PART I - GENERAL

1.0 OVERVIEW [Background for PSC]

A. Preference for Rotary Control Valves

1. The University has transitioned from the use of sliding stem globe type control valves to the use of rotary valves for HVAC applications with few exceptions.

2. This is not accomplished without challenge given that HVAC grade rotary valves are not available in all sizes and temperature ratings required. Industrial grade rotary valves, on the other hand, are available for every imaginable application in any size desired. However, they are significantly more expensive, especially in smaller sizes. Thus, the University has standardized on the use of HVAC grade rotary valves for most hydronic applications and the use of industrial grade valves for a limited number of applications where HVAC grade valves are deemed inappropriate or inadequate.

3. Steam valves present a special challenge. Since the University utilizes superheated district steam for heating applications in the majority of its buildings, control valves with high temperature ratings are required. HVAC grade rotary valves rated for superheated steam service are not available at the time of this writing, regardless of valve size. Thus, for the sake of economy, the University allows the use of standard HVAC grade globe valves in smaller sizes while requiring the use of industrial grade rotary valves in larger sizes.

B. Rationale

1. The University’s preference for rotary control valves over sliding stem globe valves is based upon the following rationale:

2. Rotary valves typically have greater rangeability than comparable HVAC grade globe valves, especially in larger sizes. In some cases this allows the use of a single rotary valve in lieu of two globe valves installed in a parallel configuration (see sizing criteria). A typical HVAC grade globe valve has an inherent rangeability of 30/1 whereas the inherent rangeability of various industrial grade rotary valves is as follows: eccentric plug 100/1, characterized ball 200/1, segmented ball 300/1.

3. Rotary valves lend themselves to failing in last position (fail-in-place). This is preferable for many applications on campus, including most heating applications.

4. Given that globe valves have sliding stems, packing wear proves to be a perennial problem requiring on-going maintenance. Rotary valves, on the other hand, have rotating shafts that result in virtually no seal wear. Thus, these valves require very little, if any, maintenance.

5. Rotary valves are especially well suited for use with electric/electronic actuators. The application of rotary electric/electronic actuators to sliding stem globe valves is awkward at best.

6. HVAC grade rotary valves are typically less expensive than HVAC grade globe valves. In large sizes, even industrial grade rotary valves can be less expensive than HVAC grade globe valves.

C. Pressure Independent Control Valves

1. For a considerable length of time the University has encouraged the use of pressure independent control valves where applicable. The installation of such valves is more beneficial and cost effective when applied to large units rather than numerous small units. This is especially true of large chilled water coils. Use of PI control valves results in higher and more consistent chilled water “delta T”. This, of course, is beneficial to the larger central chilled water system. For this reason the use of PI
valves is now required for use with chilled water coils in central station units (AHUs) unless pressure dependent valves are deemed more appropriate for a given application. Application of PI control valves is typically less critical for small cooling units such as fan coils. Standard rotary PD control valves have proven to perform adequately for these applications to-date. Thus, standard pressure dependent control valves shall be provided as default for fan coils and other units smaller than AHUs. It is acknowledged that in some cases use of PI valves may result in objectionable noise. In such cases it may be necessary to use PI valves to address this problem.

2. Given that PI control valves are now required at all sizable CHW coils it is no longer necessary to provide DP control at the building level in most cases. Thus, building level CHW control valves are typically no longer required. In simple terms, the University has switched from pressure independent buildings to pressure independent air handling units within buildings.

3. With the longstanding pressure independent building approach it has become a common practice to deactivate the differential pressure control function of the building control valve at low load conditions. This typically occurs throughout the winter months. Why? Because it is not possible to control low flow rates with a control valve sized for much larger summer loads. Deactivating the building control valve in this manner often results in elevated and variable differential pressures throughout the building system during low load conditions. Thus an advantage of PI control at the AHU level.

4. Dedicated PI control valves are typically discouraged for use with individual devices in hot water heating systems that utilize steam as their heat source. Temperature differential is less critical with steam-generated heating. Avoiding the application of PI control valves in hot water heating system applies to all heating coils and devices of all sizes. This includes heating coils in air handling units as well as reheat coils, perimeter heating units, cabinet unit heaters, etc. If normalized DP in the system is desired, Differential Pressure Controllers can provided in branch piping near the pump. However, an attractive PI valve application for heating is the control of hot water heating devices within a condensing HW generator (boiler) system. This promotes increased HW delta T and resultant reduced HW return temperature.

1.1 SECTION INCLUDES

A. Control Valves for Hydronic Applications
   1. HVAC Grade
   2. Industrial Grade

B. Control Valves for Low Pressure Steam Applications
   1. HVAC Grade
   2. Industrial Grade

C. Control Valves for Medium Pressure Steam Applications
   [Note to PSC: Clearly indicate if HVAC Grade or Industrial Grade control valves are to be provided for specific application. Provide control valve schedule and appropriate valve specifications in project documents. Detailed requirements for control valve schedules are developed below]
   [Note to PSC: All control valves in chilled water plants shall be industrial grade.]

1.2 RELATED SECTIONS

A. Section 23 09 13.34 – Control Valve Actuators

B. Section 23 21 16 – Hydronic Piping
C. Section 23 22 13 - Stream and Condensate Piping

1.3 REFERENCES
A. ASME Standard B31.9 - Building Services Piping
B. Applicable ASME B16 standards
C. Illinois Steel Products Procurement Act
D. International Mechanical Code

1.4 QUALITY ASSURANCE
A. Products and execution shall be in compliance with applicable codes and standards including those referenced above in the section entitled REFERENCES.
B. Installation, start-up and operation shall be in compliance with Manufacturer’s recommendations and IOM.

1.5 CONTROL VALVE APPLICATIONS
A. Hydronic Systems (i.e. Water-Based Heat Transfer Systems)
   1. All automated valves in hydronic systems shall be rotary type. Modulating control valves shall be either characterized ball or segmented ball type. Modulating control valves in variable flow systems shall be two-way. Two position (on-off) valves shall be either ball or butterfly type. Two valve grades are specified herein, HVAC and industrial grade.

   Exception: In a very limited number of cases control valves may be globe type. Typically these are small pneumatically actuated valves given that small pneumatically actuated rotary control valves are not readily available. Valve type shall be as scheduled or otherwise indicated in project documents.

   2. In cases where still required, automated building chilled water pressure regulating valves in CHW supply lines shall be industrial grade (segmented ball valves). Also, if two position (on-off) valves in adjacent chilled water return lines are automated they too shall be industrial grade (high performance butterfly valve). If not automated, valves may be HVAC grade (resilient seated butterfly valve).

   3. If automated building chilled water supply pressure regulating valves are provided, such shall be two valves configured in parallel unless indicated otherwise in project drawings. One valve shall be sized for winter operation and the combination of the two for summer operation.

   [Note to PSC: Since all CHW control valves serving AHUs are now required to be pressure independent type, automated building entrance control valves and adjacent automated shut-off valves are typically no longer required. In such cases adequate building isolation can be accomplished via manual HVAC grade valves (resilient seated butterfly valves].

