LIRA

Specialist in Process Control

Analisys Density Flow
Level Pressure Viscosity

LE VALVOLE DI SICUREZZA

Pressure Relief Valves

Farris

A cura di Davide Chierichetti

SAVE – Verona 28/10/15

CONVEGNO AIS ISA Italy Section

Associazione Italiana Strumentisti

ISA Italy Section

Agenda

INDICE

1. Terminology
2. Pressure Relief Valve Operation
3. Codes and Standards
4. Product Scope
5. Conclusion and Q/A

Definition of Terms

Pressure Relief Valve

- A pressure relief device designed to open and relieve excess pressure **and** to re-close and prevent the further flow of fluid after normal conditions have been restored.
  - Relief Valve – Liquid Service
  - Safety Valve – Vapor/Gas Service
  - Safety Relief Valve – Either Liquid or Vapor/Gas Service

Definition of Terms

Coefficient of Discharge (K_D)

- The ratio of the mass flow rate in a valve to that of an ideal nozzle (used for calculating flow through a PRV).
  - Nine (9) tests are required for each valve series
    - Average of the 9 tests shall be the coefficient of discharge (as long as each of the tests is ±5% of the average).
    - Cannot be greater than 0.975.

De-rated Coefficient of Discharge (K)

- The product of the coefficient of discharge (K_D) and 0.9 (a 10% de-rating factor mandated by the ASME).
  - The de-rated coefficient of discharge shall be used in all sizing calculations and capacity calculations.

Maximum Allowable Working Pressure (MAWP)

- The maximum gauge pressure allowed at the top of a completed vessel.

Accumulation

- The pressure increase over the MAWP of the vessel allowed during discharge through the PRV (governed by applicable codes).

Definition of Terms

Set Pressure

- The inlet gauge pressure at which the PRV is set to open.

Overpressure

- The pressure increase over the set pressure of the PRV.
  - Same as accumulation only when PRV is set to open at the MAWP.

Relieving Pressure (P_1)

- The sum of the set pressure and overpressure.

Definition of Terms

Blowdown

- The difference between the set pressure and the closing pressure of a PRV (expressed as a percentage of set pressure).

Simmer

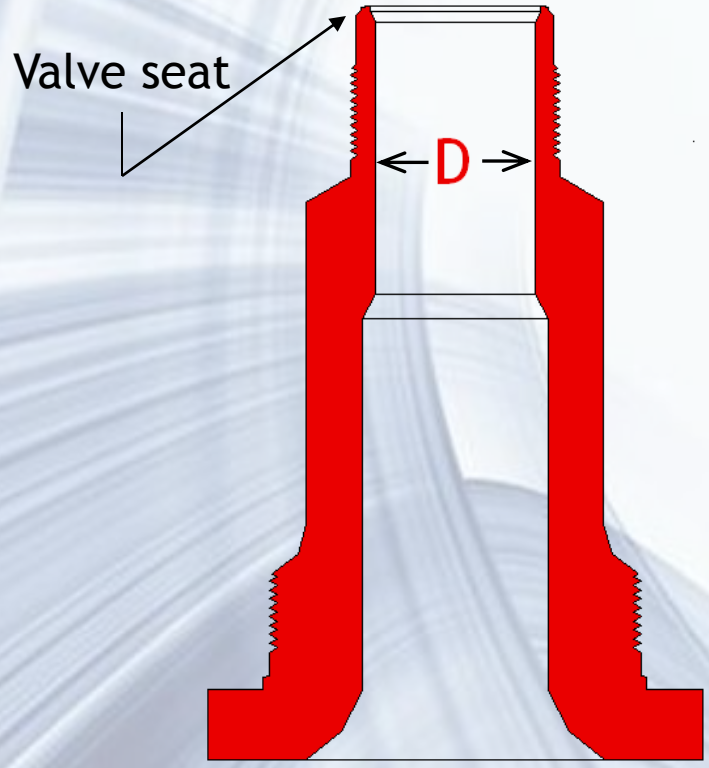
- The audible or visible escape of compressible fluid between the seat and disc of the PRV
  - Typical values between 93 and 98% (depending on valve design)

Operating Pressure Ratio

- The ratio of operating pressure to set pressure.
  - Should not exceed 90%.

