A. Codes and Standards

1. The design and construction of all University work must comply with the codes and standards listed in the introduction plus the following:

   ASME Codes and Standards
   ANSI Codes and Standards
   ASTM Standards
   AWWA Standards
   ASHRAE Standards
   SMACNA Standards
   NEMA Standards
   AMCA Standards
   NIH Standards
   NEBB Standards
   ARI Standards
   US Dept HEW "Guide for Laboratory Animal Facilities and Care"
   EPA Regulations, for Asbestos Removal
   OSHA Regulations, for Asbestos Removal
   CDPHE - Colorado Air Quality Control Commission Regulations, for Asbestos Removal
   NFPA Standards

   See Definitions Appendix for abbreviations.

B. Human Comfort Design Conditions:

1. The outdoor design conditions for building envelope load calculations should be based on ASHRAE’s Climatic Conditions for Fort Collins as listed below, except for critical applications. These should be discussed with project manager.

   Cooling  98 °F dry bulb and 62 °F wet bulb
   Heating  -5 °F dry bulb

   The outdoor design conditions for evaporative cooling and cooling tower sizing shall be 91°F dry bulb and 68°F wet bulb.

2. For indoor design calculations, the following conditions should be used for most campus buildings for the purpose of calculating heating and cooling loads and selecting equipment size and capacities except where other requirements exist such as computer rooms, animal laboratories or research labs.

   Cooling  72°F dry bulb
   Heating  72°F dry bulb

   However, actual operating conditions are governed by a campus temperature policy that dictates the indoor set points for most campus buildings are as follows. These operating conditions should be identified to temperature controls contractors for purposes of setting thermostats.

   Cooling  78°F dry bulb
   Heating  68°F dry bulb
3. Humidity control shall not be provided except when specifically required by the program plan. Plant steam may be used only for generation of clean steam served by a softened domestic water source.

4. It is desirable that outside air be used for cooling whenever economical. Systems should be designed with economy cycles that automatically allow the quantity of outside air supplied to the building to be varied to net maximum efficiency while maintaining indoor air quality.

C. HVAC Equipment Size and Capacity:

1. Generally all HVAC equipment shall have 20% excess capacity for future expansion. However, if the excess capacity requires an unusual equipment selection and/or the incremental cost appears excessive, then the A/E should advise the University Representative and seek approval to waive this requirement.

2. The following HVAC equipment requires full redundancy i.e. two pieces of equipment are required both of which are sized to meet demand loads.

   - Building Heat Exchangers - using steam-to-hot water.
     Each sized for 100% of the peak heating demand.

   - Building Hot Water Circulation Pumps.
     Each sized for 100% of the peak heating flow rate.

   - Building chilled water circulation pumps
     Each sized for 100% of the peak cooling flow rate.

3. Chillers shall have 20% excess capacity.

4. Boilers and primary heating equipment shall have 20% excess capacity.

5. Air supply and exhaust fans shall have 20% excess capacity.

6. Air supply and exhaust ducts shall have 20% excess capacity (i.e. larger) for primary branches and significant secondary branches.

D. Animal Holding Areas Design Conditions:


2. Sewage solids from animal facilities shall be reduced in size to match strainers on floor drains. Bedding material for animals shall not be flushed down floor drains, but disposed of in proper containers.

E. Biohazard Areas & Systems:


F. Domestic Water Systems:
1. Hot water design conditions shall be 120°F. Higher temperature hot water needed for dishwashers, etc. shall be attained by booster heating units furnished as part of the equipment. Mixing valves shall not be used. Temperature settings on water devices will be made by Facilities Management Plumbing Shop personnel.

2. Equipment cooling with domestic water is prohibited by the University and by City of Fort Collins ordinance. Chillers, connection to District Cooling Utility, cooling towers or other cooling methods shall be proposed.

G. Sanitary and Storm Sewer Systems:

1. The City of Fort Collins regulates sanitary sewer requirements; storm water generally flows to City storm sewers but is regulated by the University’s MS4 permit administered by the Colorado Department of Public Health and Environment. Storm water drainage must go into its own drainage system whether that is on or below grade, and would include rainwater, underground seepage, etc. Incorporate water quality improvement systems. Coordinate with the University Representative to ensure all discharges are conveyed to the appropriate system and any required permits are obtained. Wastewater which goes into the sanitary sewer system is regulated by City ordinance and monitored in special manholes as it exits the campus. This allows the City to detect and restrict excess levels of pollutants and/or change the rate structure to the University appropriately. Discharge of uncontaminated groundwater and stormwater to the City’s sanitary sewer system is prohibited.

