

PSV SIZING in 5 minutes!!

1. Heat Exchanger Data Input

High pressure side	Reformed Gas
Low pressure side	Cooling Water
Design Pressure of high pressure side	29 barg
Design Pressure of low pressure side	7.5 barg
Operating Pressure	24.2 barg
M	11.24
Cp/Cv	1.39
Z	1
Relieving Temperature	56.4
Tube OD	19.05
Tube Thk.	2.11

2. Check if a PSV is needed

In order to perform this step, do the calculation below:

multiply design pressure of high pressure side by 10/13:

$$29 * 10/13 = 22.3 \text{ barg}$$

So, design pressure of low pressure side should be at least 22.3 barg in order not to need a PSV. Here it is 7.5 bars, thereby requiring a PSV.

3. Use the formula below to calculate Relief Load

K_G : 2.93 (Metric), 385 (USC)	Vapors	$W_G = K_G d^2 P_1 \sqrt{\frac{M}{zT}}$
K_L : 1.77 (Metric), 2645 (USC)	Liquids	$W_L = K_L d^2 \sqrt{\rho_L (P_1 - P_2)}$

W_G	:	gas flow through tube break, kg/hr or lb/hr
W_L	:	liquid flow through tube break, kg/hr or lb/hr
d	:	tube inside diameter, mm or inch
$P_1(*)$	:	HP side normal pressure, bara or psia (alternatively the HP side design pressure may be considered for P_1 , as required by some clients).
$P_2(*)$	:	relieving pressure of the low pressure side, usually 1.1 x gauge set pressure, bara or psia
M	:	molecular weight
z	:	compressibility factor
$T(*)$	:	vapor temperature, °K or °R
$\rho_L(*)$	:	liquid density, kg/m ³ or lb/ft ³

4. Relief Load Result

Parameters	Input	Unit
ID	15.75	mm
Kg	2.93	
P1	24.2	barg
M	11.24	
Z	1	
T	329	K
Results	Output	
Wg	3387.181488	kg/h

5. Use the formula below to calculate orifice area

Gas or Vapor Relief – Critical flow

In USC units:

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

$$A = \frac{V \sqrt{TZM}}{6.32 CK_d P_1 K_b K_c}$$

$$A = \frac{V \sqrt{TZG_v}}{1.175 CK_d P_1 K_b K_c}$$

In SI units:

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

$$A = \frac{2.676 \times V \sqrt{TZM}}{CK_d P_1 K_b K_c}$$

$$A = \frac{14.41 \times V \sqrt{TZG_v}}{CK_d P_1 K_b K_c}$$

USC:

$$C = 520 \sqrt{k \left(\frac{2}{k+1} \right)^{\frac{(k+1)}{(k-1)}}}$$

SI :

$$C = 0.03948 \sqrt{k \left(\frac{2}{k+1} \right)^{\frac{(k+1)}{(k-1)}}}$$

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

K_b is the capacity correction factor due to backpressure

K_c is the combination correction factor for installations with a rupture disk upstream of the PRV equals 1.0 when a rupture disk is not installed. K_c 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. a ratio evaluated at inlet

6. Results

P atm	1.0132
W	3387
Pset	7.5
Rel.Temp.	56.4
Pb	0
MW	11.24
Z	1
Cp/Cv	1.39
Overpressure	0.1
Pb/Pset	0
PSV Type	
Rel.Pressure	9.2632
Pcritical/Prel	0.529971909
Pcritical	4.909235786
C	0.026966299
Kb	1
Kc	1
Kd	0.975
Required A	752.8471916
Required A	1.166915481

Note that since the PSV outlet is discharged to atmosphere, a Conventional type is selected.

Thank you for your attention

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