USV-2092/USV-2093

Sizing and Design Principle

Education Institute for

Equipment & Process Design

1.Operating Condition

Note : Block Saturated Natural Gas to Steam/NG Mixture

Equipment/Pipe : 24"-PRG-20-108-F24-H
Fluid : Process Gas

	Minimum	Operating	Design	Unit
Pressure	-	42.1	55	bar g
Temperature		262	290	°C

Calculation according to ISA S75.01:

Fluid Phase: G **Viscosity:** 0.019 cP **Compressibility:** 0.94 **Ratio of Specific Heats:** 1.19
Mole Weight: 17.47 **Vapour Pressure:** **Outlet Valve Diameter:** 24 inch

	Minimum	Normal	Maximum	Special	Unit	ISA Factors
Flow		423949			Nm3/h	**Fp:** 1.0
Upstream Pressure		42.1			bar g	**Ff:** 1.0
Downstream Pressure		42.1			bar g	**Fl:** 0.68
Temperature		262			°C	**Flp:**
Density					kg/m3	**Fr:** 1.0
Flash %						**Fd:** 0.7
Cv valve						**Xt:** 0.38
Outlet Velocity					m/s	**Xtp:**

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2. Body/Bonnet

In Body/Bonnet Tab the following information should be determined:

1.Type

2. Size

3.Rating

4.Connection type

5.Body material

6.Pipe inlet and outlet

Type:

7.12 Shutdown Valves

These valves are generally selected in line size. Valve size criteria shall also be considered.

For tight shut-off valves (TSOV) leakage class V, ball valves up to and including 4" or offset disc butterfly valves shall be considered. Line size body and full-size trim shall be used. Soft-seated valves shall be approved fire-safe. Triple offset butterfly valves shall be specified for high shut-off pressures.

Gate valves with electric motors can be used as block valves around the shift converters and for the steam systems if the unpredictable failure action and the relatively large stroking time are acceptable.

Single-seated, unbalanced, line-size and full-size trim globe valves can be used as shutdown valves if desired or if other types are not suitable for the service

Since the valve is used as tight shut-off valve, based on above explanation, butterfly or ball valve should be used and due to the fact that a line-size body and a full-size trim shall be used, among these choices butterfly type is selected since the line sizing is 24 in. which is more than 4 in.

Rating:

The rating of valves is the same as the rating of connecting pipes. Since the adjacent pipe class is 600, the valve class would be 600.

Connection type:

The three most common methods of installing control valves into pipelines are by means of screwed pipe threads, bolted gasketed flanges, and welded end connections.

Screwed end connections, popular in small control valves, offer more economy than flanged

ends. The threads usually specified are tapered female NPT (National Pipe Thread) on the valve body. They form a metal-to-metal seal by wedging over the mating male threads on the pipeline ends.

This connection style, usually limited to valves NPS 2 (DN 50) or smaller, is not recommended for elevated temperature service. Valve maintenance might be complicated by screwed end connections if it is necessary to take the body out of the pipeline because the valve cannot be removed without breaking a flanged joint or union connection to permit unscrewing the valve body from the pipeline.

Flanged end valves are easily removed from the piping and are suitable for use through the range of working pressures for which most control valves are manufactured. Flanged end connections can be used in a temperature range from near absolute zero to approximately 815°C (1500°F). They are used on all valve sizes. The most common flanged end connections include flat-face, raised-face, and ring-type joint.

Screwed End	Flanged End	Welded End
2” and smaller	Up to class 900	Suitable for class 1500 and 2500

Some valve types, such as eccentric spherical disc valves and butterfly valves shall be wafer-type for installing between flanges. If specified, lug-style butterfly valves shall have free holes in the lugs allowing the use of stud bolts.

Since the valve type is butterfly, wafer type with RF is used for connection of the valve to adjacent piping,

Body material

1.A216 WCB/WCC or forged carbon steel, A105 is used in non-corrosive services from -28 to 427C.

2. If there are some severe conditions such as flashing, it is typical to use A217 WC9

3. For high temperature services like steam let-down station or HHPS it is a practice to use A217 WC6.

4. A351 CF8 is used mostly for combined flashing and corrosive services and for temperatures below -28C.

5. For oxygen services, it is highly recommended to use Monel.

Based on the next-page Table, A 216 WCB is selected.

