

PART I - GENERAL

1.0 OVERVIEW [Background for PSC]

A. Preference for Rotary Control Valves

1. The University is endeavoring, in conjunction with the current trend in the valve industry, to move from the use of sliding stem globe type control valves to the use of rotary valves for HVAC applications.
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 at small cooling units such as fan coils. Application to such units shall be evaluated on a case by case basis. Evaluation shall include potential for valve generated noise in addition to valve size given that PI control valves are typically larger than standard valves. This can pose a problem within the confines of a unit cabinet.

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 devices within buildings.
3. In conjunction with the pressure independent building approach it has become 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. Pressure independent control valves are typically discouraged for use with hot water heating systems that utilize steam as their heat source. Temperature differential is less critical with steam-generated heating.

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 applications. 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 - Steam 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 (high performance butterfly 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 parallel 1/3-2/3 valves unless indicated otherwise in project drawings.

*[Note to PSC: Since all CHW control valves within building systems 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, system turn-down has proven to be inadequate when a single building pressure control valve is provided. Thus, parallel 1/3-2/3 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 ( $\leq 15$ PSIG)

- a. Modulating control valves 1" and smaller 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. Low pressure steam valves larger than 1" shall be industrial grade eccentric plug type unless indicated otherwise. In medium pressure steam systems (typically the case with no building PRV) all valves shall be industrial grade eccentric plug type. Valve grade and actuator type shall be as scheduled or otherwise indicated.

*[Note to PSC: HVAC grade globe valves (as opposed to rotary valves) are allowed in these smaller sizes only because economical rotary valves with adequate*

*temperature and pressure ratings are not available at the time of this writing. If they become available this specification will be updated.]*

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 30-50% 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 .30 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.

*[Note to PSC: This requires that the system be analyzed to determine the appropriate design DP for each valve. The resultant Cv shall be listed in the control valve schedule.]*

*[Note to PSC: 5 PSI differential is often used as the basis for control valve sizing in hydronic systems. This is based upon the assumption that the pressure differential across each branch circuit will be approximately 10 PSID. In reality the DP will vary throughout any given system. It will be highest near the pump(s) and lowest at the most hydraulically remote location. This must be taken into account when sizing valves, especially those serving central station equipment such as AHUs. This is less of an issue with systems that are somewhat self-balancing such as those with “oversized-main” design or reverse-return configuration. Thus, these system designs are encouraged.]*

#### 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.

*[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.]*

*[Note to PSC: If a heat exchanger is known to be intentionally oversized to provide backup capacity for an associated heat recovery system and/or to provide reserve capacity for anticipated future load growth, additional steps must be taken by the designer to ensure proper valve sizing. “Engineered” sizing of multiple parallel valves (rather than default 1/3- 2/3 sizing) is a first step. It may actually be necessary to provide more than two parallel control valves in some instances.]*

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  $\leq 12$  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. Convector
6. Unit heaters
7. Cabinet unit heaters
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. Exception: Utility Plant applications.

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

Fail open:

1. Preheat coils
2. Finned tube units
3. Radiant panel heaters
4. Convectors
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

[Note to PSC: See section entitled "Control Valve/Actuator Worksheet" located at the end of this document for approved valve/actuator combinations. This worksheet shall be used to prepare detailed control valve schedule(s) for inclusion in project drawings.]

## 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, See Control Valve Worksheet.)
13. Actuator Identification Number (Similarly, identifies actuator type, construction and options. Example: HVAC-E-R-SR)
14. Other pertinent information
15. Control Valve/Actuator Worksheet

See section entitled "Control Valve/Actuator Worksheet" located at end of this document for approved valve/actuator combinations. This section provides helpful information for preparation and interpretation of control valve schedules.

*[Note to PSC: Provide control valve schedule. This is non-optional. Based upon feedback from contractors it has become clear that given the complexities of these control valve and actuator specifications it is essential that a complete and detailed control valve schedule be provided directly on the project drawings. This schedule shall include all of the information identified above.]*

*[Note to PSC: As stated above, see section entitled "Control Valve/Actuator Worksheet" located at the end of this document for approved valve/actuator combinations. This worksheet shall be used to prepare detailed control valve schedule(s) for inclusion in project drawings.]*

## 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

*[Note to PSC: 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.]*

### A. HVAC GRADE

#### 1. MODULATING, TWO-WAY (HVAC HYDRONIC)

*[Note to PSC: Globe valves may only be used in sizes 1 1/4" and smaller for pneumatic applications. They are allowed in this small size range rather than characterized ball valves given the non-availability of suitable rotary pneumatic actuators in small sizes.]*

##### 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 O-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: Belimo, Siemens, VSI
  - (v) Basis of Design: Belimo CCV
- 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 Characterized Ball Valve (See Section 23 09 13.34 for actuator specification.)

