PSV-2121-2122

Blocked Outlet Scenario

Determine relief load

The rated capacity of FT-2002 is 27180 kg/h , so the relief load is 27180 kg/h.

2.Calculate orifice area

Determine if it is in critical flow:

$$\frac{P_{cf}}{P_1} = \left[\frac{2}{k+1}\right]^{\frac{k}{k-1}}$$

where

P_{cf} is the critical flow nozzle pressure;

P_1 is the upstream relieving pressure;

k is the ratio of specific heats (C_p/C_v) for an ideal gas at relieving temperature.

If so, then:

$$A = \frac{W}{CK_d P_1 K_b K_c}\sqrt{\frac{TZ}{M}}$$

K_d is the coefficient of discharge; for preliminary sizing, use the following effective values:

— 0.975, when a PRV is installed with or without a rupture disk in combination;

— 0.62, when a PRV is not installed and sizing is for a rupture disk in accordance with 5.12.1.2;

P_1 is the upstream relieving pressure, psia (kPa); this is the set pressure plus the allowable overpressure (see 5.4) plus atmospheric pressure;

K_b is the capacity correction factor due to backpressure; this can be obtained from the manufacturer's literature or estimated for preliminary sizing from Figure 31. The backpressure correction factor applies to balanced bellows valves only. For conventional and pilot-operated valves, use a value for K_b equal to 1.0 (see 5.3). See 5.6.4 for conventional valve applications with backpressure of a magnitude that will cause subcritical flow;

K_c is the combination correction factor for installations with a rupture disk upstream of the PRV (see 5.12.2);

— equals 1.0 when a rupture disk is not installed;

— equals 0.9 when a rupture disk is installed in combination with a PRV and the combination does not have a certified value;

T is the relieving temperature of the inlet gas or vapor, °R(°F + 460) [K(°C + 273)];

Z is the compressibility factor for the deviation of the actual gas from a perfect gas, evaluated at inlet relieving conditions;

M is the molecular weight of the gas or vapor at inlet relieving conditions; various handbooks carry tables of molecular weights of materials, but the composition of the flowing gas or vapor is seldom the same as that listed in tables. This value should be obtained from the process data. Table 10 lists values for some common fluids, lbm/lb-mole (kg/kg-mole);

V is the required flow through the device, SCFM (Nm^3/min);

G_v is the specific gravity of gas at standard conditions referred to air at standard conditions (normal conditions); in other words, G_v = 1.00 for air at 14.7 psia and 60 °F (101.325 kPa and 0 °C).

Results

T	467	W	27180 kg/h
Z	0.93	A	69 cm2
M	1.2	A	10.7 inch2
C	0.0256		

Note that the relieving temperature is obtained from TOPSOE EXCEL

5.Use API-526 to determine the designation and the inlet and outlet sizing

Since it is more than 6.38 inch and less than 11.05, then Q is selected. Also, by checking its rating and temperature limitation, 6Q8 is selected.

Designation	Effective Orifice Area ($in.^2$)
D	0.110
E	0.196
F	0.307
G	0.503
H	0.785
J	1.287
K	1.838
L	2.853
M	3.60
N	4.34
P	6.38
Q	11.05
R	16.00
T	26.00

Table 14—Spring-loaded Pressure-relief Valves "Q" Orifice [†] (Effective Area = 11.05 in.^{2})

Materials [b]	Valve Size	ASME Flange Class		Maximum Inlet Flange (Set) Pressure Limit [a] (psig)						Outlet Pressure Limit [a] (psig)		Center-to-Face Dimensions (in.)	
				Conventional and Balanced Bellows Valves									
Body/ Bonnet	Inlet by Orifice by Outlet	INLET	OUTLET	−450 °F to −76 °F	−75 °F to −21 °F	−20 °F to 100 °F	450 °F	800 °F	1000 °F	Flange Rating Limit [a] 100 °F	Bellows Rating Limit [a] 100 °F	INLET	OUTLET
Temperature Range Inclusive −20 °F to 800 °F													
Carbon Steel	6Q8	150	150			(165)	(165)	80		(115)	70	9 7/16	9 1/2
	6Q8	300	150			(300)	(300)	(300)		(115)	115	9 7/16	9 1/2
Temperature Range Inclusive 801 °F to 1000 °F													
Chrome Molybdenum Steel	6Q8	300	150					(165)	(165)	(115)	115	9 7/16	9 1/2
	6Q8	600	150					(600)	430	(115)	115	9 7/16	9 1/2
Temperature Range Inclusive −450 °F to 1000 °F													
Austenitic Stainless Steel	6Q8	150	150	(165)	(165)	(165)	(165)	80	20	(115)	70	9 7/16	9 1/2
	6Q8[c]	300	150	(165)	(165)	(165)	(165)	(165)	(165)	(115)	70	9 7/16	9 1/2
	6Q8	300	150	(250)	(300)	(300)	(300)	(300)	(300)	(115)	115	9 7/16	9 1/2
	6Q8	600	150	(300)	(600)	(600)	(600)	(600)	(600)	(115)	115	9 7/16	9 1/2

Select proper PSV type by checking backpressure

According to licensor data, superimposed and build-up backpressure are max 10 barg. Since the backpressure is constant and it is discharged to atmosphere then a conventional type could be selected even though the percentage is high