   [Note to PSC: Typically, building entrance control turn-down has proven to be inadequate when a single building pressure control valve is provided. Thus, two parallel control valves shall now be provided as default. Discuss with Owner prior to design and show on drawings as appropriate.]

   4. The grade of other automated valves shall be HVAC or industrial as scheduled or otherwise indicated within the documents. Except for retrofit applications, HVAC grade valves shall have electronic actuation. Actuators for industrial grade valves shall be electric or pneumatic as scheduled or otherwise indicated.

B. Steam Systems
   1. Low Pressure (≤15 PSIG)
a. Modulating control valves in low pressure steam systems may be either HVAC globe valves or industrial grade rotary valves with either electronic or pneumatic actuation as scheduled or otherwise indicated within the documents.

2. Medium Pressure (15-60 PSIG)
   a. Modulating control valves in medium pressure systems shall be industrial grade eccentric plug type with either electric or pneumatic actuation. Actuator type shall be as scheduled or otherwise indicated within the documents.

Note: Building heating devices (e.g. heat exchangers) are typically served directly by medium pressure steam given that building PRVs are typically no longer provided.

1.6 CONTROL VALVE SIZING

A. Two Position (On-Off) Control Valves
   1. Valves shall typically be sized for minimal fluid/steam pressure drop. In such case, valve connection size shall be equal to pipe size with no reducers.
   2. In certain cases it may be desirable to serve a modulating load with a two position (on-off) control valve. Examples include fan coil units and other small terminal devices. This approach promotes incremental turbulent flow as opposed to continuous modulating laminar flow during part-load operation. The goal here is to reduce overall flow rate and increase fluid delta T. In such cases it may be appropriate to provide a valve with connection size smaller than line size

B. Modulating Control Valves
   
   [Note to PSC: Be mindful that most HVAC systems are substantially over-designed and thus, for any given application, the actual maximum flow rate is likely to be substantially less than full design flow rate. This often results in oversized control valves.]

   1. Control valves shall be sized to operate at no less than 70% of available stroke at maximum flow rate. [Note to PSC: The goal here is to utilize the full available range of the control valve. When control valves are oversized only a portion of their available range (as represented by stroke) is utilized.]

   2. At minimum flow rate, control valves shall be sized to operate at or above minimum recommended valve position as determined by manufacturer. Note to PSC: This prevents seat damage resulting from operating the valve too near its closed position.]

   [Note to PSC: Control valve sizing shall be based upon installed Cv rather than rated Cv. Installed Cv takes into account the effect of pipe size reduction. The greater the pipe size reduction at the control valve the greater the reduction in Cv. The use of valve sizing software is required to determine installed Cv. The difference between installed Cv and rated Cv tends to be greater for steam applications, given that pipe size reduction is typically more significant.]

C. Modulating Control Valves for Hydronic Applications

   1. Unless otherwise scheduled or indicated within the documents, each control valve shall be sized for a full-open fluid pressure drop at design flow rate that is equal to 25-50% of the total pressure drop through the branch or dedicated circuit that it controls. The total branch pressure drop equals the sum of the pressure drops through the branch piping, fittings, controlled equipment, control valve, balancing valve, isolation valves and any hydronic specialties (e.g. strainers). This approach yields .25 to .50 valve authority. Control valve Cv calculation shall be based upon the actual differential pressure required for each valve to achieve this valve authority. The standard practice of using 5 PSID for Cv calculation for all valves throughout the system regardless of location relative to the pump is not acceptable.
D. Modulating Control Valves for Steam Applications

1. For steam supply pressures of 12 PSIG or less, valves shall be sized to yield a gage pressure drop of 80-100% of the inlet gage pressure at the maximum flow rate, unless otherwise scheduled or indicated within the documents. For steam supply pressures of greater than 12 PSIG, valves shall be sized for a pressure drop of 45% of the inlet absolute pressure at the maximum flow rate, unless otherwise scheduled or indicated within the documents. For HVAC applications, control valves in low pressure steam systems (i.e. with building pressure regulators) shall be sized for a supply steam pressure of 12-15 PSIG unless historical data indicates that this pressure cannot be consistently maintained. In no case shall a control valve serving an HVAC system be sized for a steam inlet pressure less than 10 PSIG. Exception, a steam valve may be sized for lower inlet pressure if it serves a lower pressure “radiation” or “perimeter heat” steam distribution system.

D. Modulating Control Valves for Steam Applications

[Note to PSC: Sizing for higher supply pressure helps protect against oversizing. Although sizing for 10 PSIG supply pressure has been common in the past, sizing for 12-15 PSIG helps prevent oversizing. Given that virtually all steam-to-hot water heat exchangers (a.k.a. hot water converters) are grossly oversized, control valves for these applications shall be “rounded down” in size rather than increased to a Cv that is substantially greater than that which is required to satisfy the design capacity requirement. Oversizing of such heat exchangers creates a great challenge in selecting/sizing steam control valves that will have adequate valve life and performance capabilities for these applications.]

2. Control valves shall be sized such that the steam velocity at design conditions does not exceed 0.5 mach for limited periods of time (i.e. several hours). Velocity shall not exceed 0.3 mach for extended periods of time (i.e. days on end).

E. Parallel Valves

1. Sliding stem globe valves

a. For steam-to-hot water heat exchangers and other high turndown applications a minimum of two control valves shall be provided for each heat transfer device and shall be piped in parallel. In such cases these valves shall be sequenced such that the appropriate sized valve opens first. Sizing of each valve shall be in compliance with the criteria presented above. A common approach to sizing parallel valves is that of selecting one valve for 1/3 of the total system flow rate and another for the remaining 2/3. This rule of thumb approach is not necessarily optimal. Thus, an engineered approach shall be used that optimizes valve sizing
and sequencing relative to specific minimum and maximum flow conditions within the system.

[Note to PSC: Optimal valve capacity ratios may be 1/2-1/2, 1/4-3/4, or any other Cv ratio. Similarly, the optimal sequence may result in the larger valve opening prior to the smaller rather than the traditional “small one first” approach.]

2. Rotary valves
   a. Installation of multiple parallel control valves is also encouraged for rotary steam control valves and shall be treated as default design. However, since rotary control valves typically have much higher rangeability than do comparable globe valves it may not be necessary to provide multiple rotary valves in all cases. Typically, for small heat exchangers, if system turndown does not exceed 10 to 1 a single rotary valve may be used. Turndown ratio is defined as the ratio of maximum design flow rate to minimum design flow rate. Unless indicated otherwise in schedule or drawings two control valves shall be provided.

[Note to PSC: As stated above, a typical HVAC grade globe valve has an inherent rangeability of 30/1 whereas the inherent rangeability of various industrial grade rotary valves is as follows: eccentric plug 100/1, characterized ball 200/1, segmented ball 300/1.]