Body Size

Body size = Line size = 24 inch

Valve Body Material Selection based on Fluids

Fluid	Material
NG	SA216 WCB
Purge Gas	SA216 WCB
Syngas	SA216 WCB/A351 CF8
Process Condensate	A351 CF8
LPS	SA216 WCB
MPS	SA216 WCB
HPS	SA216 WCB /SA217 WC6
HHPS	SA217 WC6
LPC	SA217 WC6/WC9
MPC	SA216 WCB
HPC	SA217 WC9
BFW	SA216 WCB/ SA217 WC6
WMW	A351 CF8
Nitrogen	SA216 WCB
Crude Methanol	SA216 WCB
Flashed Methanol	A351 CF8
Refined Methanol	SA216 WCB
Process Gas	SA216 WCB/ A351 CF8
Oxygen	Monel

3. Trim

For Trim Tab the following should be specified:

1.Cv required

2.Charachteristic

3.Type

4.Material

5.Leakage Class

Cv calculation

Cv required = line sized

Trim type

Triple offset is selected when a butterfly valve is selected.

Trim Charachteristic

ON/OFF

Trim material

As standard, the material shall be AISI 316, unless otherwise specified.

Erosion-resistant trim with hardened or hard-faced surfaces are required when the pressure drop across the valve exceeds 10 bar, the temperature is above 315°C, the pressure drop across the valve exceeds 5 bar in steam service, or when there is a risk of flashing/incipient cavitation.

Anti-cavitation trim is selected for high-pressure drop applications to prevent the onset of cavitation.

Anti-noise trim is selected for reducing the noise generated by the fluid.

Trim material for butterfly and gate valves may be the same as the body material.

Since a butterfly valve is used the trim material is the same as body material which is A 216 WCB

Leakage Class

Control valves are designed to throttle, but they are also often expected to provide some type of shut-off capability.

A control valve's ability to shut off has to do with many factors: Balanced or unbalanced plug, seat material, actuator thrust, pressure drop, and the type of fluid can all play a part in how wella particular control valve shuts off.

7.7 Seat Leakage Classifications

The classifications per ANSI/FCI 70-2 are:

Class II: 0.5% of rated capacity
Class III: 0.1% of rated capacity
Class IV: 0.01% of rated capacity
Class V: 0.03 ml water/min. per 100 mm port diameter per bar differential
Class VI: See table in ANSI/FCI 70-2

Vent valves that are normally closed shall be very tight to minimise leak losses; class V is the minimum. Block valves in double block-and-bleed arrangement shall be class V-VI (VI in oxygen service). Pump minimum flow valves must be tight, class V to avoid leakage and seat damage

Class IV is also known as a “Metal-to-Metal” seat classification. It is the kind of leakage rate you can expect from a valve with a metal plug and metal seat

Class VI is known as a “Soft Seat” classification. Soft Seat Valves are those where either the plug or seat or both are made from some kind of composition material such as Nitrile or Polyurethane.

For tight shut-off valves minimum V shall be selected

Actuators

The diaphragm- or piston-type actuators for shutdown valves shall generally be spring-to-safe position. Stroking time shall be considered carefully. The valves shall be supplied with 3-way solenoid valves with class H insulation allowing continuous operation in an 85°C ambient temperature. The solenoid valves shall be high-capacity valves ensuring the desired stroking time. When high availability as well as safety is required the solenoid valves are to be in a 2oo2D type configuration.

When shutdown valves are part of a safety function with a SIL requirement, the vendor shall provide failure rates, safe/dangerous failure fractions of the valve, actuator and solenoid valve required to calculate the shutdown valve PFD and spurious trip rate.

Digital valve controllers installed on the shutdown valves monitoring the valve response shall be considered for critical shutdown applications when partial stroke testing is required to fulfil the SIL requirements.

Limit switches shall be hermetically-sealed NAMUR proximity switches. Solenoid valves and limit switches shall have enclosure protection class IP 65 with screw terminals for 2.5 mm^2 wire.

for actuator and positioners Tab the following should be specified:

1.Type

2.Modulating or ON/OFF

3.Failiure position

4.dP for sizing

Actuator Type:

Based on above criteria, Piston with spring return shall be selected

ON/OFF type is selected.

Failure position

Control valves shall be such that on air failure the valve takes automatically a safe position

either open, or close, or locked in position, depending upon the process requirements.

Based on process requirement FC is selected.

dp for sizing

dp equals design pressure which is 55 barg

Solenoid Valve

Type = 3 way 2oo2 configuration

7.9 Flow Tendencies

For valves in shut-off service, flow tendency shall comply with the action required to put the plant in a safe condition in the case of power failure. In some cases it is the back-flow scenario that shall be considered.

Generally, it is the flow-to-open tendency that is the most stable type of operation for modulating control valves. This is therefore the preferred flow direction for globe valves. For angle valves, the direction should be flow-tends-to-close. The direction of flow shall be clearly marked on the valve body.

Hand Wheel

No hand wheel is required.

Note

Stroking time

10 sec