2. Chemical, carcinogenic, biological or other toxic or hazardous wastes shall not be put into the sanitary sewer. They shall be disposed of by proper methods as approved by Environmental Health Services and Facilities Management through the University Representative on a case-by-case basis.

3. Acid waste shall be treated at point of use, i.e. acid waste neutralizer tanks at sinks. See Section 15410 - Plumbing Piping.

H. Energy Conservation:

1. When specifying equipment, controls, and operation sequences, energy conservation must be given consideration. Check with Facilities Management Design and Construction through University Representative for current life cycle and/or payback criteria and suggested analysis methods.

2. ASHRAE/IES Standard 90.1 "Energy Efficient Design of New Buildings Except New Low-rise Residential Buildings" shall govern the design of new buildings and significant remodel work of existing buildings. Designers shall identify and submit to the University Representative all specific items of the design that do not conform to the Standard.

3. The University is a Green Lights Partner. This partnership commits Facilities Management to conserving electrical energy by incorporating interior lighting technologies that are both energy efficient and cost effective. See Section 16500 - Lighting for more information.

I. Asbestos:

1. Asbestos exists in many areas on Campus and especially in mechanical rooms. Whenever asbestos is encountered, instruct all parties to stop work and notify Facilities Management through the University Representative. When asbestos must be removed, specifications must address the proper procedures. Only certified workers and personnel may conduct work involving asbestos or asbestos containing material.
2. See Division 2 – Existing Conditions for Asbestos Material Abatement information regarding testing, handling and removal.

J. Vibration Analysis & Coordination:

1. Facilities Management may employ a vibration consultant to analyze both overall building structure and specific placement of machinery and equipment with moving parts. The architect and structural, mechanical and electrical engineers will be required to coordinate their work with this consultant and to follow Facilities Management direction based upon the recommendations of the vibration consultant.

2. See Division 23 – HVAC for Air Handling for fan specification requirements and performance criteria.

K. Balancing, Testing, and Adjusting:

1. Firms performing air balance must meet one of the following certification requirements; AABC, AEE, CTAB, NEBB, TABB, or approved equal. In addition, there may be other qualifications set forth by the design engineer and Colorado State University which require specific credentials and equipment be provided for specific balancing projects.

2. See Division 23 – HVAC for Testing, Adjusting and Balancing information.

L. Trades Requiring Licensed or Certified Workers:

1. Plumbing work for new and remodel construction projects shall be performed by a Colorado Licensed Master or Journeyman Plumber.

2. Welding work shall be performed by welders certified to ASME or AWS standards within the last year for the type of material and application suited for the job. Contractors shall submit copies of qualification tests of the welders to the University Representative for review prior to construction. Periodic checks of welders will be made to assure that welders match the persons on the submitted qualification.

3. Backflow prevention testing shall be performed by technicians who possess a valid certification from the American Society of Sanitary Engineering (ASSE), the American Backflow Prevention Association (ABPA), or the Association of Boards of Certification (ABC). Contractors shall submit copies of the certification cards to the University Representative for review prior to testing. Completed test reports shall be provided to the University Representative.

4. Refrigeration work shall be performed by technicians who are certified by the EPA and registered with the State of Colorado for the type of work necessary. Contractors shall submit copies of the certification and registration cards to the University Representative for review prior to construction.

M. Alarm & Security Systems:

1. Requirements to monitor specific mechanical equipment or conditions; i.e. temperature, status of fans, pumps, etc. can be accomplished through the BAS. If the BAS is not available locally, the designer shall consult with and submit to Facilities Management-Environment Shop alternate designs, through University Representative for approval. The design shall show monitoring devices, control panel, wiring and communication requirements to Facilities Management's central BAS.

2. Building occupants may request a Security System for the protection of the space or equipment. The University Alarm Policy shall be followed to meet this need. The design of a
system shall be reviewed by Facilities Management Alarm Shop and University Alarms Committee through the University Representative. The system design shall identify alarm requirements, devices and communication procedures using the BAS system. Wireless transmitters/receivers are recommended when wiring is difficult.

N. Utilities:

1. All steam and chilled water utility equipment and accessories must be reviewed and approved by the District Energy Manager.

2. The University owns most of the utility distribution systems. Consult with Facilities Management, Utilities Services through the University Representative for questions and clarifications.

3. Refer to the Division 33 - Utilities for additional information concerning utility materials, location and metering requirements.

4. The University Representative will furnish information regarding the preferred locations of incoming utility services to the building and waste outlets. This will generally be furnished in the form of a site plan and pertinent elevations will be given. Piping in the building must be generally arranged and oriented to conform to these. Layouts should not be started until this information has been furnished.

5. All incoming utilities shall be metered and have proper means for isolation before entering building. See Division 33 - Utilities for specified meter manufacturers.