3. Bypass valves
   a. A bypass line with manual throttling valve shall be provided at each steam control valve station, whether it has a single valve or multiple valves in parallel. This manual valve enables control of steam flow rate if for any reason one or more control valves are disabled. More importantly, it facilitates warm up of the steam system downstream of the control valve(s).

1.7 ADDITIONAL VALVE SELECTION CRITERIA

A. Valve Characteristic
   1. Control valves in CHW and HW applications shall have equal percentage characteristic.
   2. Control valves in steam applications shall have linear or equal percentage characteristic.
      a. Equal percentage characteristic is preferred for steam pressures ≤12 PSIG
      b. Linear characteristic is preferred for steam pressures > 12 PSIG

B. Shut-Off Rating
   1. Control valve/actuator assemblies in all hydronic systems shall have shut-off ratings of at least 1.5 times the shut-off head of the system pump(s).
   2. Control valve/actuator assemblies in chilled water systems shall have shut-off ratings of 50 PSID minimum. This is the anticipated maximum DP in the campus central CHW system.
   3. Control valves in all hydronic systems shall have operating differential pressure (dynamic pressure) rating of 50 PSID minimum.

C. Leakage Class
   1. Metal-seated valves shall be leakage class IV minimum.
   2. Soft-seated control valves shall be leakage class VI unless otherwise specified.

D. Cavitation
   1. Control valves shall be selected to meet their intended service without cavitation. If necessary, anti-cavitation trim shall be provided.
E. Noise
   1. Control valves shall be selected to meet their intended service without creating objectionable noise.
   2. Default maximum sound level shall be 85 dBA at a distance of 5’. This will likely need to be adjusted based upon location, adjacencies, etc.
   3. If necessary, noise attenuating trim shall be provided.

F. Velocity
   1. As stated above, steam velocity shall not exceed 0.3 mach although in some cases an absolute maximum velocity of 0.5 mach may be considered.

1.8 FAIL POSITION

A. Heating/cooling applications with rotary actuators (e.g. electric, pneumatic rack and pinion).
   Fail in last position (non-spring return):
   1. Preheat coils
   2. Reheat coils
   3. Finned tube units
   4. Radiant panel heaters
   5. Convectors
   6. Unit heaters
   7. Cabinet unit heats
   8. HW fan coil units
   9. HW blower coil units
   10. Steam-to-hot water heat exchangers that serve all devices listed above
   11. Fan coil units – heating coil
   12. Blower coil units – heating coil
   13. CHW coils not exposed to outdoor air
   14. Chilled beams
   15. Computer room cooling units
   16. Other specialty cooling equipment

   Fail open (spring return or electronic):
   1. Chilled water coils potentially exposed to outdoor air*
      * HVAC grade rotary valves are available with factory mounted actuators with electronic fail safe feature in lieu of spring return mechanism (e.g. Belimo “super-capacitor”). HVAC grade rotary valves with such factory mounted actuators are allowed although valves and actuators must satisfy all other specified requirements.
   2. Building CHWS pressure regulating / flow control valve at BTU metering station near service entrance**
   3. Building CHWR isolation valve near service entrance**
      ** Industrial grade actuators that fail in last position are acceptable for industrial grade rotary valves 2 ½” and larger. Valves of this size require more torque than can cost-effectively be achieved with industrial grade spring-return electric actuators. In such
cases control programming shall drive valve open/closed on a scheduled basis to prove proper function via position feedback.

B. Heating/cooling applications with pneumatic spring-and-diaphragm actuators

**Fail open:**
1. Preheat coils
2. Finned tube units
3. Radiant panel heaters
4. Convector
5. Unit heaters
6. Cabinet unit heaters
7. Fan coil units – heating coil
8. Blower coil units – heating coil
9. ...Steam-to-hot water heat exchangers that serve all devices listed above
10. Fan coil units – cooling coil
11. Blower coil units – cooling coil
12. CHW coils potentially exposed to outdoor air
13. Building CHWS pressure regulating valve at BTU metering station near service entrance
14. Building CHWR isolation valve near service entrance

**Fail closed:**
1. Reheat coils
2. Steam-to-hot water heat exchangers that serve them

C. Safety related applications with spring-return rotary or spring-and-diaphragm actuators.

**Fail closed:**
1. Domestic water heaters
2. Steam humidifiers
3. Process equipment
4. Other potentially hazardous applications

D. Cooling tower applications

1. Condenser water bypass – Fail closed
2. Cooling tower shut-off (individual cells) – Fail closed
3. Cooling tower makeup – Fail open
4. Cooling tower blow-down – Fail closed
5. Cooling tower winter drains – Fail open

E. Automated check valves for large pumps – Fail open or closed based upon application.

*Note to PSC: This represents a change from previous standard which was fail closed only.*

*Note: For constant flow systems (typically with three-way valves)*
Fail open = flow to/through coil/device (no flow through bypass)

Fail closed = no flow to/through coil/device (full flow through bypass)

[Note to PSC: The rationale for using “fail in last position” as default for rotary actuated control valves is as follows: The temperature of the area served by the heating/cooling system should be at or near set point when control system failure occurs. Since most HVAC loads change slowly the temperature will drift slowly from set point. An alarm will be registered and communicated via EMS when an excursion is detected (programming is required). In this manner, maintenance staff will be notified that service is needed. In some cases the problem can be corrected before failure is apparent to the end user.

[Not to PSC: For valves with either type of actuator (rotary or spring-and-diaphragm) the rationale for using “fail open” as the default fail position for CHW cooling coils that are potentially exposed to outdoor air is as follows: The University standard freeze protection system requires that the CHW control valve be opened quickly upon detection of near-freezing temperatures at the coil. Thus, it is essential that this valve fail open to ensure coil protection when a control system failure occurs. In conjunction with this it is essential that the automated building CHW valves at the service entrance also fail open.

1.9 ACTUATORS

A. Valve actuators
   1. Refer to Section 23 09 13.34 – Control Valve Actuators for actuator specifications
   2. Refer to Control Valve Schedule for application-specific valve/actuator combinations

1.10 CONTROL VALVE SCHEDULE

A. Control valves and actuators shall be provided as identified in control valve schedule. If project documents do not include a complete control valve schedule as itemized below PSC shall be contacted to provide such.

Complete Control Valve Schedule shall include:

1. Valve tag (Each control valve for central station and unitary equipment shall be identified with unique tag)
2. Application (e.g. AHU-xx-PHC, AHU-xx-CHWC, HX-xx, CRAC-xx)
3. Media (e.g. steam, chilled water, hot water, hot water/glycol)
4. Maximum design capacity/flow rate (e.g. GPM, PPH)
5. Minimum design capacity/flow rate (essential for determining valve turn-down and determination if one valve or two in parallel are required)
6. Design pressure differential (valve inlet/outlet) used for Cv calculation
7. Pipe size (needed for calculation of effective Cv)
8. Rated Cv, flow coefficient
9. Effective Cv (includes effect of pipe reducers)
10. Fail position (e.g. spring return fail-open, spring return fail-closed, fail-in-place (aka fail-last-position))
11. Positioner (yes/no)
12. Valve Identification Number (Clearly identifies valve type, construction and options in same way as a manufacturer’s model number. Example: HYD-HVAC-2W-MOD-CBV-THD-S1
13. Actuator Identification Number (Similarity, identifies actuator type, construction and options. Example: HVAC-E-R-SR)
14. Other pertinent information
PART 2 - PRODUCTS

Valve Identification Number Breakdown:

[Note to PSC: This may seem complex but it is necessary given that there are numerous valve actuator combinations.]

