PSV Orifice Sizing Calculation Note

PSV-1038/1043

1.Calculate the orifice area, using API-520 Part1

Use the following formula to calculate orifice area:

$$A = \frac{F' \times A}{\sqrt[2]{P1 \times 100}}$$

Here is the calculation from relief load calculation note:

Parameters	Value	Parameters	Value
Aw	53.84 m2	KD	0.975
C9	0.2772	F’	131
C10	0.0395	Relief Load	2165 kg/hr
C	0.0254		

By setting F’, Aw, p1 to 182, 53.84 and 67500 Kpa, we obtain 0.12 inch^2.

$$A = \frac{182 \times 53.84}{\sqrt{67500}} = 0.86\ cm$$

PSV-2121/2122

Parameter	Value	Unit
Relief Load (W)	27180	Kg/hr.
Relieving Pressure	11.46	bara
KN	1	
Kb	1	
Kc	1	
Kd	0.975	
KSH	1	

$$A = \frac{190.5 \times \mathrm{W}}{\mathrm{P1} \times \mathrm{Kd} \times \mathrm{Kb} \times \mathrm{Kc} \times \mathrm{KN} \times \mathrm{KSH}}$$

$$\mathrm{A} = \frac{190.5 \times 27180}{1146.32 \times 0.975 \times 1 \times 1 \times 1 \times 1} = 4632.7 \text{ mm\^{}2}$$

Notes about K_N calculation (API-520-Part-1, Page 91) :

$$K_N = 1.0 \tag{27}$$

where

P_1 ≤ 1500 psia (10,339 kPa).

In USC units:

$$K_N = \frac{0.1906 \times P_1 - 1000}{0.2292 \times P_1 - 1061} \tag{28}$$

where

P_1 > 1500 psia (10,339 kPa) and ≤ 3200 psia (22,057 kPa).

In SI units:

$$K_N = \frac{0.02764 \times P_1 - 1000}{0.03324 \times P_1 - 1061} \tag{29}$$

where

P_1 > 1500 psia (10,339 kPa) and ≤ 3200 psia (22,057 kPa);

K_{SH} is the superheat correction factor; this can be obtained from Table 12 or Table 13. For saturated steam at any pressure, K_{SH} = 1.0. For temperatures above 1200 °F, use the critical vapor sizing Equation (6) through Equation (11).

K_N Calculation

P_1 = 11.46 bar × 14.7 = 168.4 psia < 1500 psia

So K_N = 1

Based on the table and calculated orifice area in inches, which is 7.18 $inch^2$, Q 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

Based on the following table, 6Q8 is selected.

Table 14—Spring-loaded Pressure-relief Valves "Q" Orifice [f] (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[c]	300	150			(165)	(165)	(165)		(115)	70	9 7/16	9 1/2
	6Q8	300	150			(300)	(300)	(300)		(115)	115	9 7/16	9 1/2
	6Q8	600	150			(600)	(600)	(600)		(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
Temperature Range Inclusive –20 °F to 900 °F [d]													
Nickel/ Copper Alloy [d]	6Q8	150	150			(165)	(165)	80	50	(115)	70	9 7/16	9 1/2
	6Q8[c]	300	150			(165)	(165)	(165)	(140)	(115)	70	9 7/16	9 1/2
	6Q8	300	150			(300)	(300)	(300)	275	(115)	115	9 7/16	9 1/2
	6Q8	600	150			(600)	(600)	(600)	550	(115)	115	9 7/16	9 1/2
Temperature Range Inclusive –20 °F to 300 °F [e]													
Alloy 20 [e]	6Q8	150	150			(165)	(165)			(115)	70	9 7/16	9 1/2
	6Q8[c]	300	150			(165)	(165)			(115)	70	9 7/16	9 1/2
	6Q8	300	150			(300)	(300)			(115)	115	9 7/16	9 1/2
	6Q8	600	150			(600)	(600)			(115)	115	9 7/16	9 1/2

PSV-2171/2172

Parameter	Value	Unit
Relief Load (W)	48000	Kg/hr.
Relieving Pressure	11.46	bara
KN	1	
Kb	1	
Kc	1	
Kd	0.975	
KSH	1	

$$A = \frac{190.5 \times \mathrm{W}}{\mathrm{P1} \times \mathrm{Kd} \times \mathrm{Kb} \times \mathrm{Kc} \times \mathrm{KN} \times \mathrm{KSH}}$$

$$\mathrm{A} = \frac{190.5 \times 48000}{1146.32 \times 0.975 \times 1 \times 1 \times 1 \times 1} = 8642 \text{ mm^2}$$

Notes about K_N calculation (API-520-Part-1, Page 91) :

$$K_N = 1.0 \tag{27}$$

where

P_1 ≤ 1500 psia (10,339 kPa).