Actual (or ASME) Area

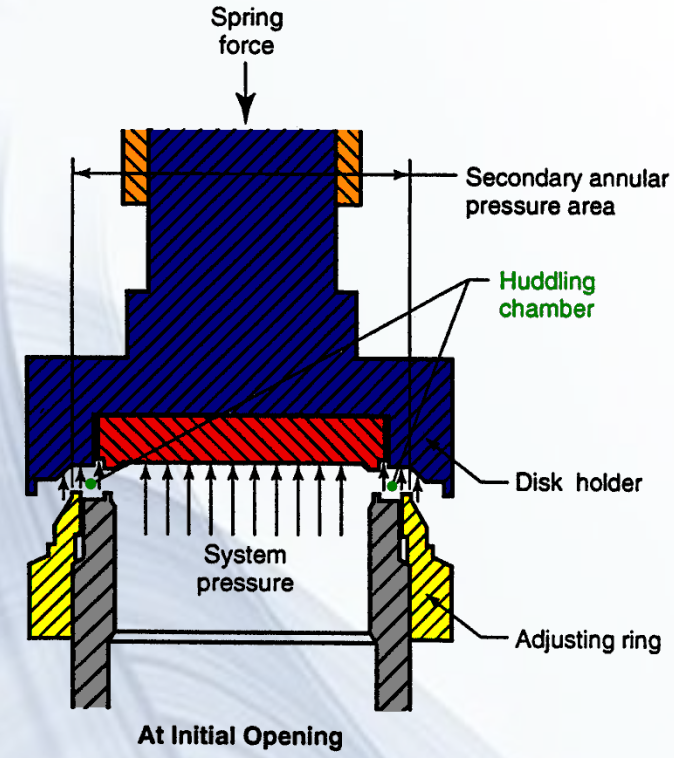
- The minimum net area that determines the flow through a valve.