- HYD = Hydronic
- LPS = Low Pressure Steam
- MPS = Medium Pressure Steam
- HVAC = HVAC Grade
- IND = Industrial Grade
- MOD = Modulating
- 2P = Two Position
- PIV = Pressure Independent Valve
- 2W = Two-way
- 3W = Three-way
- GV = Globe Valve
- BV = Ball Valve
- CBV = Characterized Ball Valve
- SBV = Segmented Ball Valve
- BFV = Butterfly Valve
- HPBF = High Performance Butterfly Valve
- ABFV = AWWA Butterfly Valve
- EPV = Eccentric Plug Valve
- THD = Threaded Connections
- FLG = Flanged Connections
- LG = Lug Connections
- S1 = Size Increment 1
- S2 = Size Increment 2
- S3 = Size Increment 3
- S4 = Size Increment 4
- M = Mechanical
- E = Electronic

[Note to PSC: Contractor’s Option - Overlap in sizes for a given valve type provides an option for the Contractor to select from multiple valve types within that size range.]

2.1 CONTROL VALVES FOR HYDRONIC APPLICATIONS
A. HVAC GRADE

1. MODULATING, TWO-WAY (HVAC HYDRONIC)

[a. Globe Valves (See Section 23 09 13.34 for pneumatic actuator specification.)]

1) Size 1 1/4” and Smaller, Threaded Globe Valve

HYD-HVAC-MOD-2W-GV-THD-S1

(a) Pressure class 250
(b) 50 PSID shut-off rating
(c) 50 PSI differential pressure rating (dynamic pressure rating)
(d) Leakage class IV
(e) Bronze body
(f) NPT connections
(g) Replaceable stainless steel stems, plugs, and seats
(h) Adjustable or live-loaded packing
(i) Performance characteristic: Equal percentage

[b. Characterized Ball Valve (See Section 23 09 13.34 for electronic actuator specification.)]

1) Sizes 2” and Smaller, Threaded Characterized Ball Valve

--Terminal and unitary equipment

HYD-HVAC-MOD-2W-CBV-THD-S1

(a) 600 PSI cold working pressure
(b) 100 PSI shut-off rating
(c) 50 PSI differential pressure rating (dynamic pressure rating)
(d) 250F temperature rating
(e) Rated for 50% glycol/water solution
(f) Leakage class IV
(g) Forged brass body
(h) NPT connections, sweat connections acceptable only if pre-piped at factory
(i) Stainless steel ball
(j) Stainless steel stem with EPDM 0-ring stem seals
(k) Blow-out proof stem design
(l) Valve position indicator on top of bare stem
(m) PTFE seats with O-ring backup
(n) Flow characterizing insert disc available in various size/shape openings for specific Cv and performance characteristic
(o) Characterized ball with no discs also allowed (preferred)
(p) Ball valve without characterization not allowed
(q) Cv of .5 or greater to prevent clogging
(r) Performance characteristic: Equal percentage
(s) Five year unconditional warranty from date of purchase
(t) Control valve and actuator shall be preassembled by manufacturer
(u) Approved Manufacturers:
   i. Belimo CCV
   ii. Siemens

c. Segmented Ball Valve (See Section 23 09 13.34 for pneumatic actuator specification.)
   1) Size 1 ½ and 2", Threaded Segmented Ball Valve
      --Small central station units (e.g. AHUs)
      HYD-HVAC-MOD-2W-BSV-THD-S1
      (a) Pressure class 150
      (b) 150 PSID shut-off rating
      (c) 250F temperature rating
      (d) Rated for 50% glycol/water solution
      (e) Leakage class VI, bi-directional
      (f) Carbon steel body
      (g) Flanged connections
      (h) Stainless steel segmented ball and stem
      (i) Reinforced PTFE (RPTFE) seats
      (j) Adjustable shaft packing
      (k) Performance characteristic: Equal percentage
      (l) Approved manufacturers
         i. Valve Solutions (VSI)
         ii. Belimo
         iii. Neles/Jamesbury
         iv. Samson

   2) Size 2 1/2" and Larger, Flanged Segmented Ball Valve (See Section 23 09 13.34 for pneumatic or electronic actuator specification.)
      --Larger central station units (e.g. AHUs)
      HYD-HVAC-MOD-2W-BSV-FLG-S2
      (a) Pressure class 150
      (b) 150 PSID shut-off rating
      (c) 250F temperature rating
(d) Rated for 50% glycol/water solution
(e) Leakage class VI, bi-directional
(f) Carbon steel body
(g) Flanged connections
(h) Stainless steel segmented ball and stem
(i) Reinforced PTFE (RPTFE) seats
(j) Adjustable shaft packing
(k) Performance characteristic: Equal percentage
(l) Approved manufacturers
   i. Valve Solutions (VSI)
   ii. Belimo
   iii. Neles/Jamesbury
   iv. Samson

2. MODULATING, PRESSURE INDEPENDENT, TWO-WAY (HVAC HYDRONIC)
   a. Pressure Independent Valve (See Section 23 09 13.34 for actuator specification.)
      1) Size 2” and Smaller, Threaded Pressure Independent Valve, Mechanical
         (See Section 23 09 13.34 for electronic actuator specification)
         HYD-HVAC-MOD-2W-PIV-THD-S1-M
         (a) 300 PSI cold working pressure
         (b) 100 PSID shut-off rating
         (c) Pressure independent operation up to system pressure differential of 50 PSID minimum
         (d) Minimum pressure differential no greater than 5.0 PSID
         (e) 220F temperature rating
         (f) Rated for 50% glycol/water solution
         (g) Leakage class IV
         (h) Rangeability: 100 to 1 minimum
         (i) Cast bronze body
         (j) NPT connections
         (k) Brass, stainless steel, PTFE internal components. Plastic components not acceptable
         (l) Seals renewable with valve in place
         (m) Performance characteristic: Equal percentage
         (n) Basis of design: Delta P

         [Note to PSC: The PI valve specified is industrial grade yet is to be used for HVAC grade applications. No HVAC grade pressure independent control valve has been identified to-date with adequate quality and simplicity for installation at UIUC.]