In USC units:

$$K_N = \frac{0.1906 \times P_1 - 1000}{0.2292 \times P_1 - 1061} \tag{28}$$

where

P_1 > 1500 psia (10,339 kPa) and ≤ 3200 psia (22,057 kPa).

In SI units:

$$K_N = \frac{0.02764 \times P_1 - 1000}{0.03324 \times P_1 - 1061} \tag{29}$$

where

P_1 > 1500 psia (10,339 kPa) and ≤ 3200 psia (22,057 kPa);

K_{SH} is the superheat correction factor; this can be obtained from Table 12 or Table 13. For saturated steam at any pressure, K_{SH} = 1.0. For temperatures above 1200 °F, use the critical vapor sizing Equation (6) through Equation (11).

K_N Calculation

P_1 = 11.46 bar × 14.7 = 168.4 psia < 1500 psia

So K_N = 1

Based on the table and calculated orifice area in inches, which is 13.4 inch^2, R 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

Based on the following table, 6R10 is selected.

Table 15—Spring-loaded Pressure-relief Valves "R" Orifice [f] (Effective Area = 16.00 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						Flange Rating Limit [a]	Bellows Rating Limit [a]		
Body/ Bonnet	Inlet by Orifice by Outlet	INLET	OUTLET	–450 °F to –76 °F	–75 °F to –21 °F	–21 °F to 100 °F	450 °F	800 °F	1000 °F	100 °F	100 °F	INLET	OUTLET
Temperature Range Inclusive –20 °F to 800 °F													
Carbon Steel	6R8 6R8[c] 6R10 6R10	150 300 300 600	150 150 150 150			(100) (100) (230) (300)	(100) (100) (230) (300)	80 (100) (230) (300)		(60) (60) (100) (100)	60 60 100 100	9 7/16 9 7/16 9 7/16 9 7/16	9 1/2 9 1/2 10 1/2 10 1/2
Temperature Range Inclusive 801 °F to 1000 °F													
Chrome Molybdenum Steel	6R8 6R10	300 600	150 150					(100) (300)	(100) (300)	(100) (100)	100 100	9 7/16 9 7/16	9 1/2 10 1/2
Temperature Range Inclusive –450 °F to 1000 °F													
Austenitic Stainless Steel	6R8 6R8[c] 6R10 6R10	150 300 300 600	150 150 150 150	(55) (55) (150) (200)	(100) (100) (230) (300)	(100) (100) (230) (300)	(100) (100) (230) (300)	80 (100) (230) (300)	20 (100) (230) (300)	(60) (60) (100) (100)	60 60 100 100	9 7/16 9 7/16 9 7/16 9 7/16	9 1/2 9 1/2 10 1/2 10 1/2
Temperature Range Inclusive –20 °F to 900 °F [d]													
Nickel/ Copper Alloy [d]	6R8 6R8[c] 6R10 6R10	150 300 300 600	150 150 150 150			(100) (100) (230) (300)	(100) (100) (230) (300)	80 (100) (230) (300)		(60) (60) (100) (100)	60 60 100 100	9 7/16 9 7/16 9 7/16 9 7/16	9 1/2 9 1/2 10 1/2 10 1/2
Temperature Range Inclusive –20 °F to 300 °F [e]													
Alloy 20 [e]	6R8 6R8[c] 6R10 6R10	150 300 300 600	150 150 150 150			(100) (100) (230) (300)	(100) (100) (230) (300)			(60) (60) (100) (100)	60 60 100 100	9 7/16 9 7/16 9 7/16 9 7/16	9 1/2 9 1/2 10 1/2 10 1/2

