shall be a Marley or Evapco tower with a ladder and guardrails installed for maintenance access. The tower's motor must be installed out of the airstream. Include a VFD for the fan.

23 6516 – NATURAL DRAFT COOLING TOWERS

Towers shall be a Marley or Evapco tower with a ladder and guardrails installed for maintenance access. The tower's motor must be installed out of the airstream. Include a VFD for the fan.

23 6522 – EJECTOR COOLING TOWERS

23 6533 – LIQUID COOLERS

23 7223 – PACKAGED AIR TO AIR ENERGY RECOVERY UNITS

23 7313 – MODULAR CENTRAL STATION AIR HANDLING UNITS

23 7413 – PACKAGED OUTDOOR CENTRAL STATION AIR HANDLING UNITS

23 7433 – PACKAGED OUTDOOR HEATING AND COOLING MAKE-UP AIR UNITS

23 8101 – TERMINAL HEAT TRANSFER UNITS

23 8113 – PACKAGED TERMINAL AIR CONDITIONERS

23 8119 – SELF CONTAINED AIR-CONDITIONERS

23 8124 – COMPUTER ROOM AIR CONDITIONERS-FLOOR MOUNTED

MANUFACTURERS:

Liebert

23 8125 – COMPUTER ROOM AIR CONDITIONERS-CEILING MOUNTED

MANUFACTURERS:

1. Liebert

23 8127 – SMALL SPLIT SYSTEM HEATING AND COOLING

23 8129 – VARIABLE REFRIGERANT VOLUME (VRV) HVAC SYSTEM

23 8130 – BASIS OF DESIGN VRV EQUIPMENT

23 8149 – WATER TO WATER HEAT PUMPS

23 8200 – CONVECTION HEATING AND COOLING UNITS

23 8216 – AIR COILS

23 8216.11- HYDRONIC AIR COILS

238216.12 STEAM AIR COILS

23 8216.13- REFRIGERANT AIR COILS

23 8216.14 – ELECTRIC RESISTANCE AIR COILS

23 8300 – RADIANT HEATING UNITS

23 8313 – RADIANT HEATING CABLES

23 8413 – HUMIDIFIERS

23 8414 – EVAPORATIVE PAN HUMIDIFIERS

23 8416 – STEAM HUMIDIFIERS

23 8417 – SPRAYED COIL DEHUMIDIFIERS

END OF DIVISION 23