1) Size 2" and Smaller, Threaded Pressure Independent Valve, Mechanical

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

- (a) Same specification as HYD-HVAC-MOD-2W-CBV-THD-S1 *Characterized Ball Valve* except valve shall also include a pressure compensating cartridge that...

- i compensates for pressure changes in the hydronic system, maintaining constant pressure drop across the flow control portion of the valve assembly.
- ii maintains pressure independent operation up to a system pressure differential of 50 PSID minimum.
- iii imposes a minimum pressure differential no greater than 6.0 PSID
- iv is replaceable without removing valve from piping

- (b) Approved manufacturers

- i Belimo PICCV

*[Note: If these valves are provided with electronic actuator and integral microprocessor, then 24VDC dedicated circuit will be provided as power source.]*

- 2) Size 2" 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
- 3) Size 3" and Larger, Flanged Pressure Independent Valve, Electronic (with integral flow meter, actuator, controller,)

HYD-HVAC-MOD-2W-PIV-FLG-S2-E

*[Note to PSC: At the time of this writing the University has limited experience with this type of electronic pressure independent valve. Yet a specification is provided in anticipation of approval. A competitor has been sought for Delta P brand mechanical PI valves and none has been found to date that satisfies our requirements for quality and performance. Thus inclusion of this specification for Belimo ePIV valves has been provided given that it is a viable competitor. When a project design incorporates a PI valve larger than 2", selection shall be discussed with the Owner regarding potential approval of valves other than Delta P. If competing valve(s) of adequate quality and performance are identified in the future such product shall be discussed with the Owner for potential approval as well.]*

- (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) 250F temperature rating
- (f) Rated for 50% glycol/water solution
- (g) Leakage class VI
- (h) Rangeability: 100 to 1 minimum
- (i) Ductile iron body
- (j) Flanged connections
- (k) Stainless steel characterized ball and stem
- (l) Blow-out proof stem design
- (m) PTFE seat with O-ring backup
- (n) Performance characteristic: Equal percentage
- (o) Integral flow meter, actuator, controller
- (p) Capacitor return fail-safe
- (q) Basis of design: Belimo ePIV

- (r) *Note: If these valves are provided with electronic actuator and integral microprocessor, then 24VDC dedicated circuit will be provided as power source. ]*

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 O-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 1/4" 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 1/2" 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

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
- (i) Blow-out proof stem design
- (j) Reinforced PTFE (RPTFE) or TFM seats
- (k) Live-loaded stem packing
- (l) Approved manufacturers
  - i. Worcester
  - ii. Jamesbury
  - iii. PBM
  - iv. Habonim

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

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

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

iv. Habonim

4. MODULATING, PRESSURE INDEPENDENT, TWO-WAY (INDUSTRIAL HYDRONIC)
- a. 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) Forged brass 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 Worcester
        - ii Jamesbury
        - iii PBM
        - iv Habonim
    - 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 Worcester
        - ii Jamesbury
        - iii PBM
        - iv Habonim
    - 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](#)

*[Note to PSC: For low pressure steam applications where compactness of size is essential, a Belimo HTCCV 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.]*

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 Quality Assurance for assistance with selection for a specific project prior to final design. Edit specification accordingly regarding valve size and type for specific project.]*

b. 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

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 PSIG, ≤350F

--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 Quality Assurance 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 Worcester
    - ii Neles/Jamesbury
    - iii PBM
    - iv Habonim
- 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 CRITICAL APPLICATIONS

#### A. Manual Bypass Valve

1. For steam applications, if a piece of equipment or device is served by a single control valve a manual throttling valve shall be provided in bypass arrangement such that control valve may be removed/replaced without interruption of service. Bypass valve shall be sized for 2/3 design capacity of equipment served.