      2) Size 3” and Larger, Flanged Pressure Independent Valve, Mechanical
         (See Section 23 09 13.34 for pneumatic or electric actuator specification.)
         HYD-HVAC-MOD-2W-PIV-FLG-S2-M
(a) 150 PSI cold working pressure
(b) 100 PSID shut-off rating
(c) Pressure independent operation up to system pressure differential of 50 PSID minimum
(d) Minimum pressure differential no greater than 5.0 PSID
(e) 220F temperature rating
(f) Rated for 50% glycol/water solution
(g) Leakage class IV
(h) Rangeability: 100 to 1 minimum
(i) Ductile iron body
(j) Flanged connections
(k) Brass, carbon steel, stainless steel, PTFE internal components. Plastic components not acceptable
(l) Seals renewable with valve in place
(m) Performance characteristic: Equal percentage
(n) Basis of design: Delta P

[Note to PSC: The PI valve specified is industrial grade yet is to be used for HVAC grade applications. No HVAC grade pressure independent control valve has been identified to-date with adequate quality and simplicity for installation at UIUC.]

3. MODULATING, THREE-WAY (HVAC HYDRONIC)
   a. Characterized Ball Valve, Three-Way Mixing (See Section 23 09 13.34 for actuator specification.)
      1) Size 3” and smaller, Threaded Three-Way Characterized Ball Valve
         HYD-HVAC-MOD-3W-CBV-THD-S1
            (a) 360 PSI cold working pressure
            (b) 40 PSID shut-off rating
            (c) 40 PSI differential pressure rating (dynamic pressure rating)
            (d) 250F temperature rating
            (e) Rated for 50% glycol/water solution
            (f) Leakage class IV
            (g) Forged brass body
            (h) NPT connections, sweat connections acceptable only if pre-piped at factory
            (i) Stainless steel ball
            (j) Stainless steel blow-out proof stem with EPDM 0-ring stem seals, renewable with valve in place
            (k) PTFE seats with O-ring backup
            (l) Flow characterizing ports available in various size/shape openings for specific Cv and performance characteristic
            (m) Full port ball without characterizing disc not allowed
            (n) Cv of 1.0 or greater to prevent clogging
(o) Universal mounting plate
(p) Performance characteristic: Equal percentage
(q) Basis of design: Griswold Unimizer

2) Size 4" and larger, Flanged Three-Way Characterized Ball Valve
   HYD-HVAC-MOD-3W-CBV-FLG-S2
   (a) 240 PSI cold working pressure
   (b) 50 PSID shut-off rating
   (c) 50 PSI differential pressure rating (dynamic pressure rating)
   (d) 250F temperature rating
   (e) Rated for 50% glycol/water solution
   (f) Leakage class IV
   (g) Cast iron body
   (h) Flanged Connections
   (i) Stainless steel ball
   (j) Stainless steel blow-out proof stem(s) with EPDM O-ring stem seals
   (k) PTFE seats
   (l) Flow characterizing parabolic ports, available in various size/shape
       openings for specific Cv and performance characteristic
   (m) Full port ball without characterizing ports not allowed
   (n) Universal mounting plate
   (o) Performance characteristic: Equal percentage
   (p) Basis of design: Griswold Unimizer

4. TWO POSITION (ON-OFF), TWO-WAY (HVAC HYDRONIC)

   [Note to PSC: Globe valves may only be used in sizes 1 ¼" and smaller for pneumatic
   applications. They are allowed in this small size range rather than characterized ball
   valves due to unavailability of rotary pneumatic actuators in small sizes.]
   a. Globe Valve - (Pneumatic applications only, see Section 23 09 13.34 for actuator
      specification.)
      1) Size 1 1/4" and Smaller, Threaded Globe Valve
         HYD-HVAC-2P-2W-GV-THD-S1
         (a) Pressure class 250
         (b) 50 PSID shut-off rating
         (c) 50 PSI differential pressure rating (dynamic pressure rating)
         (d) Leakage class IV
         (e) Bronze body
         (f) NPT connections
         (g) Replaceable stainless steel stems, plugs, and seats
         (h) Adjustable or live-loaded packing, renewable in place
         (i) Performance characteristic: Equal percentage
b. Ball Valve (Electronic applications: see section 23 09 13.34 for actuator specification)

1) Sizes 1 1/4” and Smaller, Threaded Ball Valve
   HYD-HVAC-2P-2W-BV-THD-S1
   (a) Same specification as HYD-HVAC-2P-2W-BV-S1 except without flow characterizing disc

c. Ball Valve (Electronic applications: see section 23 09 13.34 for actuator specification)

2) Size 2 ½” and Smaller, Threaded Two-Piece or Three-Piece Full-Port Ball Valve
   HYD-HVAC-2P-2W-BV-THD-S2
   (a) 600 CWP, 150 SWP
   (b) Leakage class VI, bi-directional
   (c) Two-piece cast bronze body.
   (d) NPT connections
   (e) ISO mounting pad
   (f) Type 316 stainless steel full-port solid tunneled ball (hollow ball not acceptable)
   (g) Type 316 stainless steel blow-out proof stem and nut
   (h) PTFE seats
   (i) Adjustable stem packing
   (j) Approved manufacturers
      i. Apollo 77-140-2450
      ii. Nibco TM-585-70-66
      iii. Milwaukee 20BSOR-02

d. Butterfly Valve (See section 23 09 13.34 for actuator specification)

1) Size 2 1/2” through 24”, Lug Style Resilient-Seated Butterfly Valve
   HYD-HVAC-2P-2W-BFV-LG-S4
   (a) Bi-directional dead end service at rated pressure
   (b) Bubble-tight shut-off
   (c) Pressure rating
      i. 12” and smaller: 200 PSIG, except AMRI 150 PSIG (for reduced torque)
      ii. 14” and larger: 150 PSIG
   (d) 250F temperature rating
   (e) Rated for 50% glycol solution
   (f) Ductile iron lug style body
   (g) Industrial paint or epoxy coating
   (h) Leakage class VI, bi-directional
   (i) Ductile iron lug style body (cast iron or wafer style body not acceptable)
(j) EPDM seat
(k) Aluminum bronze or stainless steel disc
(l) Two-piece stainless steel shaft
(m) Upper and lower bearings
(n) Blow-out proof shaft design
(o) Manual actuator
   i. Valves 6" and smaller: 10 position lever handle
   ii. Valves 8" and larger: Geared rotary hand-wheel operator
(p) Approved Manufacturers
   i. Amri Astoria
   ii. Cameron Demco
   iii. Ebro model Z014
   iv. Pratt BF Series

B. INDUSTRIAL GRADE

[Note to PSC: As stated above, clearly indicate if HVAC Grade or Industrial Grade control valves are to be provided for specific applications. Provide control valve schedule and appropriate valve specifications in project documents.]

[Note to PSC: All control valves in chilled water plants shall be industrial grade.]