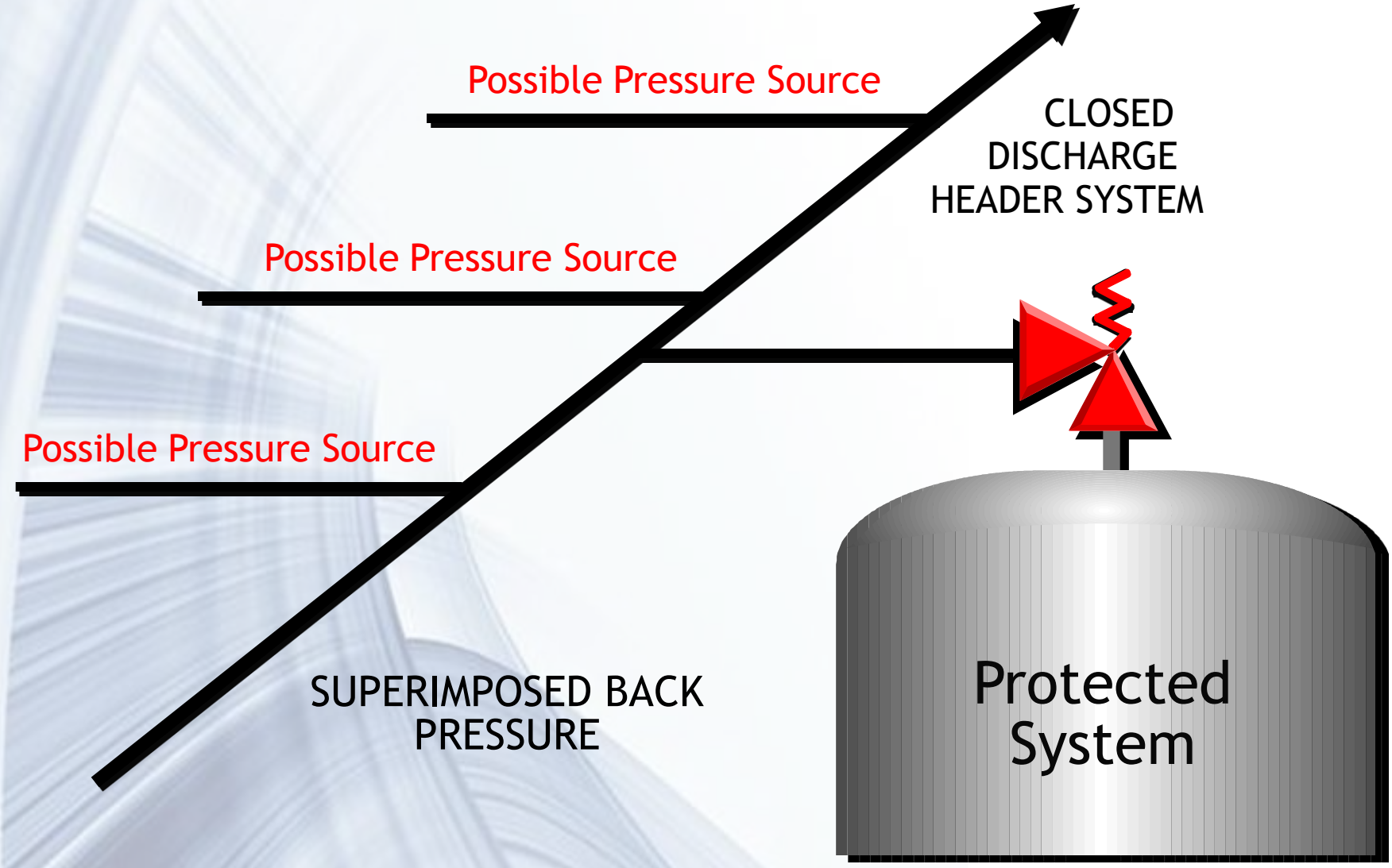
$$A = \frac{\pi D^2}{4}$$

Huddling Chamber

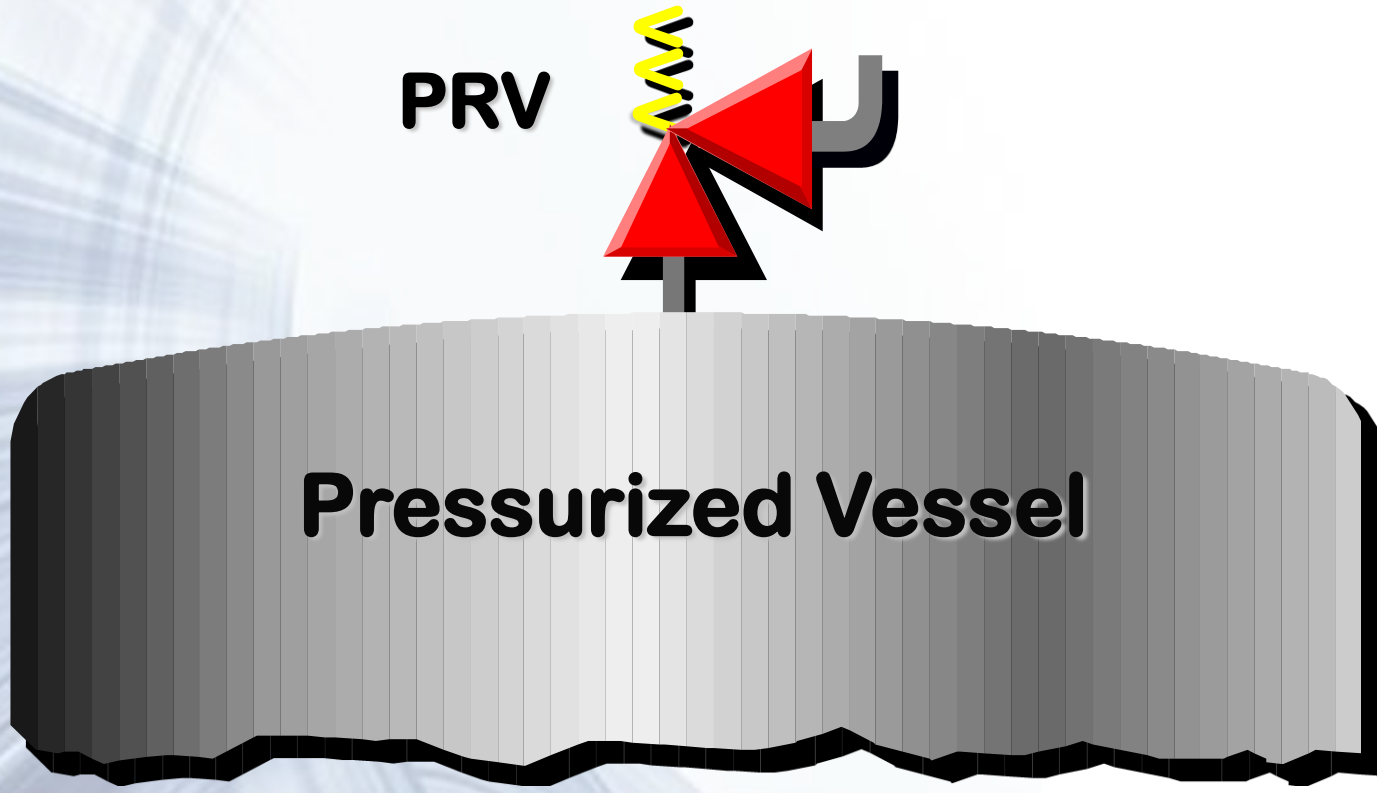
- The ring shaped chamber located downstream of the seat of a pressure relief valve for the purpose of assisting the valve to achieve lift.