6. Cross-connection conditions are prohibited and backflow prevention devices shall be used in accordance with the "Colorado Cross-Connection Manual" and the "City of Fort Collins Cross Connection Control Manual" to prevent and address cross connection contamination conditions. Install two devices in parallel with valves for testing each device. See Division 21 – Fire Suppression, Division 22 – Plumbing and Division 33 - Utilities for more information.

O. Equipment Rooms:

1. Mechanical equipment rooms shall be located on ground or basement floors with separate entrances away from main building entrance.

Mechanical rooms shall be separate from electrical equipment rooms. Access to these rooms shall be limited to authorized maintenance personnel only. Equipment requiring access by building or laboratory personnel shall be housed separately. Any exceptions shall have prior approval from Facilities Management through University Representative. Access to equipment rooms shall be arranged so entry will not disturb the occupants or normal functions of the building. Outside access doors are preferable. Door sizes shall match the largest equipment size. Adequate heights should be provided for walking and moving equipment into and out of room.

2. As required by codes, alarm systems shall be installed to detect presence of hazardous substances such as refrigerant gases. Such alarm systems will be integrated with the campus BAS.

3. Equipment rooms shall be arranged and located so that heat and sound will not be transmitted to other parts of the building. Adequate insulation and ventilation is required where applicable.

4. Equipment having parts which must be removed for maintenance (filter, coils, fan shafts, tube bundles, etc.) shall be located so that removal may be accomplished with adequate access and without interference to the operation of other equipment.
5. Provide floor drains. When located above an occupied area, surround the room with a 6-inch curb, a 2 inch fiber cant, and waterproof the floor. When chemicals will be stored in an equipment room, provide a secondary containment unit designed for chemical storage containers.

6. Provide high water detection alarms in all mechanical and equipment rooms at lowest point of floor. Provide a 3/4 inch conduit between high water alarm and BAS panel for remote alarm to central read back system.

7. Equipment rooms shall have adequate fluorescent lighting to illuminate equipment. Fan plenums shall have adequate incandescent lighting especially for rotating equipment.

8. Where possible lifting eyes should be permanently placed to aid in lifting and removal of mechanical equipment weighing over 200 pounds.

9. Provide a minimum of one duplex GFCI electrical outlet with others as necessary for service of equipment.

P. Pipe and Duct Spaces in Chases:

1. Provide 25 percent excess horizontal and vertical space in duct chases and pipe runs for future use.

2. Provide adequate access openings to pipe and duct spaces for service and maintenance.

Q. Pipe and Duct Penetrations:

1. The manner in which pipes pass through roofs, walls, floors, and ceilings must be specified or detailed. The Contractors responsible for cutting or drilling holes and flashing, sealing, or otherwise furnishing them must be clearly designated.

2. Clearance above drop ceiling grid shall be a minimum of 6” to facilitate replacement and/or removal of ceiling panels.

3. Pipe and duct penetrations shall be designed so that minimum opening remains after installation. Such openings shall be effectively sealed to prevent passage of rodents, birds, bugs, fire and smoke.

4. Where insulated pipe and duct passes through such openings the design shall provide for continuous insulation through the openings.

5. All penetrations that deviate from the plans require field approval by Facilities Management through the University Representative.

6. Provide tubing or pipe (not sheet metal) sleeves for all utility services passing through structural walls and slabs. All sleeves passing through slab floors shall project a minimum of 4 inches above the slab and be sealed water tight to the slab.

R. Access Doors:

1. Access doors of sufficient size for maintenance must be provided for all valves, traps, strainers, cleanouts, dampers, damper operators, concealed expansion joints, shock absorbers, switches, or any other equipment requiring service or maintenance.

2. Access doors for inspection of air ducts are required. Select several locations to provide a
general inspection.

S. Painting:

1. All piping, conduit and equipment in unfinished areas shall be painted as required for preservation.

2. All exposed work in finished areas shall be painted for appearance as directed by the Architect.

T. Process and Control Air:

1. Equipment requiring process air shall have a dedicated air source i.e. individual compressor.

2. All controls shall have electronic activators and thermostats. Pneumatic controls are prohibited.

U. Equipment Identification:

1. Retrofit or remodel work shall have new equipment identification follow that of existing.

V. District Cooling System

1. A district cooling utility system exists at the University. Underground piping may be available for connections to new buildings or to meet existing cooling loads.

2. A/E should check with District Energy through University Representative about connecting to the District Cooling System.

3. Details for connecting the underground chilled water piping loop to buildings and how to connect to cooling coils are located in Division 23 - HVAC.

20 05 00 – COMMON WORK RESULTS

A. The following Sections address certain common work results relevant to two or more Mechanical Divisions. See specific Division for additional information.