PSV-2485

Parameter	Value	Unit
Relief Load (W)	6254.12	Kg/hr.
Relieving Temperature	411	K
Molecular Weight (MW)	10.07	
Compressibility Factor (Z)	1	
Relieving Pressure	16.41	bara
C	0.0268	
Kb	1	
Kc	1	
Kd	0.975	

$$A = \frac{\mathrm{W}}{\mathrm{C} \times \mathrm{Kd} \times \mathrm{P1} \times \mathrm{Kb} \times \mathrm{Kc}} \sqrt{\frac{\mathrm{TZ}}{\mathrm{M}}}$$

$$\mathrm{A} = \frac{6254.12}{0.0268 \times 0.975 \times 1641 \times 1 \times 1} \sqrt{\frac{411 \times 1}{10.07}} = 9.3\ \mathrm{cm\hat{}2}$$

Based on the table and calculated orifice area in inches, which is 1.44 $inch^2$, J could be 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

PSV-2494

Parameter	Value	Unit
Relief Load (W)	3387	Kg/hr.
Relieving Temperature	329	K
Molecular Weight (MW)	11.24	
Compressibility Factor (Z)	1	
Relieving Pressure	9.26	bara
C	0.0269	
Kb	1	
Kc	1	
Kd	0.975	

$$A = \frac{\mathrm{W}}{\mathrm{C} \times \mathrm{Kd} \times \mathrm{P1} \times \mathrm{Kb} \times \mathrm{Kc}} \sqrt{\frac{\mathrm{TZ}}{\mathrm{M}}}$$

$$\mathrm{A} = \frac{3387}{0.0269 \times 0.975 \times 9260 \times 1 \times 1} \sqrt{\frac{329 \times 1}{11.24}} = 7.52 \mathrm{~cm\hat{~}2}$$

Based on the table and calculated orifice area in inches, which is 1.16 $inch^2$, J 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

Based on the following table, the initial designation of 2J3 is selected.

12 API STANDARD 526

Table 8—Spring-loaded Pressure-relief Valves "J" Orifice [f] (Effective Area = 1.287 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	2J3	150	150			285	185	80		285	230	5 3/8	4 7/8
	2J3[c]	300	150			(285)	(285)	(285)		285	230	5 3/8	4 7/8
	3J4	300	150			740	620	410		285	230	7 1/4	7 1/8
	3J4	600	150			1480	1235	825		285	230	7 1/4	7 1/8
	3J4	900	150			2220	1855	1235		285	230	7 1/4	7 1/8
	3J4	1500	300			(2700)	(2700)	2055		(600)	230	7 1/4	7 1/8
Temperature Range Inclusive 801 °F to 1000 °F													
Chrome Molybdenum Steel	3J4	300	150					510	215	290	230	7 1/4	7 1/8
	3J4	600	150					1015	430	290	230	7 1/4	7 1/8
	3J4	900	150					1525	650	290	230	7 1/4	7 1/8
	3J4	1500	300					2540	1080	(600)	230	7 1/4	7 1/8
Temperature Range Inclusive –450 °F to 1000 °F													
Austenitic Stainless Steel	2J3	150	150	275	275	275	180	80	20	275	230	5 3/8	4 7/8
	2J3[c]	300	150	(275)	(275)	(275)	(275)	(275)	(275)	275	230	5 3/8	4 7/8
	3J4	300	150	(500)	720	720	495	420	365	275	230	7 1/4	7 1/8
	3J4	600	150	(625)	1440	1440	990	845	725	275	230	7 1/4	7 1/8
	3J4	900	150	(800)	2160	2160	1485	1265	1090	275	230	7 1/4	7 1/8
	3J4	1500	300	(800)	(2750)	(2750)	2480	2110	1820	(600)	230	7 1/4	7 1/8
Temperature Range Inclusive –20 °F to 900 °F [d]													
Nickel/ Copper Alloy [d]	2J3	150	150			230	175	80	50	230	230	5 3/8	4 7/8
	2J3[c]	300	150			(230)	(230)	(230)	(230)	230	230	5 3/8	4 7/8
	3J4	300	150			600	475	460	275	230	230	7 1/4	7 1/8
	3J4	600	150			1200	945	915	550	230	230	7 1/4	7 1/8
	3J4	900	150			1800	1420	1375	825	230	230	7 1/4	7 1/8
Temperature Range Inclusive –20 °F to 300 °F [e]													
Alloy 20 [e]	2J3	150	150			230	180			230	230	5 3/8	4 7/8
	2J3[c]	300	150			(230)	(180)			230	230	5 3/8	4 7/8
	3J4	300	150			600	465			230	230	7 1/4	7 1/8
	3J4	600	150			1200	930			230	230	7 1/4	7 1/8
	3J4	900	150			1800	1395			230	230	7 1/4	7 1/8
	3J4	1500	300			(2700)	2330			600	230	7 1/4	7 1/8

