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### PSV inlet line sizing

**Mohammadreza Ebrahimi**

Senior Process Eng. at Nargan Engineers & Constructors

Dears,

For PSV inlet sizing normally 2 items shall be checked;

1) Pressure drop between equipment and the PSV < 3% of PSV set pressure, this item shall be checked in order to avoid chattering phenomena.

2)  $\rho V^2$ .

Would you please let me know the reason of checking 2nd item ( $\rho V^2$ )?

Thanks

Mohammad reza

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Sampath

**Sampath Kumar R**

Upstream Process Engineer at Technip

Dear Mohammad,

Rho V2 criteria is to be followed for entire flare system. PSV inlet line is part of flare system, hence this has to be met apart from <3% Pressure drop criteria. Generally, RhoV2 will be for the purpose of piping stability and as you may aware the value could be less than 200000 Pa for flare system piping.

Kind Regards

Sampath Kumar R

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Sue Chin

**Sue Chin Lim**

Principal Process Engineer at SBM Malaysia Sdn Bhd, CEng PEng MICHemE MIEM

I have no idea why momentum has to be checked for the PSV inlet line. I normally based on the pressure drop criteria only. Please be noted that this 3% of set pressure criteria is only important for reclosing relief devices to avoid chattering. For non reclosing relief devices like rupture disc, you don't have to size the line to meet this criteria.

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Sampath

**Sampath Kumar R**

Upstream Process Engineer at Technip

Dear Lim,

PSV inlet line being part of Flare System, it has to undergo RhoV2 criteria apart from 3% pressure drop criteria.

Most of the cases, the RhoV2 criteria will be met for PSV inlet lines. Generally, size changes, if any, in PSV inlet line could be due to 3% pressure drop criteria.

Kind Regards  
Sampath Kumar R

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Learn Syan

**Learn Syan Lee**  
Process Design Engineer

RhoV2 criteria for PSV inlet line sizing is mentioned in section 13.5.1 of Total's General Specification doc. no. GS EP ECP 103. Refer to extract below for quick reference:

"For the line sizing, the maximum capacity of the PSV (recalculated with the selected orifice) shall be considered even if this figure exceeds the actual maximum flow rate due to process limitations. The design of these lines shall comply with the following:  
-  $\Delta P$  between the protected equipment and the PSV < 3% of PSV set pressure (API RP 520 PT II)  
- Diameter of line  $\geq \varnothing$  PSV inlet  
-  $\rho V^2 \leq 25,000$  Pa for  $\varnothing$  of line  $\leq 2$ "  
-  $\rho V^2 \leq 30,000$  Pa for  $P \leq 50$  bar g  
-  $\rho V^2 \leq 50,000$  Pa for  $P > 50$  bar g."

Generally, RhoV2 criteria serves as a measure for typical line sizing to ensure that there is no excessively high velocities in the piping, which can lead to excessive pressure drop or vibrations.

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Jimmy

**Jimmy Lee**  
Senior Process Engineer at SBM Malaysia, CEng MIChemE

So far, i understand only Technip and Total is using  $\rho V^2$  and 3% as PSV Inlet Line criteria.

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Mohammadreza

**Mohammadreza Ebrahimi**  
Senior Process Eng. at Nargan Engineers & Constructors

Based on most standards and practices Checking of 3% set pressure in PSV inlet line is mandatory. I saw only in some gas plants and upstream project (regarding to process design criteria) checking of RohV2 is necessary.

What will happen if we don't care about RohV2 limitation?

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Mojtaba

**Mojtaba Habibi**  
Process Engineer at Petroleum Engineering and Development Company (PEDEC)  
Top Contributor

Based on section 7.3.1.2 of API 521 standard:

"In addition to flow considerations, the vessel nozzle and other inlet piping should be designed to withstand thermal loadings, reaction forces resulting from valve operation, vibration, dead weight and externally applied loadings.

The strength of the inlet piping is less than that of the valve because the inlet piping has a smaller section modulus. Any moments created by loads applied to the outlet flange and by the reactive force of the discharging fluid transmit bending stresses and rotational forces to the inlet piping."

So I think not only valve chatter but also mechanical strength of PSV inlet line are design concerns which have standard base.