Superimposed Back Pressure

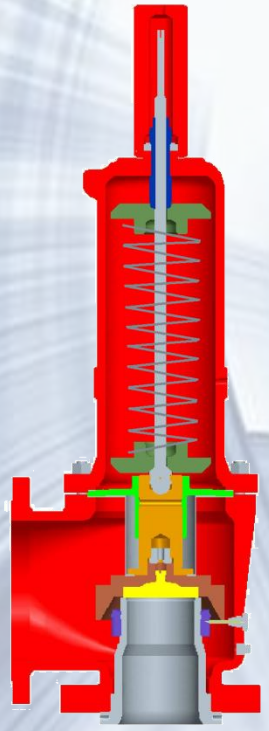


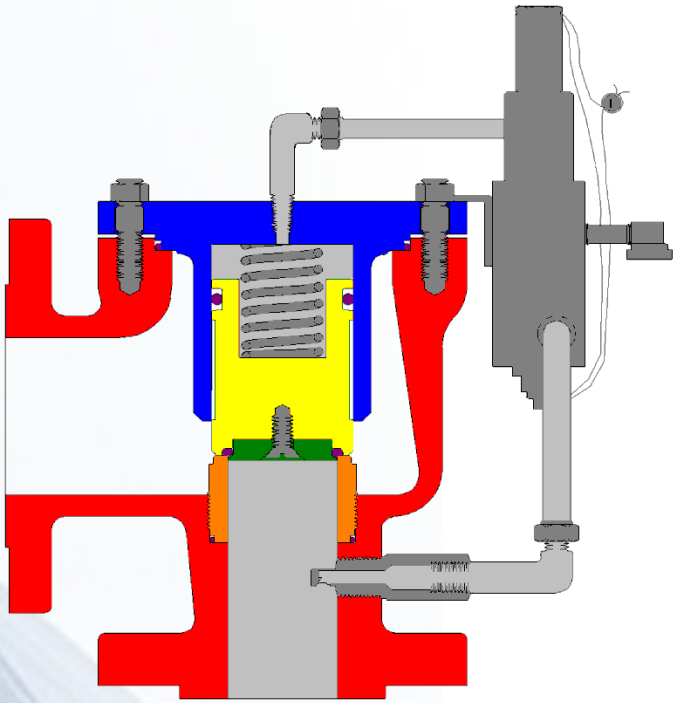
PRV Operation



PRV Operation

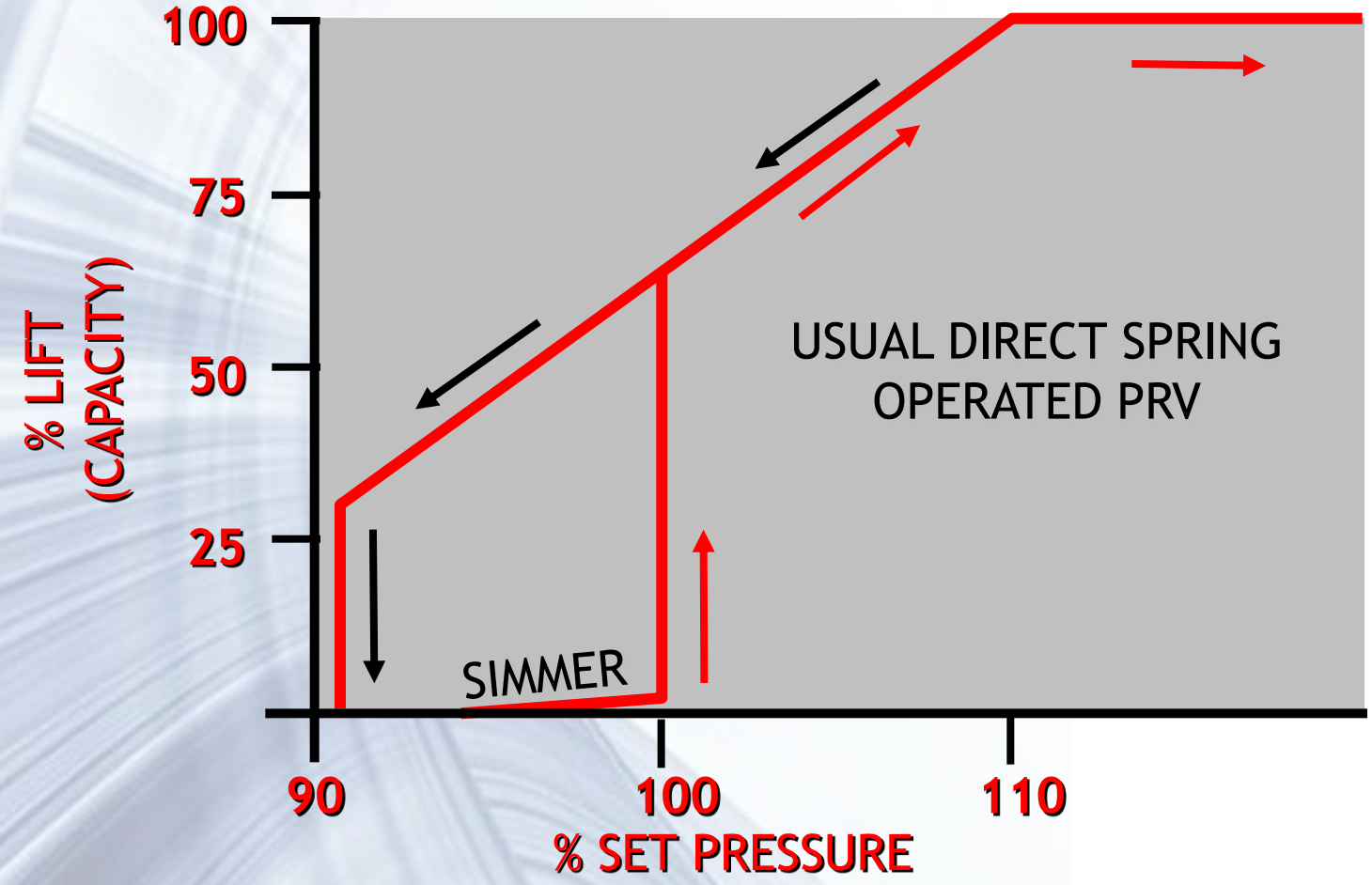
- Two types of pressure relief valve designs
  - Direct Spring Loaded
  - Pilot Operated



