

- 1- Pressure losses are to be calculated at "rated" PZV capacities in accordance with ASME & API
- 2- Steam conditions are taken from PZV datasheets
- 3- Pressure calcs aren't performed for PZVs directly mounted on equipment nozzle

### Inlet Pressure losses PZV 1069

$$T_{Steam} := 264.5 \text{ }^{\circ}\text{C}$$

absolute pressure

$$P_{Steam} := 44.4 \text{ bar}$$

$$Flow_{Steam} := 42795 \frac{\text{kg}}{\text{hr}}$$

Sh-XS 4in  
 $\epsilon$  is absolute pipe roughness

$$d_{in} := 97.18 \text{ mm}$$

$$\epsilon := 0.05 \text{ mm}$$

$$L := 742 \text{ mm}$$

$$cp := \frac{1}{100} \text{ P}$$

$$\mu := \text{CoolProp_Props}(\text{"VISCOSITY"}, \text{"T"}, T_{Steam}, \text{"P"}, P_{Steam}, \text{"WATER"}) = 0.0181 \text{ cp}$$

$$\rho := \text{CoolProp_Props}(\text{"D"}, \text{"T"}, T_{Steam}, \text{"P"}, P_{Steam}, \text{"WATER"}) = 21.633 \frac{\text{kg}}{\text{m}^3}$$

$$v := \frac{Flow_{Steam}}{\rho \cdot \left( \frac{\pi \cdot d_{in}^2}{4} \right)} = 74.0849 \frac{\text{m}}{\text{s}}$$

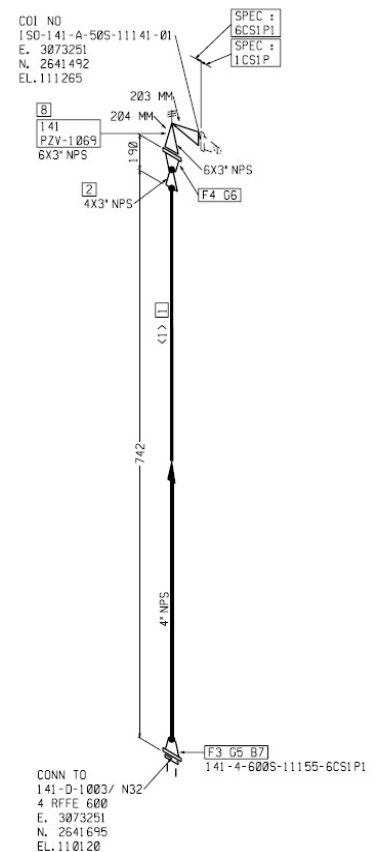
Crane TP-410M 6-2

$$N_{RE} := \frac{d_{in} \cdot v \cdot \rho}{\mu} = 8.6106 \cdot 10^6$$

Serghide Explicit Equation  
 Crane TP-410M

$$\begin{aligned} A &:= -2 \cdot \log_{10} \left( \frac{\left( \frac{\epsilon}{d_{in}} \right)}{3.7} + \left( \frac{12}{N_{RE}} \right) \right) \\ B &:= -2 \cdot \log_{10} \left( \frac{\left( \frac{\epsilon}{d_{in}} \right)}{3.7} + \left( \frac{2.51 \cdot A}{N_{RE}} \right) \right) \\ C &:= -2 \cdot \log_{10} \left( \frac{\left( \frac{\epsilon}{d_{in}} \right)}{3.7} + \left( \frac{2.51 \cdot B}{N_{RE}} \right) \right) \\ f_{pipe} &:= \left( A - \frac{(B - A)^2}{C - 2 \cdot B + A} \right)^{-2} \end{aligned}$$

$$f_{pipe} = 0.0169$$



Flushed nozzle Entrance Crane TP-410M A-30

$$K_{nozzle} := 0.04$$

Conical Reducer 3x4"

$$\begin{aligned} d_{out} &:= 73.66 \text{ mm} & \beta &:= \frac{d_{out}}{d_{in}} = 0.758 \\ \theta &:= 45^\circ \end{aligned}$$

TP-410M A-26

$$K_{reducer} := \frac{0.8 \cdot \sin\left(\frac{\theta}{2}\right) \cdot (1 - \beta^2)}{\beta^4} = 0.3946$$

$$K_{pipe} := f_{pipe} \cdot \frac{L}{d_{in}} = 0.1288$$

$$K_T := K_{pipe} + K_{nozzle} + K_{reducer} = 0.5634$$

TP-410M 6-4

$$h_L := K_T \cdot \left( \frac{v^2}{2 g_e} \right) = 157.6649 \text{ m}$$

$$\Delta p := \rho g_e \cdot h_L = 0.3345 \text{ bar}$$

3% of PZV set pressure@48barg

$$MaxAllow_{\Delta p} := \frac{3}{100} \cdot 48 \text{ bar} = 1.44 \text{ bar}$$

$$Margin_{\Delta p} := MaxAllow_{\Delta p} - \Delta p = 1.1055 \text{ bar}$$

**CASE1 - Full-port Gate Valve isolation at PZV upstream**

TP-410M A-28

$$K_{gate.v} := 8 \cdot f_{pipe} = 0.1349$$

$$K_{T'} := K_T + K_{gate.v} = 0.6984$$

$$h_{L'} := K_{T'} \cdot \left( \frac{v^2}{2 g_e} \right) = 195.4265 \text{ m}$$

Gate Valve can be installed satisfactorily

$$\Delta p' := \rho g_e \cdot h_{L'} = 0.4146 \text{ bar}$$

**CASE2 - SSV assembly in place of single PZV**

**Vendor to ensure each SSV assembly consumes below at least 15% of  $Margin_{\Delta p}$**