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Sampath

**Sampath Kumar R**  
Upstream Process Engineer at Technip

Yes, I agree with Mr. Mojtaba. However, these activities (i.e.) thermal loadings / reaction forces resulting from PSV opening shall be carried out by Piping stress team. As a Process engineer, we need to carry out 3% pressure drop criteria. Also, RhoV2 to be checked as PSV inlet line being part of flare system. It could be client's requirement too. I have checked both in my past projects.

Kind Regards  
Sampath Kumar R

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**Dhiraj Joshi**  
Process Engineer

Hi ,

Dhiraj

I understand that this discussion has happened quite sometime ago. However, in addition to the rho2 criteria, there is also rho3 criteria that i have observed in some of the client line sizing philosophies. As I understand, the physical significance of rho2 criteria is the limiting criteria for pressure (drop). However I am unable to understand the same for rho3 criteria.

Appreciate the forums' thought on the rho3 criteria.

Regards  
Dhiraj

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**Hooman Tabaraei**  
Specialist Process Engineer (MIChemE, CEng)

Hooman

I think  $pV^2$  criterion, in addition to 3% pressure drop criterion, serves as a measure to maintain the pressure drop across the nozzle of protected equipment below the allowable figure to ensure that there is no chattering in PSV.

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**Amar Naik**  
Deputy Chief Process Engineer at SNC-Lavalin

Amar

How is the 3% pressure drop criteria applied to the PSV inlet line, especially when the PSV is installed on a piping portion and not on an equipment? The case I want to know of is the case where PSV is installed on the discharge of a reciprocating compressor. Should the PSV inlet line for which the 3% criteria needs to be applied be considered for the non-flowing portion of the inlet pipe (after the TEE point) or for the entire piping upto the pressure source (in this case Compressor) needs to be considered? Please advise.

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**Jeremy Goldbloom**  
Oil & Energy Professional

Jeremy

If I remember correctly, if you are using a pilot operated PSV, the sensor can be upstream to avoid chattering and the 3 % limit on pressure is then not so important.

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**ASHOK KUMAR**  
Process Engineer at MODEC International INC

ASHOK

Dear all

I have a query.

The velocity in rho v2 is calculated based on inlet line size or the psv inlet nozzle size.

Mostly the psv inlet nozzle size will be smaller than the psv inlet line.

Thanks  
Regards  
Ashok

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**Paul Frey**  
Principal Consultant Relief and Flare at Foster Wheeler Energy Ltd

Paul

I have to agree with not calculating the  $pV^2$  value for the RVinlet line, the reason will become apparent when you consider that  $pV^2$  calculated by Process Engineers is a 'screening tool' for piping to analyse the downstream piping for Flow Induced Vibration, which is a low frequency oscillation of relief piping which can cause localised stresses at branch connections with the flare header. In severe cases, the relief valve tailpipe can rupture. To answer Ashoks question,  $pV^2$  is calculated at each change of diameter, starting with the Relief valve outlet flange.

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**PRABHAKAR SINGH**

process engineer at Foster Wheeler

sir why we consider pv2 criteria while sizing of I/L PSV line

PRABHAKAR Like • Reply privately • Delete • 2 months ago



**Jeremy Goldbloom**

Oil & Energy Professional

The calculated value for  $pV^2$  downstream of the relief valve is likely to be always higher than upstream. Hence the downstream value is usually the limiting one. As mentioned by Paul the issue is basically a mechanical one, such as vibration or the reaction force at a bend.

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**Bob Liu**

Junior Project Engineer at Swift Engineering Inc.

$pV^2$  is used to check and minimize the flow induced vibration, typically in the inlet condition, it should never exceed the limits since the gas is way more dense than the condition in flare header.

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**Obumneme Uyaemesi**

Process / Flow Assurance Engineer

In previous projects i have worked on, I normally consider both the pressure drop criteria (<3% of the PSV set pressure) and the momentum criteria of ( $pV^2 < 200,000$ ) for sizing the inlet line. I have always noticed that the momentum at the inlet is always very very small (not close to the limit). The momentum criteria should be used more for sizing the psv outlet line.

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**Obumneme Uyaemesi**

Process / Flow Assurance Engineer

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**Jeremy Goldbloom**

Oil & Energy Professional

Check NORSOK standard P-001 Section 6.5. It is only a recommended practice outside Norwegian facilities.

In general, all flare lines shall be designed to keep the  $pV^2 < 200\,000\text{ kg/ms}^2$  criteria (where p is the fluid density or mixed density for two phase conditions in  $\text{kg/m}^3$  and V is the velocity in m/s).

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