*[Note to PSC: Example of critical service: HW heating system served by a single heat exchanger with a single control valve. In such case a manual bypass globe valve shall always be provided. This is an atypical situation given that multiple parallel control valves (e.g. 1/3-2/3) will typically be provided. Example of non-critical service: 1) HW heating system served by a single heat exchanger with multiple parallel control valves (e.g. 1/3-2/3 valves). 2) HW heating system served by multiple (redundant) heat exchangers. In either case a bypass valve is not required.]*

### 3.2 BALANCING VALVES

- #### A. Hydronic balancing valves shall be provided only as indicated on drawings.

*[Note to PSC: The use of manual balancing valves in series with two-way control valves in a variable flow hydronic system is generally discouraged. This is particularly the case with small terminal and unitary devices such as reheat coils, finned tube elements and fan coil units. See section entitled Hydronic Heating/Cooling Systems within these General Guidelines for rationale. Balancing valves are more appropriately applied for balancing flow through multiple parallel devices served by a single control valve assembly such as stacked coils within an AHU. A balancing valve shall not be installed to serve solely as a flow measurement device. A venturi flow element shall be utilized in such case. See specification provided within Section 23 05 19 – Meters and Gauges for HVAC Piping.]*

### 3.3 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.

### 3.4 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, valves/actuators shall be installed such that shaft is oriented horizontally. In no case shall valve be oriented in vertically upward position. Vertical upward orientation results in overheating 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.

### 3.5 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.

### 3.6 CONTROL / ACTUATOR WORKSHEET

-- See Continuation on Following Pages --

**Note:** These worksheets must be viewed electronically for magnification.

#### A. Hydronic - HVAC Grade

CONTROL VALVE / ACTUATOR WORKSHEET								
Hydronic - HVAC Grade								
Valve			Actuator					
ID #	Application / Type	Size	Pneumatic	ID #	Positioner	Electronic	ID #	Positioner
HYD-HVAC-MOD-2W-GV-THD-S1	Hydronic - Modulating	≤ 1 1/4"	Globe - Thd	HVAC-LP-LIN-SD-GV	Per Sched.			
HYD-HVAC-MOD-2W-CBV-THD-S1	Hydronic - Modulating	≤ 1 1/4"				Characterized Ball - Thd	HVAC-E-R-SR or FIP	No
HYD-HVAC-MOD-2W-SBV-THD-S2	Hydronic - Modulating	1 1/2 - 2"	Segmented Ball - Thd	HVAC-LP-R-SD-DMP	Per Sched.	Segmented Ball - Thd	HVAC-E-R-SR or FIP	Yes
HYD-HVAC-MOD-2W-SBV-FLG-S3	Hydronic - Modulating	≥ 2 1/2"	Segmented Ball - Flg	HVAC-LP-R-SD-DMP	Per Sched.	Segmented Ball - Flg	HVAC-E-R-SR or FIP IND-E-R-SR or FIP (as req'd for torque)	Yes
HYD-HVAC-MOD-2W-PIV-THD-S1	Hydronic - PI - Modulating	≤ 2"				PI Rotary - Thd	HVAC-E-R-SR or FIP	Yes
HYD-HVAC-MOD-2W-PIV-FLG-S2	Hydronic - PI - Modulating	≥ 3"	PI Rotary - Flg	HVAC-LP-R-SD-DMP	Per Sched.	PI Rotary - Flg	HVAC-E-R-SR or FIP IND-E-R-SR or FIP (as req'd for torque)	Yes
HYD-HVAC-MOD-2W-GV-THD-S1	Hydronic - 3 Way - Mod.	≤ 1 1/4"	Globe - Thd	HVAC-LP-LIN-SD-GV	Per Sched.			
HYD-HVAC-MOD-3W-CBV-THD-S2	Hydronic - 3 Way - Mod.	≤ 3"				Characterized Ball - Thd	HVAC-E-R-SR or FIP	Yes
HYD-HVAC-MOD-3W-CBV-FLG-S3	Hydronic - 3 Way - Mod.	≥ 4"				Characterized Ball - Flg	HVAC-E-R-SR or FIP IND-E-R-SR or FIP (as req'd for torque)	Yes
HYD-HVAC-2P-2W-GV-THD-S1	Hydronic - 2 Pos (On/Off)	≤ 1 1/4"	Globe - Thd	HVAC-LP-LIN-SD-GV	No			
HYD-HVAC-2P-2W-BV-THD-S1	Hydronic - 2 Pos (On/Off)	≤ 1 1/4"				SP Ball - Thd	HVAC-E-R-SR or FIP	No
HYD-HVAC-2P-2W-BV-FLG-S2	Hydronic - 2 Pos (On/Off)	1 1/2 - 2"	FP Ball - Thd	HVAC-LP-R-SD-DMP	No	FP Ball - Thd	HVAC-E-R-SR or FIP IND-E-R-SR or FIP (as req'd for torque)	No
HYD-HVAC-2P-2W-BV-FLG-S3	Hydronic - 2 Pos (On/Off)	2 1/2 - 3"	SP Ball - Thd	HVAC-LP-R-SD-DMP	No	SP Ball - Thd	HVAC-E-R-SR or FIP IND-E-R-SR or FIP (as req'd for torque)	No
HYD-HVAC-2P-2W-BFV-LG-S4	Hydronic - 2 Pos (On/Off)	≥ 2 1/2"	RS Butterfly - Lug	HVAC-LP-R-SD-DMP	No	RS Butterfly - Lug	HVAC-E-R-SR or FIP IND-E-R-SR or FIP (as req'd for torque)	No