1. MODULATING, TWO-WAY (INDUSTRIAL HYDRONIC)
   a. Characterized Ball Valve (See Section 23 09 13.34 for actuator specification.)
      1) Size 2" and Smaller, Threaded Three-Piece Characterized Ball Valve
         HYD-IND-MOD-2W-CBV-THD-S1
         (a) Pressure class 600
         (b) 150 PSID shut-off rating
         (c) 250F temperature rating
         (d) Rated for 50% glycol/water solution
         (e) Leakage class VI, bi-directional
         (f) Carbon steel three-piece body
         (g) NPT connections
         (h) Type 316 stainless steel full port-ball and stem
         (i) Blow-out proof stem design
         (j) Reinforced PTFE (RPTFE) seats
         (k) Seat or ball available in various size/shape openings for specific Cv and performance characteristic
         (l) Performance characteristic: Equal percentage
         (m) Live-loaded stem packing
         (n) Approved manufacturers
            i. Worcester
            ii. PBM
iii. Habonim

2) Size 2 1/2” and Larger, Flanged Characterized Ball Valve
   HYD-IND-MOD-2W-CBV-THD-S1
   (a) Pressure class 150
   (b) 150 PSID shut-off rating
   (c) 250F temperature rating
   (d) Rated for 50% glycol/water solution
   (e) Leakage class VI, bi-directional
   (f) Stainless steel or carbon steel body
   (g) Flanged connections
   (h) Stainless steel ball and stem
   (i) Blow-out proof stem design
   (j) Reinforced PTFE (RPTFE) seats
   (k) Seat or ball available in various size/shape openings for specific Cv and
       performance characteristic
   (l) Performance characteristic: Equal percentage
   (m) Live-loaded stem packing
   (n) Approved manufacturers
      i. Worcester
      ii. PBM
      iii. Habonim

b. Segmented Ball Valve (See Section 23 09 13.34 for actuator specification.)

   1) Size 2” and Smaller, Threaded Segmented Ball Valve
      HYD-IND-MOD-2W-BSV-FLG-S2
      (a) Pressure class 600
      (b) 150 PSID shut-off rating
      (c) 250F temperature rating
      (d) Rated for 50% glycol/water solution
      (e) Leakage class VI, bi-directional
      (f) Stainless steel or carbon steel body
      (g) NPT connections
      (h) Stainless steel segmented ball with hard chrome plating
      (i) Reinforced PTFE (RPTFE) seats
      (j) Adjustable shaft packing
      (k) Performance characteristic: Equal percentage
      (l) Approved manufacturers for applications including building CHW control
          valve at service entrance
         i. Neles/Jamesbury
         ii. Samson
c. Segmented Ball Valve (See Section 23 09 13.34 for actuator specification.)

1) Size 2 ½” and Larger, Flanged Segmented Ball Valve

HYD-IND-MOD-2W-BSV-FLG-S2

(a) Pressure class 150
(b) 150 PSID shut-off rating
(c) 250F temperature rating
(d) Rated for 50% glycol/water solution
(e) Leakage class VI, bi-directional
(f) Stainless steel or carbon steel body
(g) Flanged connections
(h) Stainless steel segmented ball with hard chrome plating
(i) Stainless steel shaft
(j) Reinforced PTFE (RPTFE) seats
(k) Adjustable shaft packing
(l) Performance characteristic: Equal percentage
(m) Approved manufacturers for applications including building CHW control valve at service entrance
   i. Neles/Jamesbury
   ii. Samson

2. MODULATING, THREE-WAY (INDUSTRIAL HYDRONIC)

a. Standard or Full Port Three-Way Ball Valve (See Section 23 09 13.34 for actuator specification.)

1) Size 2” and Smaller, Threaded Three-Way Ball Valve

HYD-IND-MOD-3W-BV-THD-S1

(a) Pressure class 600
(b) 150 PSID shut-off rating
(c) 250F temperature rating
(d) Rated for 50% glycol/water solution
(e) Leakage class VI
(f) Carbon steel body
(g) NPT connections
(h) Type 316 stainless steel ball and stem
(j) Blow-out proof stem design
(j) Reinforced PTFE (RPTFE) or TFM seats
(k) Live-loaded stem packing
(l) Approved manufacturers
   i. Habonim
   ii. Jamesbury
   iii. PBM
iv. Worcester

(2) Size 2 ½” and Larger, Flanged Three-Way Ball Valve

HYD-IND-MOD-3W-BV-FLG-S2

(a) Pressure class 150
(b) 150 PSID shut-off rating
(c) 250F temperature rating
(d) Rated for 50% glycol/water solution
(e) Leakage class VI, bi-directional
(f) Stainless steel or carbon steel body
(g) Flanged connections
(h) Type 316 stainless steel ball and stem
(i) Blow-out proof stem design
(j) Reinforced PTFE (RPTFE) or TFM seats
(k) Live-loaded stem packing
(l) Approved manufacturers
   i. Habonim
   ii. Jamesbury
   iii. PBM
   iv. Worcester

4. MODULATING, PRESSURE INDEPENDENT, TWO-WAY (INDUSTRIAL HYDRONIC)

b. Pressure Independent Characterized Ball Valve (See Section 23 09 13.34 for actuator specification.)

1) Size 2” and Smaller, Threaded Pressure Independent Valve

HYD-IND-MOD-2W-PIV-THD-S1-M

(a) 300 PSI cold working pressure
(b) 100 PSID shut-off rating
(c) Pressure independent operation up to system pressure differential of 50 PSID minimum
(d) Minimum pressure differential no greater than 5.0 PSID
(e) 220F temperature rating
(f) Rated for 50% glycol/water solution
(g) Leakage class IV
(h) Rangeability: 100 to 1 minimum
(i) Cast bronze body
(j) NPT connections
(k) Brass, stainless steel, PTFE internal components. Plastic components not acceptable
(l) Seals renewable with valve in place
(m) Performance characteristic: Equal percentage
(n) Basis of design: Delta P

2) Size 3" and Larger, Flanged Pressure Independent Valve, Mechanical

HYD-IND-MOD-2W-PIV-FLG-S2-M

(a) 150 PSI cold working pressure
(b) 100 PSID shut-off rating
(c) Pressure independent operation up to system pressure differential of 50 PSID minimum
(d) Minimum pressure differential no greater than 5.0 PSID
(e) 220F temperature rating
(f) Rated for 50% glycol/water solution
(g) Leakage class IV
(h) Rangeability: 100 to 1 minimum
(i) Ductile iron body
(j) Flanged connections
(k) Brass, carbon steel, stainless steel, PTFE internal components. Plastic components not acceptable
(l) Seals renewable with valve in place
(m) Performance characteristic: Equal percentage

(n) Basis of design: Delta P

3. TWO POSITION (ON-OFF), TWO-WAY (INDUSTRIAL HYDRONIC)
   a. Ball Valve (See Section 23 09 13.34 for actuator specification.)
      1) Size 2" and Smaller, Threaded Three-Piece Full-Port Ball Valve

HYD-IND-2P-2W-BV-THD-S1

(a) Pressure class 600
(b) 150 PSID shut-off rating
(c) 250F temperature rating
(d) Rated for 50% glycol/water solution
(e) Leakage class VI, bi-directional
(f) Carbon steel steel three-piece body
(g) NPT connections
(h) Type 316 stainless steel full-port ball and stem
(i) Blow-out proof stem design
(j) Reinforced PTFE (RPTFE) or TFM seats
(k) Live-loaded stem packing
(l) Approved manufacturers
   i. Habonim
   ii. Jamesbury
   iii. PBM
   iv. Worcester
2) Size 2 ½” and Larger, Flanged Ball Valve