   20 05 11 – PIPE FITTINGS
   20 05 13 – MOTORS AND DRIVES
   20 05 19 – METERS AND GAUGES
   20 05 23 – VALVES
   20 05 26 – PUMPS
   20 05 31 – INSULATION
   20 05 53 – IDENTIFICATION

20 05 11 – PIPE AND PIPE FITTINGS

A. Pipe Fittings:

1. Unions or flanges shall be placed at all equipment, regulators, controls, valves, etc. which require removal or replacement. Removal shall not be blocked by adjacent equipment or piping. Where necessary for removal of equipment, unions shall be on both sides of equipment.

2. An acceptable setup for connecting dissimilar metals would be:
a. Black pipe terminates into a dielectric nipple, followed by a non-international brass Apollo ball valve, then a male threaded adaptor, then finishing with a sweated ground joint union.

3. Dielectric unions shall not be used on CSU property for hydronic or water service piping.

4. All unions shall be ground joint.

5. Reductions in size shall be made with reducing fittings.

6. All screwed nipples from copper fittings shall be red brass.

7. Isolation valves to each unit.

B. Welding:

1. All joints in black piping 2-1/2 inch and over shall be welded.

2. All welding work shall be performed by welders certified to ASME or AWS standards within the last year for the type of material and application suited for the job. Contractors shall submit copies of qualification tests of the welders to the University Representative for review prior to construction.

C. Pipe Connections:

1. Pipe connections to pumps, compressors, etc., shall have adequate allowance for movement and vibration. Connections shall be supported such that the weight is not carried by the equipment.

2. Provide required straight sections for flow measurement stations.

D. Expansion Compensation:

1. Pipes and equipment shall be arranged with due regard for the effects of thermal expansion.

2. Piping and joints shall be designed to eliminate damage by expansion and contraction.

3. Mechanical expansion devices are discouraged. Expansion loops are preferred. Where mechanical expansion devices are necessary, bellows type shall be specified. Other types with mechanical seals are not permitted.

E. Strainers:

1. Strainers shall be placed ahead of all backflow preventers, regulators, pumps, chillers, boilers, control equipment or any other equipment that could be damaged or rendered inoperative due to foreign matter in the piping. Provide adequate access for removal. Strainers shall have ball valves with caps for blow down.

2. Duplex strainers with isolation valves shall be provided on primary piping systems where operation is critical and is intended to continue during servicing. Strainers shall then be cleaned through removable caps.

3. For critical systems, pressure gauges shall be employed to indicate loading. If strainers are next to pumps provide multiple taps into pipe with gauge cocks and one common pressure gauge.

4. Clear see-through duplex strainers or filters should be considered for critical applications.
F. Shock Absorbers:

5. Shock absorbers shall be placed in water lines to equipment or fixtures having quick closing or flush valves and any equipment that might produce water hammer. Show locations and size of all shock absorbers on plans. Do not rely on general notes.

6. Isolation valves shall be installed prior to shock absorber.

G. Air Vents:

7. Manual air vents shall be threaded plug type with special key operator as made by Dole or equal. Vents shall be installed at all coil locations and all other high points.

8. Provide valve or gauge cock for isolation and repair.

9. Automatic air vents are permitted at air separators and shall be piped to floor drains. Automatic air vents are not allowed outside of equipment room.

20 05 13 – MOTORS AND DRIVES

A. General Information:

1. Provide motors for operation at 5000 feet elevation.

2. Motors should be 3 phase where possible. Motors 3/4 hp and smaller can be single phase. Larger than 3/4 hp shall be 3 phase.

3. All motors of 1-1/2 hp and larger shall be of a high or premium efficient type and have an efficiency of not less than those values as stated in the IEEE test procedures, 112A Method B. See Section 16400 C for more information.

4. Motor speeds for pumps shall be 1750 rpm. Motor speeds for fans shall be 1750 rpm unless vibration analysis shows that faster speeds meet the CSU vibration standard. This would be analyzed on a case by case basis.

5. Over-speeding motors by operating a VFD at greater than 60 Hz is not allowed.

6. All motors specified for VFD operations shall have rotor grounding devices installed.

7. Variable Frequency Drives are described in Section 26 29 23 – Variable Frequency Motor Controllers.

B. VFD Retrofit Requirements:

1. Bearings shall be replaced when converting a constant air flow fan to a variable air flow fan using a variable frequency drive.

C. Motor Frames and Mounts:

1. Motor frames shall be equipped with two axis adjustments, namely slotted frame ends for adjusting in shaft direction and adjusting screws for belt tensioning.