## B. Hydronic – Industrial Grade

CONTROL VALVE / ACTUATOR WORKSHEET								
Hydronic, Industrial Grade								
Valve			Valve / Actuator					
ID #	Application / Type	Size	Pneumatic	ID #	Positioner	Electric	ID #	Positioner
HYD-IND-MOD-2W-CBV-THD-S1	Hydronic - Modulating	≤ 2"	Characterized Ball - 3 Pc - Thd	IND-HP-R-SR or IND-HP-R-DA	Yes	Characterized Ball - Thd	IND-E-R-SR or FIP	Yes
HYD-IND-MOD-2W-CBV-THD-FLG-S2	Hydronic - Modulating	> 2 1/2"	Characterized Ball - Flanged	IND-HP-R-SR or IND-HP-R-DA	Yes	Characterized Ball - Flanged	IND-E-R-SR or FIP	Yes
HYD-IND-MOD-2W-SBV-FLG-S1	Hydronic - Modulating	≤ 2"	Segmented Ball - Flg	IND-HP-R-SR or IND-HP-R-DA	Yes	Segmented Ball - Thd	IND-E-R-SR or FIP	Yes
HYD-IND-MOD-2W-SBV-FLG-S2	Hydronic - Modulating	≥ 2 1/2"	Segmented Ball - Flg	IND-HP-R-SR or IND-HP-R-DA	Yes	Segmented Ball - Flg	IND-E-R-SR or FIP	Yes
HYD-IND-MOD-2W-PIV-THD-S1	Hydronic - PI - Modulating	≤ 2"	PI Rotary - Thd	IND-HP-R-SR or IND-HP-R-DA	Yes	PI Rotary - Thd	IND-E-R-SR or FIP	Yes
HYD-IND-MOD-2W-PIV-FLG-S2	Hydronic - PI - Modulating	≤ 3"	PI Rotary - Flg	IND-HP-R-SR or IND-HP-R-DA	Yes	PI Rotary - Flg	IND-E-R-SR or FIP	Yes
HYD-IND-2P-2W-BV-THD-S1	Hydronic - 2 Pos (On/Off)	≤ 2"	FP Ball - 3 Pc - Thd	IND-HP-R-SR or IND-HP-R-DA	No	FP Ball - 3 Pc - Thd	IND-E-R-SR or FIP	No
HYD-IND-2P-2W-BV-FLG-S2	Hydronic - 2 Pos (On/Off)	≥ 2 1/2"	SP or FP Ball - Flg	IND-HP-R-SR or IND-HP-R-DA-TP	No	Ball - Flg	IND-E-R-SR or FIP	No
HYD-IND-2P-2W-HPBV-LG-S3	Hydronic - 2 Pos (On/Off)	2 1/2" - 24"	HP Butterfly - Lug	IND-HP-R-SR or IND-HP-R-DA	No	HP Butterfly - Lug	IND-E-R-SR or FIP	No
HYD-IND-2P-2W-ABFV-FLG-S4	Hydronic - 2 Pos (On/Off)	≥ 30"	AW/WA Butterfly - Flg	IND-HP-R-SR or IND-HP-R-DA	No	AW/WA Butterfly - Flg	IND-E-R-SR or FIP	No