HYD-IND-2P-2W-BV-FLG-S2

(a) Pressure class 150
(b) 150 PSID shut-off rating
(c) 250F temperature rating
(d) Rated for 50% glycol/water solution
(e) Leakage class VI, bi-directional
(f) Carbon steel or stainless steel body
(g) Flanged connections
(h) Type 316 stainless steel ball and stem
(i) Blow-out stem design
(j) Reinforced PTFE (RPTFE) or TFM seats
(k) Live-loaded stem packing
(l) Approved manufacturers
   i. Habonim
   ii. Jamesbury
   iii. PBM
   iv. Worcester

3) Size 2 ½” and Larger, Lug Style High Performance Butterfly Valve

HYD-IND-2P-2W-HPBV-LG-S3

(a) Pressure class 150
(b) 150 PSID shut-off rating
(c) 250F temperature rating
(d) Rated for 50% glycol/water solution
(e) Leakage class VI, bi-directional
(f) Carbon steel or stainless steel lug style body
(g) Double-offset, stainless steel disc
(h) Reinforced PTFE (RPTFE) or equivalent seat
(i) Stainless steel shaft
(j) Blow-out proof shaft design
(k) Adjustable shaft packing
(l) Approved manufacturers:
   i. Neles/Jamesbury
   ii. Cameron W-K-M
   iii. Xomox

2.2 CONTROL VALVES FOR LOW PRESSURE STEAM APPLICATIONS

--Normal Operation: <15 PSIG, <300F
--Minimum Rating: 100 PSIG at 337F
[Note to PSC: This specification for low pressure steam control valves applies to buildings with steam PRV(s) for heating service. Steam valve and actuator type and sizing indicated within these standard specifications shall be treated as default. Contact F&S Engineering for assistance with selection for a specific project prior to final design.]

--All pneumatically actuated control valves in low pressure steam systems may be globe type as an approved option unless indicated otherwise in project documents.

A. HVAC GRADE

1. MODULATING, TWO-WAY (LP STEAM)
   a. Globe Valve (See Section 23 09 13.34 for actuator specification.)
      1) Size 1” and Smaller, Threaded Globe Valve
         -- This specification applies to both pneumatic actuated and electronic actuated globe valves.
         LPS-MOD-2W-GV-THD-S1
         (a) Pressure class 250
         (b) Leakage class IV
         (c) Bronze body
         (d) NPT connections
         (e) Replaceable stainless steel stems, plugs, and seats
         (f) High temperature adjustable or live-loaded packing, renewable in place
         (g) Performance characteristic: Linear preferred, equal percentage acceptable
         (h) Electronic actuated, basis of design: Belimo G2 Series
      2) Size 1 1/4” and Larger, Threaded or Flanged Globe Valve
         -- This specification applies to both pneumatic actuated and electronic actuated globe valves.
         LPS-MOD-2W-GV-THD/FLG-S1
         (a) Pressure class 125
         (b) Leakage class IV
         (c) Cast iron body
         (d) Threaded or flanged connections
         (e) Replaceable stainless steel stems, plugs, and seats
         (f) High temperature adjustable or live-loaded packing, renewable in place
         (g) Performance characteristic: Linear preferred, equal percentage acceptable

[Note to PSC: The following specification for eccentric plug valves is included in this section for low pressure steam applications given that it is a viable option in lieu of standard HVAC grade globe valves. Again, as stated above, contact F&S Engineering for assistance with selection for a specific project prior to final design. Edit specification accordingly regarding valve size and type for specific project.]

b. Characterized Ball Valve
   Note: Not approved for steam service unless specifically requested by Owner for reasons of compactness and electronic actuation.
(See Section 23 09 13.34 for electronic actuator specification.)

1) Sizes 3/4” and Smaller, NPT connections

LPS-HVAC-MOD-2W-CBV-THD-S1

(a) Belimo HTCCV

i. Rated for 15 PSIG steam, 250F

ii. Provide insulating block between valve and actuator

[Note to PSC: For low pressure steam applications where compactness of size and electronic actuation is needed, a Belimo HTCCV as specified above may be considered. For steam applications an insulation block shall be provided to separate valve and actuator. Maximum temperature rating for this valve/actuator assembly is only 248F. Thus, its application for steam service is generally discouraged. Specific approval by Owner is required prior to pursuing this option.]

c. Eccentric Plug Valve (See Section 23 09 13.34 for actuator specification.)

1) Size 1” and Larger, Flanged Eccentric Plug Valve

LPS-MOD-2W-EPV-FLG-S2

(a) Pressure class 150

(b) Leakage class IV. Provide carbon-graphite reinforced TFE seat insert for Cashco Ranger

(c) Carbon steel body

(d) Flanged connections

(e) 316 SS, 17-4PH or Alloy 6 plug

(f) Stainless steel shaft

(g) 316 SS, Inconel or Alloy 6 seat

(h) Live-loaded stem packing

(i) Four Cv options per valve

(j) Capable of easy Cv change via seat insert change

(k) Performance characteristic: Linear preferred, equal percentage acceptable

(l) Approved manufacturers

i. Cashco Ranger

ii. Warren series 3800

[Note to PSC: For a given project/application the University may elect to use an eccentric plug valve(s) in lieu of the globe valve(s) specified above. This explains the inclusion of the specification for eccentric plug valves in the low pressure steam section.]

2. TWO-POSITION (ON-OFF), TWO-WAY (LP STEAM)

--Normal Operation: <15 PSIG, <300F

--Minimum Rating: 100 PSIG at 337F

a. Globe Valve (See Section 23 09 13.34 for actuator specification.)

1) Size 2” and Smaller, Threaded Globe Valve

LPS-2P-2W-GV-THD-S1
(a) Pressure class 250
(b) Leakage class IV
(c) Bronze body
(d) NPT connections
(e) Replaceable stainless steel stems, plugs, and seats
(f) High temperature adjustable or live-loaded stem packing, renewable in place

b. Globe Valve (See Section 23 09 13.34 for actuator specification.)
1) Size 2 1/2" and Larger, Flanged Globe Valve
   -- This specification applies to both pneumatic actuated and electronic actuated globe valves.
   **LPS-MOD-2W-GV-THD-S1**
   (a) Pressure class 125
   (b) Leakage class IV
   (c) Cast iron body
   (d) Flanged connections
   (e) Replaceable stainless steel stems, plugs, and seats
   (f) High temperature adjustable or live-loaded packing, renewable in place
   (g) Performance characteristic: Linear preferred, equal percentage acceptable

c. Ball Valve (See Section 23 09 13.34 for actuator specification.)
1) Size 2 1/2" and Smaller, Threaded Three-Piece Ball Valve
   **LPS-2P-2W-BV-THD-S1**
   (a) 600 CWP, 150 WSP
   (b) Leakage class VI, bi-directional
   (c) Stainless steel or carbon steel two-piece body
   (d) NPT connections
   (e) ISO mounting pad
   (f) Type 316 stainless steel standard-port or full-port ball and stem
   (g) Ball or cavity vent
   (h) Reinforced PTFE (RPTFE) seats
   (i) Adjustable stem packing
   (j) Approved manufacturers
      i. Apollo 89-ARX-64
      ii. Nibco TM-595-CS-R66
      iii. Milwaukee 30CSOF-02
      iv. Jamesbury

d. High Performance Butterfly Valve (See Section 23 09 13.34 for actuator specification.)
1) Size 2 ½" and Larger, Lug-Style High Performance Butterfly Valve