PSV-3047/3048/3057

Parameter	Value	Unit
Relief Load (W)	276000	Kg/hr.
Relieving Temperature	535	K
Molecular Weight (MW)	18.02	
Compressibility Factor (Z)	1	
Relieving Pressure	47.36	bara
C	0.0269	
Kb	1	
Kc	1	
Kd	0.975	

$$A = \frac{190.5 \times \mathrm{W}}{\mathrm{P1} \times \mathrm{Kd} \times \mathrm{Kb} \times \mathrm{Kc} \times \mathrm{KN} \times \mathrm{KSH}}$$

$$\mathrm{A} = \frac{190.5 \times 276000}{4736 \times 0.975 \times 1 \times 1 \times 1 \times 1} = 11833.65\ \mathrm{mm}^{\wedge}2$$

Notes about K_N calculation (API-520-Part-1, Page 91) :

$$K_N = 1.0 \quad (27)$$

where

P_1 ≤ 1500 psia (10,339 kPa).

In USC units:

$$K_N = \frac{0.1906 \times P_1 - 1000}{0.2292 \times P_1 - 1061} \quad (28)$$

where

P_1 > 1500 psia (10,339 kPa) and ≤ 3200 psia (22,057 kPa).

In SI units:

$$K_N = \frac{0.02764 \times P_1 - 1000}{0.03324 \times P_1 - 1061} \quad (29)$$

where

P_1 > 1500 psia (10,339 kPa) and ≤ 3200 psia (22,057 kPa);

K_{SH} is the superheat correction factor; this can be obtained from Table 12 or Table 13. For saturated steam at any pressure, K_{SH} = 1.0. For temperatures above 1200 °F, use the critical vapor sizing Equation (6) through Equation (11).

K_N Calculation

P_1 = 11.46 bar × 14.7 = 168.4 psia < 1500 psia

So K_N = 1

The total orifice area needed for this case is about 18.34 in2, which means PSV with T designation could be used but unfortunately, they are not able to withstand such temperature and pressure rating. So, 2 PSVs with 6Q8 is selected.

Based on the following table, 6Q8 is selected.

18 API STANDARD 526

Table 14—Spring-loaded Pressure-relief Valves "Q" Orifice [f] (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						Flange Rating Limit [a]	Bellows Rating Limit [a]		
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	100 °F	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[c]	300	150			(165)	(165)	(165)		(115)	70	9 7/16	9 1/2
	6Q8	300	150			(300)	(300)	(300)		(115)	115	9 7/16	9 1/2
	6Q8	600	150			(600)	(600)	(600)		(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
Temperature Range Inclusive –20 °F to 900 °F [d]													
Nickel/ Copper Alloy [d]	6Q8	150	150			(165)	(165)	80	50	(115)	70	9 7/16	9 1/2
	6Q8[c]	300	150			(165)	(165)	(165)	(140)	(115)	70	9 7/16	9 1/2
	6Q8	300	150			(300)	(300)	(300)	275	(115)	115	9 7/16	9 1/2
	6Q8	600	150			(600)	(600)	(600)	550	(115)	115	9 7/16	9 1/2
Temperature Range Inclusive –20 °F to 300 °F [e]													
Alloy 20 [e]	6Q8	150	150			(165)	(165)			(115)	70	9 7/16	9 1/2
	6Q8[c]	300	150			(165)	(165)			(115)	70	9 7/16	9 1/2
	6Q8	300	150			(300)	(300)			(115)	115	9 7/16	9 1/2
	6Q8	600	150			(600)	(600)			(115)	115	9 7/16	9 1/2

PSV-3163

1.Calculate the orifice area, using API-520 Part1

Use the following formula to calculate orifice area:

$$A = \frac{F' \times A}{\sqrt[2]{P1 \times 100}}$$

Here is the calculation from relief load calculation note:

Parameters	Value	Parameters	Value
Aw	100 m2	KD	0.975
C9	0.2772	F’	350
C10	0.0395	Relief Load	13236 kg/hr
C	0.026		

By setting F’, Aw, p1 to 350, 100 and 12080 Kpa, we obtain 0.49 inch^2.

$$A = \frac{350 \times 100}{\sqrt{12080}} = 3.18\ cm2$$

PSV-5370

In USC units:

$$A = \frac{Q}{38 \times K_d K_w K_c K_v}\sqrt{\frac{G_l}{P_1 - P_2}}$$

In SI units:

$$A = \frac{11.78 \times Q}{K_d K_w K_c K_v}\sqrt{\frac{G_l}{P_1 - P_2}}$$

P_1 is the upstream relieving pressure, psig (kPag);

P_2 is the total backpressure, psig (kPag).

