Inlet Pressure Drop

Objectives of this Presentation. Knowledge to learn.

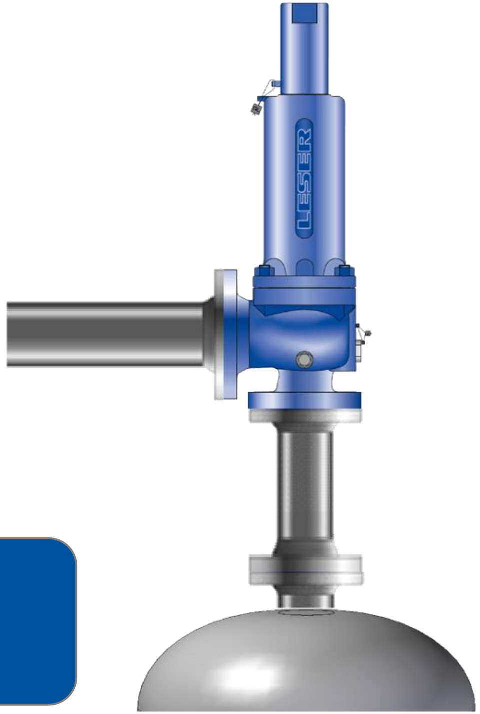
The aim of this presentation is to explain
inlet pressure drop, the effects and influences
as well as **measures for adjustments.**

LESER
The-Safety-Valve.com

General Remarks. Description.

- **Inlet pressure drop** (Δp) is the **pressure loss from the vessel to the seat of the safety valve**
  while blowing.
- If the inlet pressure drop is to high
  a proper operation can not be guaranteed.
- The **maximum inlet pressure drop** according to the most common codes and standards shall be **3%.**

Δp < 3%



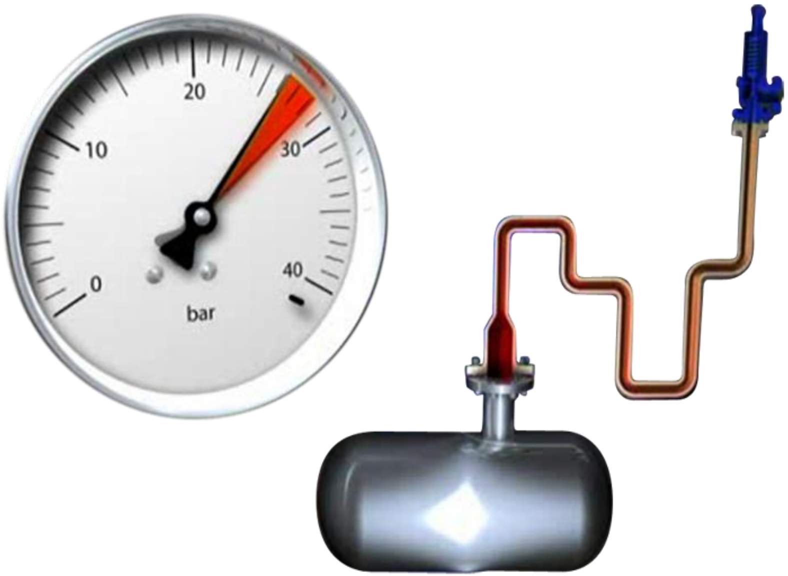
LESER
The-Safety-Valve.com

Parameter. Influencing Factors.

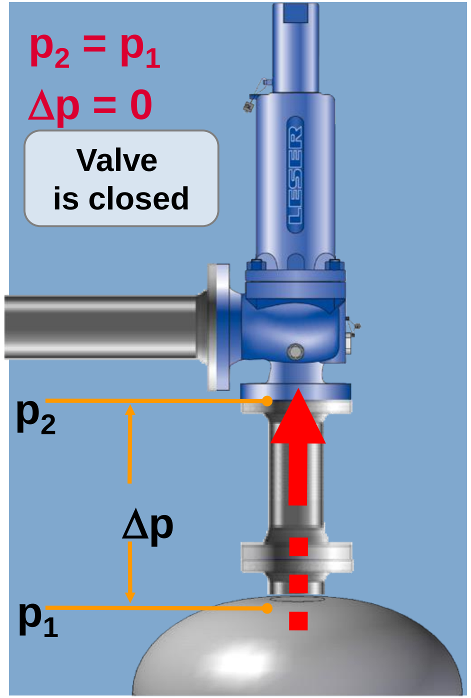
The following **parameters** are **influencing the inlet pressure drop**:

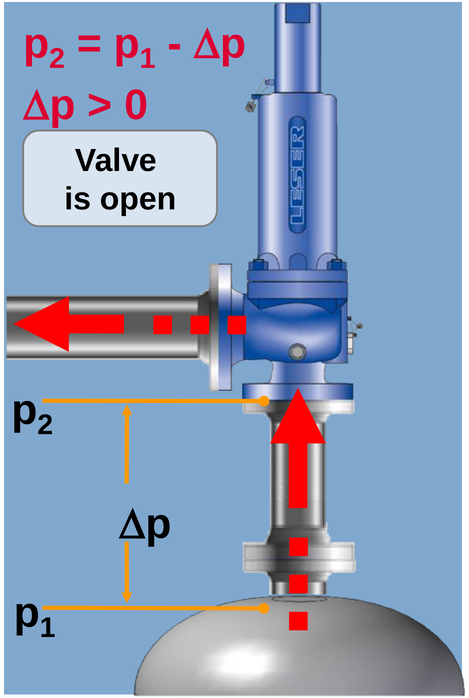
- Diameter of the inlet piping
- Length of the inlet piping
- Pressure loss in the inlet piping (e.g. roughness)
- Components (e.g. bends, contractions Change-over Valve)

Δp



Parameter. Influencing Factors.



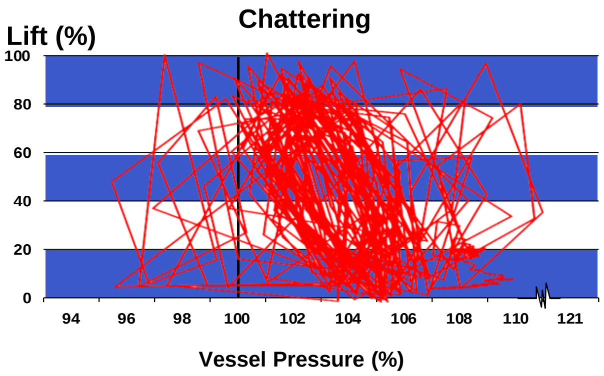


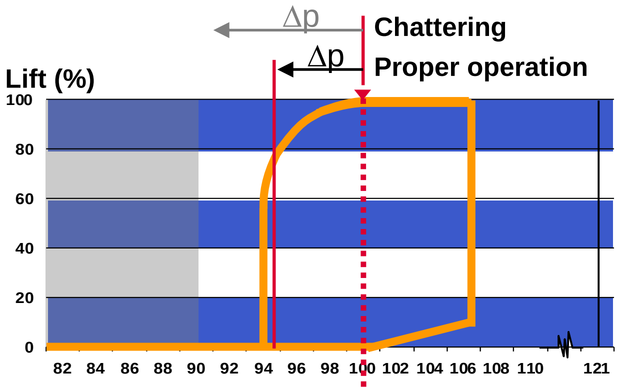
LESER
The-Safety-Valve.com

Effects.

An **inlet pressure drop above 3 %** has an **effect on the proper function** of the safety valve.

This can cause the **following malfunctions**:





The-Safety-Valve.com

Definitions. Codes and Standards.