**LPS 2P-2W HPBV-LG-S3**

- (a) Pressure class 150
- (b) Leakage class VI, bi-directional
- (c) Stainless steel or carbon steel lug-style body
- (d) Type 316 stainless steel disc and shaft
- (e) Blow-out proof shaft design
- (f) Carbon-graphite reinforced TFM seat preferred, TFM seat acceptable
- (g) Adjustable graphite shaft packing
- (h) Geared rotary hand-wheel operator
- (i) Approved manufacturers
  - i. Neles/Jamesbury
  - ii. Cameron W-K-M
  - iii. Xomox

2.3 CONTROL VALVES FOR MEDIUM PRESSURE STEAM APPLICATIONS

--Normal Operation: \( < 60 \text{ PSIG}, < 350\text{F} \)

--Minimum Rating: 200 PSIG, 400F

[Note to PSC: Steam valve and actuator type and sizing indicated within these standards shall be treated as default. Contact F&S Engineering for assistance with selection for a specific project prior to final design.]

A. INDUSTRIAL GRADE

1. MODULATING, TWO-WAY (MP STEAM)

   a. Eccentric Plug Valve (See Section 23 09 13.34 for actuator specification.)

      1) All sizes

      **MPS-MOD-2W-EPV-FLG-S1**

      - (a) Pressure class 150
      - (b) Leakage class IV. Provide carbon-graphite reinforced TFE seat insert for Cashco Ranger
      - (c) Carbon steel body
      - (d) Flanged connections
      - (e) 316 SS, 17-4PH or Alloy 6 plug
      - (f) Stainless steel shaft
      - (g) 316 SS, Inconel or Alloy 6 seat
      - (h) Live-loaded stem packing
      - (i) Four Cv options per valve
      - (j) Capable of easy Cv change via seat insert change
      - (k) Performance characteristic: Linear (preferred) or equal percentage
      - (l) Approved manufacturers
        - i. Cashco Ranger
ii. Warren Series 3800

2. TWO-POSITION (ON-OFF), TWO-WAY (MP STEAM)
   a. Ball Valve (See Section 23 09 13.34 for actuator specification.)
      1) Size 2” and Smaller, Threaded Three-Piece Full-Port Ball Valve
         MPS-2P-2W-BV-THD-S1
            (a) Pressure class 600
            (b) Leakage class VI, bi-directional
            (c) Carbon steel three-piece body
            (d) NPT connections
            (e) Type 316 stainless steel full-port ball and stem
            (f) Blow-out proof stem design
            (g) Ball or cavity vent
            (h) Carbon-graphite reinforced TFM seats
            (i) Adjustable graphite stem packing
            (j) Approved manufacturers
               i. Habonim
               ii. Neles/Jamesbury
               iii. PBM
               iv. Worcester

   b. High Performance Butterfly Valve (See Section 23 09 13.34 for actuator specification.)
      1) Size 2 ½” and Larger
         MPS-2P-2W-HPBV-LG-S2
            (a) Pressure class 150
            (b) Leakage class VI, bi-directional
            (c) Stainless steel or carbon steel lug-style body
            (d) Type 316 stainless steel disc and shaft
            (e) Blow-out proof shaft design
            (f) Carbon-graphite reinforced TFM seat preferred, TFM seat acceptable
            (g) Adjustable graphite shaft packing
            (h) Geared rotary hand-wheel operator
            (i) Approved manufacturers
               i. Neles/Jamesbury
               ii. Cameron W-K-M
               iii. Xomox

PART 3 - EXECUTION

3.1 INSTALLATION
   A. Accessibility
1. Control valves shall be located for ease of access to valve and actuator for service and removal/replacement.

B. Unions/Flanges
1. Pipe union or flanges shall be provided on each side of each control valve to facilitate removal and replacement.

C. Strainers
1. Line-size strainer shall be provided in piping system upstream of each control valve.

3.2 ORIENTATION

[Note to PSC: Control valve orientation requirements are often violated by installing contractors, typically due to lack of training. It is common for valves to be installed in the vertically upward position with the actuator located directly above the valve. This often results in premature actuator failure due to overheating. Electric actuators are particularly vulnerable in this regard. Appropriate steps shall be taken to ensure that this does not occur.]

A. Rotary Control Valves
1. For hydronic applications, valve shall be oriented with shaft horizontal. In no case shall valve be installed with shaft oriented vertically downward (i.e. with actuator at bottom). Exception: Small rotary valves with electronic actuators (e.g. at reheat coils and fan coil units) may be installed in any orientation.

2. For steam applications, valve shall be oriented with shaft horizontal. In no case shall valve be installed in the vertically upward position. Vertical upward orientation results in overhearing of actuator and accessories.

3. Valve shall be installed such that the preferred direction of flow as indicated within product literature matches the actual direction of fluid flow through the valve.

B. Sliding stem (e.g. globe) control valves
1. For hydronic applications, valve shall be installed such that stem is oriented within 45 degrees of the vertical upward position. If this orientation cannot be practically achieved, valve may be installed such that stem is oriented horizontally. In no case shall valve be installed such that stem is oriented vertically downward.

2. For steam applications, valve shall be installed such that stem is not oriented in the vertically upward position to prevent overheating of actuator and accessories. Preferred orientation is 45 degrees from vertically upward position. If this orientation cannot be practically achieved, valve may be installed such that stem is oriented horizontally. In no case shall the valve be installed such that stem is oriented vertically downward.

3. For all applications valve shall be installed such that direction of flow indication on valve body and/or product literature matches actual direction of fluid flow through valve.

4. Manufacturer’s recommended straight pipe length shall be provided upstream and downstream of valve.

5. Velocity in piping upstream and downstream of steam valve shall not exceed manufacturer’s recommended maximum.

3.3 INSULATION

A. Insulated Piping Applications
1. Control valves in insulated piping systems shall have bodies, flanges, etc. completely insulated. This applies to valves in heating systems (i.e. steam and hot water) as well as those in cooling systems. Practice of leaving heating valves and associated unions/flanges un-insulated is not acceptable. Steam valves shall be insulated such that actuator and accessories are protected from excessive convective and radiated heat.
2. Insulated valves shall be equipped with extended stems and protective shields as required to allow operation without disturbing insulation.

END OF SECTION 23 09 13.33