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
4- Static pressure heads because of gas phase are safely neglected

Inlet Pressure losses PZV 1069

$T_{Steam} := 264.5\ °C$

absolute pressure

$P_{Steam} := 44.4\ bar$

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

Sh-XS 4in
ε is absolute pipe roughnesss

$d_{in} := 97.18\ mm$

$\varepsilon := 0.05\ mm$

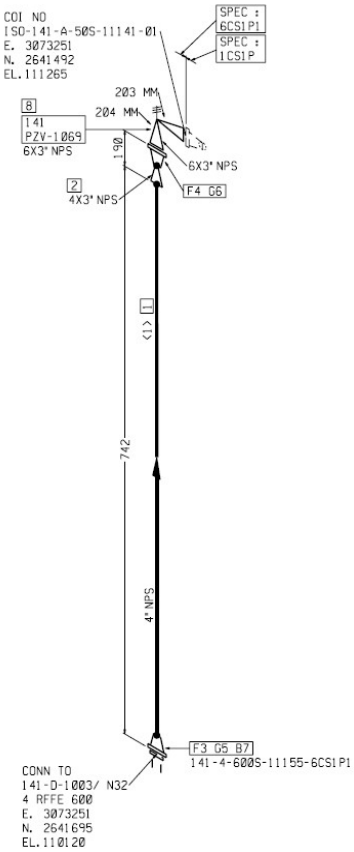
$L := 742\ mm$

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

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

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

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



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

$$A := -2 \cdot \log10\left(\left(\frac{\left(\frac{\varepsilon}{d_{in}}\right)}{3.7}\right) + \left(\frac{12}{N_{RE}}\right)\right)$$

$$B := -2 \cdot \log10\left(\left(\frac{\left(\frac{\varepsilon}{d_{in}}\right)}{3.7}\right) + \left(\frac{2.51 \cdot A}{N_{RE}}\right)\right)$$

$$C := -2 \cdot \log10\left(\left(\frac{\left(\frac{\varepsilon}{d_{in}}\right)}{3.7}\right) + \left(\frac{2.51 \cdot B}{N_{RE}}\right)\right)$$

$$f_{pipe} := \left(A - \frac{(B-A)^2}{C - 2 \cdot B + A}\right)^{-2}$$

$f_{pipe} = 0.0169$

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

Flushed nozzle Entrance Crane TP-410M A-30

$K_{nozzle} := 0.04$

Conical Reducer 3x4"

$d_{out} := 73.66\ mm$ $\quad \beta := \frac{d_{out}}{d_{in}} = 0.758$

$\theta := 45\ °$

$K_1 := \left(0.6 + 0.48 \cdot f_{pipe}\right) \cdot \left(\frac{1}{\beta}\right)^2 \cdot \left(\left(\frac{1}{\beta}\right)^2 - 1\right)$

$K_{reducer} := K_1 \cdot \sqrt{\sin\left(\frac{\theta}{2}\right)}$

$K_{reducer} = 0.4849$

$K_T := K_{pipe} + K_{nozzle} + K_{reducer} = 0.6537$

TP-410M 6-4

$h_L := K_T \cdot \left(\frac{v^2}{2\ g_e}\right) = 182.9258\ m$

$\Delta p := \rho\ g_e \cdot h_L = 0.3881\ bar$

3% of PZV set pressure@48barg

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

$Margin_{\Delta p} := MaxAllow_{\Delta p} - \Delta p = 1.0519\ bar$

CASE1 - Full-port Gate Valve isolation at PZV upstream

TP-410M A-28

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

$K_T, := K_T + K_{gate.v} = 0.7886$

$h_L, := K_T, \cdot \left(\frac{v^2}{2\ g_e}\right) = 220.6873\ m$

Gate Valve can be installed satisfactorily

$\Delta p' := \rho\ g_e \cdot h_L, = 0.4682\ bar$

CASE2 - SSV assembly in place of single PZV

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