K_w is the correction factor due to backpressure; if the backpressure is atmospheric, use a value for K_w of 1.0. Balanced bellows valves in backpressure service will require the correction factor determined from Figure 31. Conventional and pilot-operated valves require no special correction (see 5.3);

K_d is the rated coefficient of discharge that should be obtained from the valve manufacturer; for preliminary sizing, an effective discharge coefficient can be used as follows:

— 0.65, 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 5.11.1.2.1.

Parameter	Value	Unit
Q	1.05	
K_d	1	
K_w	1	
K_c	0.65	
K_v	1	
G_1	0.99	
P_1	8.25	
P_2	0	

$$A = \frac{11.78 \times Q}{Kd \times Kw \times Kc \times Kv}\sqrt{\frac{G1}{P1 - P2}}$$

$$A = \frac{11.78 \times 1.05}{1 \times 1 \times 0.65 \times 1}\sqrt{\frac{0.99}{825 - 0}} = 0.66\ mm2$$

Note: Kv calculation

1. Estimate Kv=1
2. Calculate Orifice area
3. Calculate Reynold's Number according to the following equation:

$$Re = \frac{Q(18{,}800 \times G_l)}{\mu\sqrt{A}}$$

4. Calculate new Kv

$$K_v = \left(0.9935 + \frac{2.878}{Re^{0.5}} + \frac{342.75}{Re^{1.5}}\right)^{-1.0}$$

5. Divide calculated orifice area in step 2 by new Kv

R_e	3697
K_v	0.95
A_{new}	0.00106

6. Check API-526 for nearest orifice area

Selected Orifice Area	0.11
PSV Designation	3/4D1

PSV-5339

In USC units:

$$A = \frac{Q}{38 \times K_d K_w K_c K_v}\sqrt{\frac{G_l}{P_1 - P_2}}$$

In SI units:

$$A = \frac{11.78 \times Q}{K_d K_w K_c K_v}\sqrt{\frac{G_l}{P_1 - P_2}}$$

P_1 is the upstream relieving pressure, psig (kPag);

P_2 is the total backpressure, psig (kPag).

K_w is the correction factor due to backpressure; if the backpressure is atmospheric, use a value for K_w of 1.0. Balanced bellows valves in backpressure service will require the correction factor determined from Figure 31. Conventional and pilot-operated valves require no special correction (see 5.3);

K_d is the rated coefficient of discharge that should be obtained from the valve manufacturer; for preliminary sizing, an effective discharge coefficient can be used as follows:

— 0.65, 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 5.11.1.2.1.

Parameter	Value	Unit
Q	23.7	
K_d	1	
K_w	1	
K_c	0.65	
K_v	1	
G_1	0.99	
P_1	8.25	
P_2	0	

$$A = \frac{11.78 \times Q}{Kd \times Kw \times Kc \times Kv}\sqrt{\frac{G1}{P1 - P2}}$$

$$A = \frac{11.78 \times 1.05}{1 \times 1 \times 0.65 \times 1}\sqrt{\frac{0.99}{825 - 0}} = 14.89\ mm2$$

Note: Kv calculation

1. Estimate Kv=1
2. Calculate Orifice area
3. Calculate Reynold's Number according to the following equation:

$$Re = \frac{Q(18{,}800 \times G_l)}{\mu\sqrt{A}}$$

4. Calculate new Kv

$$K_v = \left(0.9935 + \frac{2.878}{Re^{0.5}} + \frac{342.75}{Re^{1.5}}\right)^{-1.0}$$

5. Divide calculated orifice area in step 2 by new Kv

R_e	83183
K_v	0.9965
A_{new}	0.023

6. Check API-526 for nearest orifice area

Selected Orifice Area	0.11
PSV Designation	3/4D1