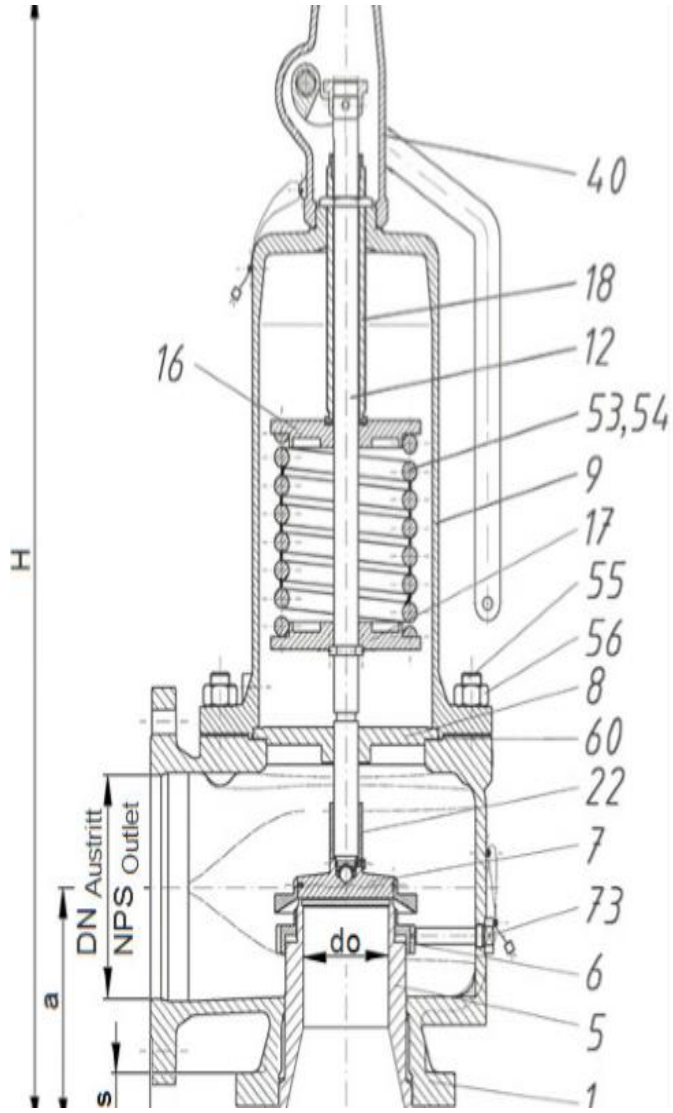
superimposed	Build-up	Total
0 barg	10 barg	10 barg
0%	100%	100%

Table 9.1 Maximum backpressure percentages on gas/vapour applications

Backpressure Type	Effects on valves				Selection
	Value (% of set)	Conventional	Balanced Spring Valve	Pilot Operated	
Constant	<30% [1]	Set point increased by backpressure [3]	No effect	No effect	Conventional, balanced or POSRV
	30%–50%		Lift/capacity reduced (coefficient) [6]		
	>50% [2]	Set point increased by backpressure; flow becomes subsonic [4]	Generally unstable *Do not use*	Flow becomes subsonic [4]	Conventional or POSRV
Variable superimposed	<10%	Set point varies with backpressure [5]	No effect	No effect	Balanced or POSRV
	10%–30% [1]	Unstable			
	30%–50%	*Do not use*	Lift/capacity reduced (coefficient) [6]		
	>50% [2]		Generally unstable *Do not use*	Flow becomes subsonic [4]	POSRV only
Variable built-up	<10%	No effect	No effect	No effect	Conventional, balanced or POSRV
	10%–30% [1]	Unstable			Balanced or POSRV
	30%–50%	*Do not use*	Lift/capacity reduced (manufacturer coefficient) [6]		
	>50% [2]		Generally unstable *Do not use*	Flow becomes subsonic [4]	POSRV only

Material Selection

Since it is Steam, A216 WCB could be used for its body



2	LESER Job No.	20329048
3	LESER Pos.	70
4	Type	5262.6585
5	Orifice	Q
6	Inlet size	NPS 6"
7	Inlet pressure rating	300 lbs ASME B16.5
8	Inlet flange facing	Serr spiral finish, Ra=3,2-6,3
9	Outlet size	NPS 8"
10	Outlet pressure rating	150 lbs ASME B16.5
11	Outlet flange facing	Serr spiral finish, Ra=3,2-6,3
12	d0 [mm]	105,50
13	Set pressure	9,50
14	Pressure unit	barg
15	CDTP [barg]	9,59
16	Dimension a [mm]	240,00
17	Dimension b [mm]	241,00
18	Dimension s [mm]	57,00
19	Dimension H [mm]	1056,00
20	Weight [kg]	221,00
21	Tag No. 1 + 2	PSV-2121; PSV-2122
22	Tag No. 3 + 4	
23	Tag No. 5 + 6	
24	Tag No. 7 + 8	
25	Tag No. 9 + 10	
26	Tag No. 11+ 12	

List of Parts Main Valve			
Pos	Description	Qty	Material
1	Body	1	1.0619/ WCB/ WCC
5	Nozzle	1	1.4408/ CF8M (stellited)
6	Adjusting ring	1	1.4408/ CF8M
7	Disc A5	1	1.4401/ 1.4404/ 316/ 316L (stellited)
8	Guide A5	1	1.0460/ SA-105
9	Bonnet	1	1.0619/ WCB/ WCC
12	Spindle	1	1.4021/ Chrome Steel
16	Spring Plate	1	1.0460/ SA-105
17	Spring Plate	1	1.0460/ SA-105
18	Adjusting Screw A5	1	1.4104/ 430F + PTFE/ Glas
22	Lift stopper	1	1.4401/ 1.4404/ 316/ 316L
40	Cap/ Lifting Device A5	1	0.7040/ 60-40-18
53	Compression Spring	1	1.8159 (51CrV4) or 1.7102 (54SiCr6) or FDSiCr / High temp. Alloy Steel
54	Compression Spring	1	1.8159 (51CrV4) or 1.7102 (54SiCr6) or FDSiCr / High temp. Alloy Steel