2. Installations shall be checked for "soft foot" conditions and shimmed appropriately.
20 05 19 – METERS AND GAUGES

A. Meters:
   1. Provide primary or sub-meters to measure potable water, steam, chilled water and natural gas for each building. Connect meters into BAS for meter reading.
   2. Meters should be considered for systems or equipment where monitoring is useful for maintenance and/or troubleshooting.
   3. Provide bypass piping and valves around domestic water meters for removal during service. See Drawing Appendix.
   4. See Division 33 - Utilities for information on utility metering requirements.

B. Gauges:
   1. Provide gauge cocks at all gauges for removal under operation.
   2. A single, common pressure gauge with suitable range shall be employed across pumps, strainers, pressure reducing stations, etc., with multiple taps into piping with individual gauge cocks.
   3. Mercury filled thermometers are prohibited. Alcohol filled or dial thermometers are acceptable. Typical sizes shall be 9 inch bulb type with swivel joints to be located in matching thermal wells. Direct insertion type thermometers are not permitted.

C. Air Filters:
   1. Provide pressure manometers across main building air filters. Connect, set warning and alarm limits to the Building Automation System.
   2. Provide calibration documentation.

D. Pressure Reducing Valves:
   1. Provide single pressure gauge across pressure reducing valves with unions on either side and one ball valve to indicate both high and reduced pressure with arrangement described above.

E. Hydronic and Domestic Water Systems:
   1. Provide thermometers on hot water systems, domestic and heating, to indicate supply and return temperatures.
   2. Provide thermometers, pressure gauges, and pressure-temperature taps in:
      a. Chilled water lines to and from water chiller.
      b. Condenser water lines to and from each condenser.
      c. Chilled water to and from each cooling coil.
      d. Hot water to and from each heating coil.
      e. Heating water to and from each steam-hot water heat exchanger.
      f. Line to and from each pump just inside of isolation valves, checks, etc.

F. Air Systems:
1. Provide sensors and thermometers on HVAC systems to indicate temperatures at supply, return and mixed air points.

G. Pumps:

1. Provide pressure gauges and pressure-temperature taps at each pump suction and discharge with arrangement described above.

20 05 23 – VALVES

A. Acceptable Products:

1. Ball Valves
   - Hydronic: Apollo, Crane, Nibco, Stockham, Walworth
   - Steam: Medium pressure, steam meter valve
     - Inline 202F at controls series 88
     - Low pressure building - same as hydronic
   - Condensate: Apollo series 77, Inline 202F at controls series 88
   - Plumbing: Apollo – Made in the USA

2. Butterfly Valves
   - Hydronic: DeZurik, Jamesberry830L or 815L, Keystone, Milwaukee
   - Steam: Jamesberry, Keystone K-LOK Model 362 with lugged carbon body, 316ss disc and seat and gear actuator with hand wheel, or Vanessa 30,000 or 32,500 series
   - Condensate: same as steam except PTFE seat for K-LOK

3. Gate Valves
   - Hydronic: Crane, Jenkins, Lunkenheimer, Milwaukee, Nibco, Stockham, Walworth
   - Steam: same as hydronic
   - Condensate: same as hydronic
   - Plumbing: same as hydronic

4. Globe Valves
   - Hydronic: Crane, Jenkins, Lunkenheimer, Milwaukee, Nibco, Stockham or Walworth
   - Steam: Same as hydronic. High Pressure steam isolation valves larger than 2 inches must have a globe valve by-pass for safe warm-up.

5. Integral Balance and Flow Measuring Valves
   - Hydronic: Armstrong, Bell & Gossett, Tour & Anderson

6. Check Valves
Condensate up to 3” Durabla model SCV 316 ss spring check;
Condensate 3” and up Tyco/Prince model 813 with 316ss external spring wafer check, Carbon steel body, 150 psig rating.

B. Products Not Permitted:
1. Butterfly and ball valves Apollo International.

C. Valve Selection:
1. Ball Valves
   Hydronic Preferred.
   Steam In the plant and medium pressure distribution system, permitted only for steam meter valve isolation!
   Permitted in the low-pressure steam building system.
   Condensate same as hydronic.
   Plumbing Full port valves are required.
   Branch lines on domestic hot and cold water service.
   Deionized water system branches to each laboratory and room
   Backflow devices 2 inch and smaller.

2. Butterfly Valves
   Hydronic Preferred only when ball valves are not economical.
   Steam Permitted only when access is difficult and confined.
   Condensate Same as hydronic.

3. Gate Valves
   Hydronic Not preferred.
   Steam Required for plant and medium pressure distribution system.
   Preferred for low pressure steam building system.
   Condensate same as hydronic.
   Plumbing Required for main building street service and building main supply lines
   and for isolation of meters, backflow devices larger than 2 inches and other major components.