For the most common international codes and standards a **maximum pressure loss of 3%** from the vessel to the safety valve is required. Examples are…

API 520-2 7.3.4

The total nonrecoverable pressure loss between the protected equipment and the pressure-relief valve **should not exceed 3%** of the PRV set pressure except as noted below:

- thermal relief valves
- remotely sensed pilot-operated relief valves
- an engineering analysis is performed for the specific installation

Note that keeping the Pressure loss below 3% becomes progressively more difficult at low pressures and / or as the orifice size of a pressure relief valve increases. In certain applications, it is difficult to meet the 3 % criterion for largest API 526 orifice size for a given inlet flange diameter. There are some non-API 526 valves that also exhibit this behavior.

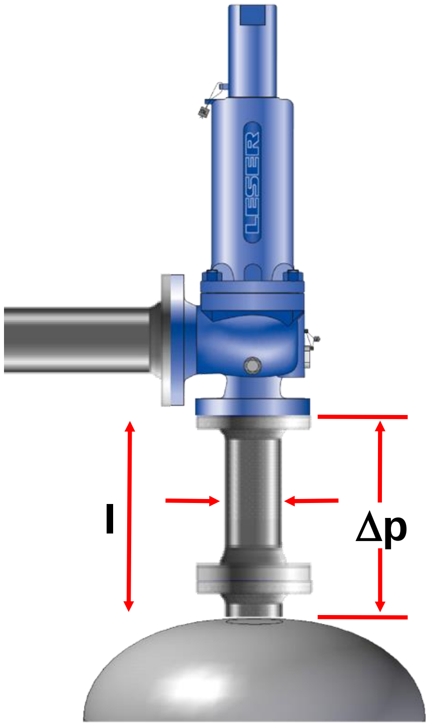
AD 2000-Merkblatt A2, 6.2.2

The pressure loss in the supply line **shall not exceed 3% of the difference in pressure** between the response pressure and the extraneous back pressure in the case of the maximum mass flow discharged. A pre-condition for proper functioning in the event of such pressure loss is that the difference in closing pressure of the fitted safety valve shall be at least 5%.

Calculation.

$$\Delta p = \underbrace{(\lambda \cdot l/d + \Sigma\zeta)}_{\text{Flow resistance}} \cdot \underbrace{\rho/2 \cdot w^2}_{\text{Flow speed}}$$

λ = Friction coefficient (piping)
l/d = Length and inner diameter of pipe
ζ = Resistance coefficient (components)
ρ = Density
w = Velocity



LESER
The-Safety-Valve.com

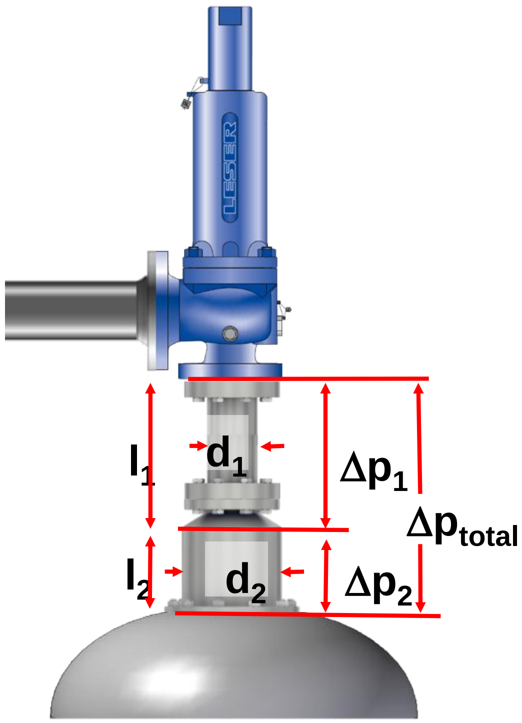
Calculation with different cross sections within the inlet line.

$$\Delta p_{total} = \Delta p_1 + \Delta p_2$$

$$= \left(\lambda_1 * \frac{l_1}{d_1} + \Sigma\zeta_1\right) * \frac{\rho}{2} * W_1^2 + \left(\lambda_2 * \frac{l_2}{d_2} + \Sigma\zeta_2\right) * \frac{\rho}{2} * W_2^2$$

λ = Friction coefficient (piping)
l/d = Length and inner diameter of pipe section
ζ = Resistance coefficient (components)
ρ = Density
w = Velocity
1/2 = Indices of the related pipe sections

Attention:
- Zeta values have always a specific related area
- Zeta values with differing areas can not be added up



LESER
The-Safety-Valve.com

Exceptions to the 3% pressure loss criterion.