## C. Low Pressure Steam – HVAC Grade

CONTROL VALVE / ACTUATOR WORKSHEET								
Low Pressure Steam - HVAC Grade or Industrial Grade								
Valve			Valve / Actuator					
ID #	Application / Type	Size	Pneumatic	ID #	Positioner	Electronic	ID #	Positioner
LPS-MOD-2W-GV-THD-S1	LP Steam - Modulating	≤ 2"	Globe - Thd	HVAC-LP-LIN-SD-GV	Per Sched.	Globe - Thd	HVAC-E-LIN-SR or FIP	Yes
LPS-MOD-2W-GV-FLG-S2	LP Steam - Modulating	≥ 2 1/2"	Globe - Flg	HVAC-LP-LIN-SD-GV	Per Sched.	Globe - Flg	HVAC-E-LIN-SR or FIP	Yes
LPS-MOD-2W-EPV-FLG-S1	LP Steam - Modulating	All Sizes	Eccentric Plug - Flg	IND-LP-R-SD	Per Sched.	Eccentric Plug - Flg	IND-E-R-SR or FIP	Yes
LPS-MOD-2W-EPV-FLG-S1	LP Steam - Modulating	All Sizes	Eccentric Plug - Flg	IND-HP-R-SR or FIP	Per Sched.	Eccentric Plug - Flg	IND-E-R-SR or FIP	Yes
LPS-MOD-2W-GV-THD-S1	LP Steam - 2 Pos (On/Off)	≤ 2"	Globe - Thd	HVAC-LP-LIN-SD-GV	No	Globe - Threaded	HVAC-E-LIN-SR or FIP	Yes
LPS-2P-2W-GV-THD-S1	LP Steam - 2 Pos (On/Off)	≤ 2"	SP or FP Ball - Flg		No	SP or FP Ball - Thd	HVAC-E-LIN-SR or FIP	No
LPS-2P-2W-BV-FLG-S2	LP Steam - 2 Pos (On/Off)	≥ 2 1/2"	SP or FP Ball - Flg	HVAC-LP-LIN-SD-DMP	No	SP or FP Ball - Flg	HVAC-E-LIN-SR or FIP	No
LPS-2P-2W-HPBV-LG-S3	LP Steam - 2 Pos (On/Off)	≥ 2 1/2"	HP Butterfly - Lug	HVAC-LP-LIN-SD-DMP	No	HP Butterfly - Lug	HVAC-E-LIN-SR or FIP	No

## D. Medium Pressure Steam – Industrial Grade

CONTROL VALVE / ACTUATOR WORKSHEET								
Medium Pressure Steam - Industrial Grade								
Valve			Valve / Actuator					
ID #	Application / Type	Size	Pneumatic	ID #	Positioner	Electric	ID #	Positioner
MPS-MOD-2W-EPV-FLG-S1	MP Steam - Modulating	All sizes	Eccentric Plug - Flg	IND-HP-R-SR or IND-HP-R-DA or IND-LP-R-SD	Per Sched.	Eccentric Plug - Flg	IND-E-R-SR or FIP	Yes
MPS-2P-2W-BV-THD-S1	MP Steam - 2 Pos (On/Off)	≤ 2"	Ball - 3 Pc - Thd	IND-HP-R-SR or IND-HP-R-DA	No	Ball - 3 Pc - Thd	IND-E-R-SR or FIP	No
MPS-2P-2W-BV-FLG-S2	MP Steam - 2 Pos (On/Off)	≥ 2 1/2"	Ball - 1 or 2 Pc - Flg	IND-HP-R-SR or IND-HP-R-DA	No	Ball - 1 or 2 Pc - Flg	IND-E-R-SR or FIP	No
MPS-2P-2W-HPBV-LG-S2	MP Steam - 2 Pos (On/Off)	≥ 2 1/2"	HP Butterfly - Lug	IND-HP-R-SR or IND-HP-R-DA	No	HP Butterfly - Lug	IND-E-R-SR or FIP	No

END OF SECTION 23 09 13.33

This section of the *U of I Facilities Standards* establishes minimum requirements only.  
It should not be used as a complete specification.