4. Globe and Eccentric Plug Valves
   Hydronic Preferred for balancing if integral flow and balancing devices are not used.

D. General Information:
1. All valves must be shown on the drawings. Do not rely on a general note in the specifications or on the plans.
2. Where frequent operation is required on hydronic systems, ball or butterfly valves are preferred, service permitting and if economical.

3. Valves adjacent to equipment shall have unions or flanges provided to allow for removal.

4. All valves shall be numbered with a brass tag and a schedule shall be submitted with valve number, purpose and normal operating position. Valve schedule shall be mounted in a protected form in mechanical rooms and in O&M manual. Remodel projects shall add and update valve schedules.

5. All valves shall be mounted so operation is possible without interference from pipes, pipe hangers, walls, etc. All valves shall be mounted with the stem in the upright position as to alleviate debris accumulation.

6. Provide 3/4 inch drain valves at main shut-off valves and at low points of piping and equipment. Drain valves shall be standard port ball valves with a male threaded hose connection and cap.

7. Valves 2-1/2 inch and larger which are located more than 10 feet above floor in mechanical equipment rooms shall be chain operated if frequent operation is anticipated. Chains shall be extended to 6 feet above floor.

8. Blow down valves on strainers shall be standard port ball valves to permit quick opening service.

9. Hydronic balancing shall be performed using ultrasonic flow measuring equipment. Thus, only balancing valves are required on pipes one inch and larger. Venturi flow stations are not permitted. Branch pipes less than one inch or inside fan coils, unit ventilators, etc. shall have integral balancing and flow measuring valves such as circuit setters. Balancing valves shall be globe or plug valves. Ball and butterfly valves are not permitted for balancing. See Division 23 - HVAC for information on balancing and measuring stations.

E. Isolation Valves:

1. Valves for isolating sections of piping systems shall be provided. Valves shall be installed to isolate separate floors, separate wings, laboratory rooms, toilet rooms, machinery rooms and other natural subdivisions of the buildings.

2. Valves for isolating equipment and fixtures shall be provided. Valves (with strainers) shall be placed on both sides to permit component removal. Typical equipment includes pumps, coils or heat exchangers, temperature control valves, pressure reducing valves, steam traps, condensate receivers, etc.

3. If equipment is close coupled with other equipment over a short distance, then isolation valves may be placed on the upstream and downstream sides of the components and the valves in between deleted.

4. Isolation valves shall not be used for balancing and balancing valves shall not be used for isolation.

F. Ball Valves:

1. Typical ball valves shall comply with Standard MSS-SP110 and shall be rated for 150 psi SWP and 600 psi non-shock WOG. Construction shall include 2-piece cast bronze body, TFE seat, separate pack nut with adjustable stem packing, anti-blow out stems, chrome plated brass or bronze ball, ANSI threads or extended solder connection.
2. Ball valves for special applications in medium pressure steam systems shall be rated for 1000 psi WOG.

3. Full port ball valves shall be provided for all plumbing and hydronic systems.

4. If valves will be insulated, a 2 inch handle extension with a protective sleeve shall be provided that allows operation of valve without breaking the vapor seal.

G. Butterfly Valves:

1. Typical butterfly valves shall comply with Standard MSS-SP67 and be rated for 200 psi non-shock cold water pressure. Construction shall include lug style cast or ductile iron body with aluminum bronze alloy disc with EPDM rubber seat and seals or EPDM rubber encapsulated disc with polymer-coated body. Stem shall be 400 series stainless steel and shall not have exposed stem to disc fasteners. Lug style shall be capable for use as isolation valves for dead-end service at full pressure without the need for downstream flanges.

Sizes 2-1/2 inch to 6 inch shall be lever operated with 10-position throttling plate. Sizes 8 inch and larger shall have weatherproof gear operators.

H. Gate Valves:

1. Typical hydronic, steam and condensate gate valves, 2 inch and smaller, shall comply with Standard MSS-SP80 and be rated Class 150 for 150 psi SWP and 300 psi WOG. Construction shall include cast bronze body with rising stem, union bonnet, solid wedge with body, bonnet and wedge made of bronze ASTM B-62. Stems shall be of dezincification-resistant silicon bronze ASTM B-371, copper-silicon alloy or low-zinc alloy B-99 with non-asbestos packing and malleable or ductile iron handwheel. Valve ends shall ANSI threads or extended soldered connections.

2. Typical hydronic, steam, condensate and plumbing gate valves, 2-1/2 inch and larger, shall comply with Standard MSS-SP70 and be rated Class 125 for 125 psi SWP and 200 WOG. Construction shall include iron body with flanged connections, bolted bonnet, OS&Y, bronze trim, with body and bonnet conforming to ASTM A126 Class B cast iron. Packing and gaskets to be non-asbestos.