- For high capacity safety valves the pressure drop is allowed to be higher than 3%, if the certified coefficient of discharge and stable function is ensured by the user.
- Therefore, high capacity LESER safety valves were tested on the LESER performance test bench, witnessed by a third party
- The test set up consisted of high capacity safety valves with an inlet line of a Change-over Valve and a 5xDN pipe piece
- As a result a Manufacturer's Declaration is provided to support the user
- For Pilot Operated Safety Valves it is possible to allow higher pressure drops by installation of a remote sensing line

Measures. Adjustment.

The following **adjustments prevent malfunction** are based on **inlet pressure drop**:

- **Reduction of flow speed by**

  - increasing pipe diameter

  - reduction of flow capacity using a smaller valve

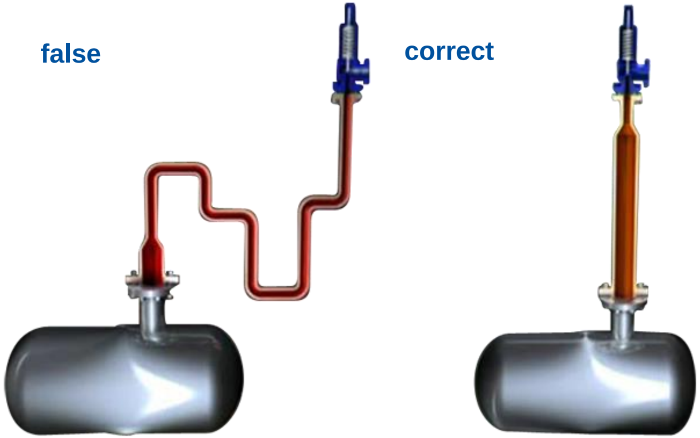
  - reduction of flow capacity using a lift restriction

  - reduction of flow capacity using an O-ring damper

- **Reduction of flow resistance by**

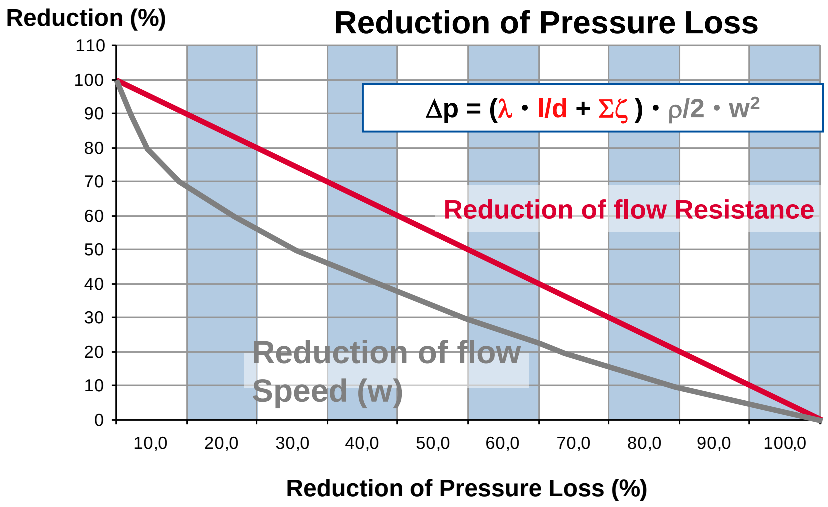
  - shorter inlet pipe

  - smooth connection to the vessel



LESER
The-Safety-Valve.com

The **reduction of flow speed** is **more effective** than the **reduction of flow resistance.**



The-Safety-Valve.com

Inlet Pressure Drop
Thank you for your attention.