3. Typical plumbing gate valves, 2 inch and smaller, shall comply with Standard MSS-SP80 and be rated Class 125 for 150 psi SWP and 200 psi WOG. Construction shall include cast bronze body with rising stem, union bonnet, solid wedge with body, bonnet and wedge made of bronze ASTM B-62. Stems shall be of dezincification-resistant silicon bronze ASTM B-371, copper-silicon alloy or low-zinc alloy B-99 with non-asbestos packing and malleable or ductile iron handwheel. Valve ends shall be extended soldered connections.

4. Gate valves for use at the steam heating plant may require higher ratings. Check with Facilities Management-Heating Plant through the University Representative.

I. Globe

1. Typical globe valves, 2 inch and smaller, shall comply with Standard MSS-SP80 and be rated Class 150. Construction shall include bronze body and bonnet, TFE seat disc, copper-silicon alloy or silicon bronze stem and non-asbestos packing.

2. Typical globe valves, 2-1/2 inch and larger, shall comply with MSS-SP85 and be rated Class 125. Construction shall include iron body, bronze trim, OS&Y, bolted bonnet flanged connection and non-asbestos packing.
PART III - CSU TECHNICAL STANDARDS

DIVISION 20 – GENERAL MECHANICAL

J. Temperature Control Valves


20 05 26 – PUMPS

A. Sole Source Products:

1. HVAC hydronic horizontal in-line pumps - see Sole Source Appendix.

B. Acceptable Products:

1. HVAC hydronic base-mounted pumps - Armstrong Series 4030, Bell & Gossett ITT Series 1510, ITT-AC (Allis Chalmers), Taco or equal.
2. Vacuum Pumps - Nash or equal.
3. Sump Pumps - Weil-McLain, Zurn or equal.

C. Products Not Permitted:

1. All Pumps - Amtrol (Thrush)

D. General Information:

1. HVAC pumps shall have mechanical seals with carbon and ceramic materials. Packed seals are not permitted.
2. Plumbing and domestic water pumps - See Division 22 - Plumbing.
3. Pump speeds shall be limited to nominal 1800 rpm for typical hydronic and plumbing applications.
4. Pump motors larger than 3/4 hp shall be 3 phase.
5. Duplex pump systems shall include automatic lead/lag changeover control through a mechanical alternator or through the BAS.
6. Main building heating and cooling pumps shall be alarmed.
7. Suction diffusers are not desirable. Suction piping shall be a straight run of pipe equal to 5 pipe diameters for flow of 5 feet per second and less.
8. Pumps shall be arranged such that the suction and discharge piping is next to mechanical room walls and the pump motor faces the interior of the room. This permits easier access to service and replace the pump and pump motor.
9. Pump and piping accessory arrangements are shown in the Drawing Appendix.

E. In-line Pumps:

1. Closed loop hydronic systems shall have bronze fitted pumps which shall include a bronze impeller, cast iron volute, stainless steel shaft or steel shaft with stainless steel or bronze shaft
sleeve. Specifications shall include horizontal, oil-lubricated, self-aligning couplers, companion flanges, 125 psig working pressure, and 225 F water temperature.

2. "Quiet operation" shall be specified for pumps outside of mechanical rooms and where noise reduction is necessary.

3. Installation of in-line pumps equal to or larger than 1-1/2 hp shall require a clear floor space below the pump with 12 inches of clearance above and around all sides of pump. Pump shall not be located above other equipment, nor above a finished ceiling. If pumps must be above ceilings, then a drain pan with 3/4 inch drain pipe to sanitary sewer shall be provided. Ideal pump locations include mechanical rooms, janitor’s closets or accessible equipment chases.

4. See the Drawing Appendix for piping arrangement.

F. Base-mounted Pumps:

1. Closed loop hydronic systems shall have bronze fitted pumps which shall include a bronze impeller, cast iron volute, stainless steel shaft or steel shaft with stainless steel or bronze shaft sleeve. Specifications shall include a self-aligning, flexible J-coupling as made by Woods, LoveJoy or equal, companion flanges.

2. Pump alignment shall be performed on base-mounted pumps using either reverse dial or laser-light instruments and methods. These methods shall be performed by a factory authorized representative, a qualified balancer or with Facilities Management-Motor Shop.

3. Pump alignment shall be verified after start-up by Facilities Management-Motor Shop.

4. Base-mounted pumps shall be mounted on housekeeping pads.

5. See the Drawing Appendix for piping arrangement.

20 05 29 – HANGERS AND SUPPORTS

A. Pipe Supports:

1. The Mechanical Engineer shall specify methods and span of supporting pipes. Pipe support shall not be left to the Contractor’s discretion.

B. Piping Arrangements:

1. See the Drawing Appendix for piping arrangements.

20 05 31 – INSULATION

A. Asbestos-containing materials are prohibited. All materials or products must be certified or verifiable to be asbestos free by the supplier or manufacturer. See Division 2 – Existing Conditions for additional information concerning asbestos.

B. Sole Source Products:

1. Underground Direct Buried Piping Insulation – see Sole Source Appendix

C. Acceptable Products:
1. Removable Valve Covers - Thermal Stitch or equal.

D. Pipe Insulation:

1. Piping requiring insulation shall have the maximum R-value that is economically appropriate. Obtain current utility costs from the University Representative to calculate the optimum insulation thickness.

2. Steam and condensate lines shall be insulated with fiberglass insulation except for underground or areas where other insulation types are more appropriate.

3. Hot and cold pipes near each other or in a common confined space shall be insulated.

4. Insulate all hot water circulating lines and chilled water lines.

5. Insulated unions shall be marked or tagged.

6. Insulate cold/chill water lines to prevent condensation with the minimum R-value and vapor barrier that prevents condensation. Insulation shall be installed in such a way to provide a continuous barrier, despite the application. All wall penetrations shall be large enough to accommodate the diameter of the insulation and vapor barrier without compression.

7. Insulate chilled water systems at temperatures less than 35 deg. F with flexible, elastomeric (i.e., black foam rubber) insulation. Insulation shall meet required smoke and flame spread ratings for location in plenums and above ceilings.

8. Refrigeration suction and hot gas piping shall be insulated with flexible, elastomeric (i.e., black foam rubber) insulation.

9. Outside piping shall have protective aluminum jacket or other covering over insulation. Jacket shall be painted only when visible from normal pedestrian walkways. Painting of insulation is not an acceptable substitute.

10. Piping in areas where damage may occur shall have protective aluminum or other suitable jacket over insulation.

E. Fixed and Removable Valve Insulation Covers:

1. Valves, strainers and other equipment on steam, condensate, and hot water lines shall be insulated.

2. Steam and hot water valves, 3 inch and larger, shall be insulated with a removable insulation jacket. Valves 2-1/2 inch and smaller shall not be insulated unless removable type is shown to be cost effective or effect of heat loss is shown to be detrimental.

3. Removable insulation jackets shall be 1 inch thick fiberglass insulation of 7 lb. per cubic foot density and suitable for temperatures to 1000°F secured with stainless steel quilting pins. The inner and outer jacket shall be silicone-coated fiberglass, 17 oz. per sq. yard, chemical resistant, suitable for temperatures to 500°F. The seam closure shall be teflon coated fiberglass threads suitable for temperatures to 600°F of type 20 lb. tensile strength. The fastening system shall be type 304 stainless steel double D-rings with silicone coated fiberglass belts with velcro on ends. Belt shall be 1 inch wide and sewn to adjacent insulation, flanges, etc. Cords shall be stainless steel wire, minimum 1/4 inch diameter and teflon coated. An I.D. tag shall be furnished which is of type 304 stainless steel or aluminum and riveted to jacket with item description, location and factory number.
4. Core unit shall be fabricated in one piece wherever possible and shall fit over adjacent insulation flanges, etc., a minimum of 2 inches.

5. All jackets shall be field measured by manufacturer's representative. Manufacturer shall guarantee jacket will fit snugly without force, folding, bending or stretching.

F. Underground Trench or Tunnel Pipe Insulation:

1. Underground trench pipe shall be insulated with fiberglass ASTM C 547 Class I with a "K" coefficient of 0.23 at 75°F with an outdoor jacket.

G. Underground Direct Buried Pipe Insulation:

1. Steam, condensate, hot or chilled water direct buried piping shall be insulated in a bed of dry, free flowing granular, inert and hydrophobic inorganic insulation. The insulation material shall have a thermal conductivity coefficient of no more than 0.60 Btu/hr/sf/F/in at a bulk density of 40 lbs/cf at a mean temperature of 175°F.

2. Insulation material shall be installed according to manufacturer's recommendations.

H. Duct Insulation:

1. In most cases, ducts carrying heated and cooled air shall be insulated on the outside. Duct liner is prohibited. Methods of insulating shall be specified.

20 05 53 – IDENTIFICATION

A. Pipe Identifications:

1. All piping shall be identified as to contents and direction of flow at a minimum of 20’ intervals and at branch points. Mechanical Engineer shall specify identification material, method and terminology. Identification criteria shall not be left to the Contractor's discretion.