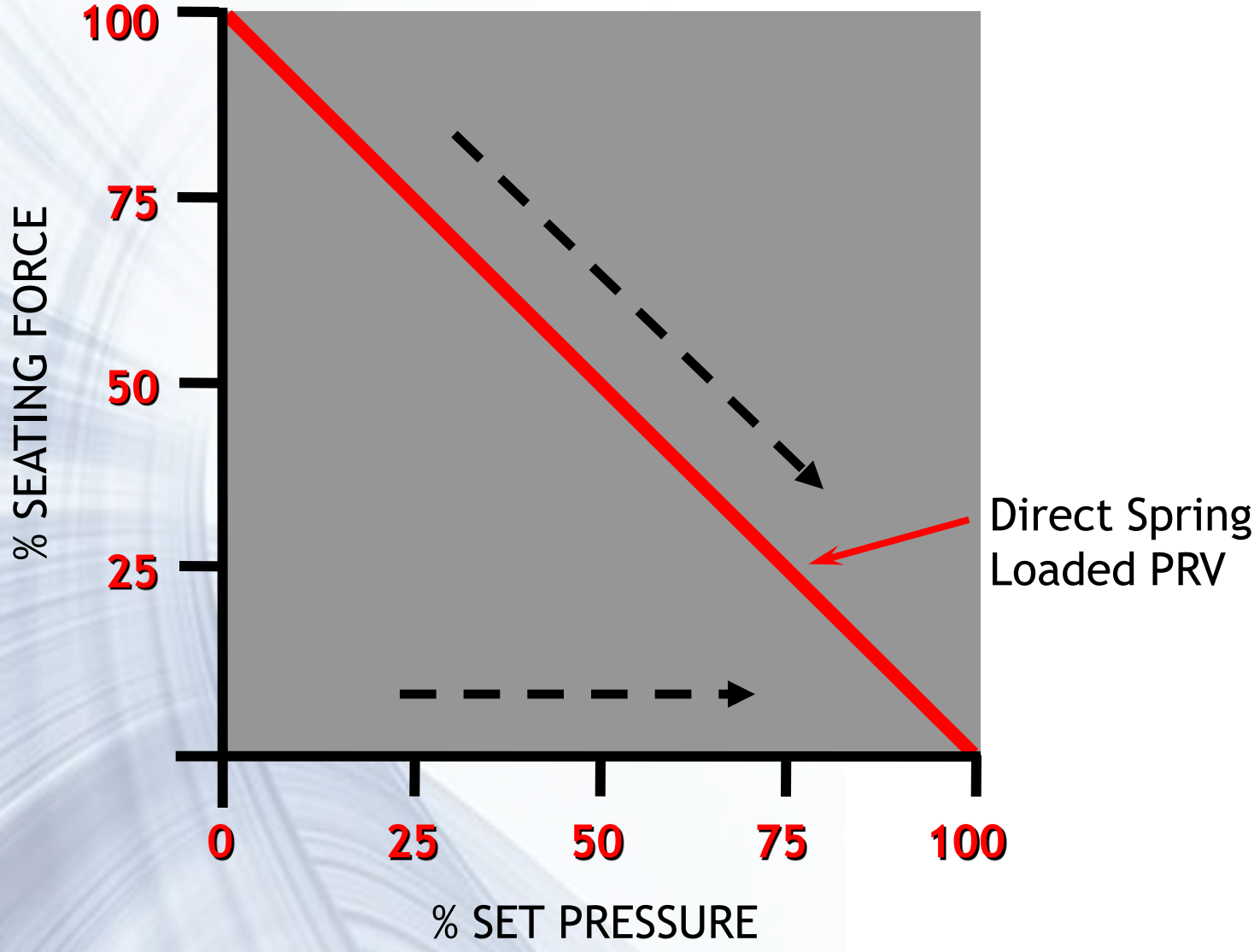


Spring Loaded Pressure Relief Valve Operation

Lifting and Closing Curves



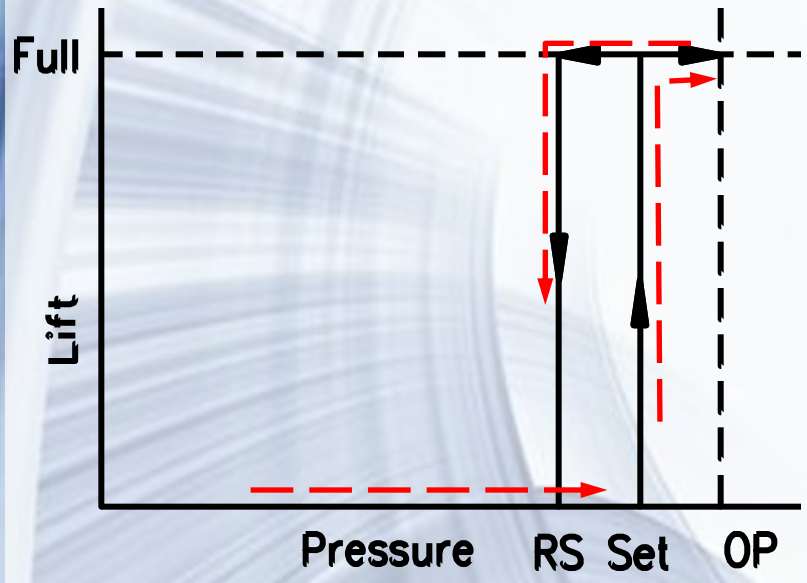
Spring Loaded Pressure Relief Valve Operation



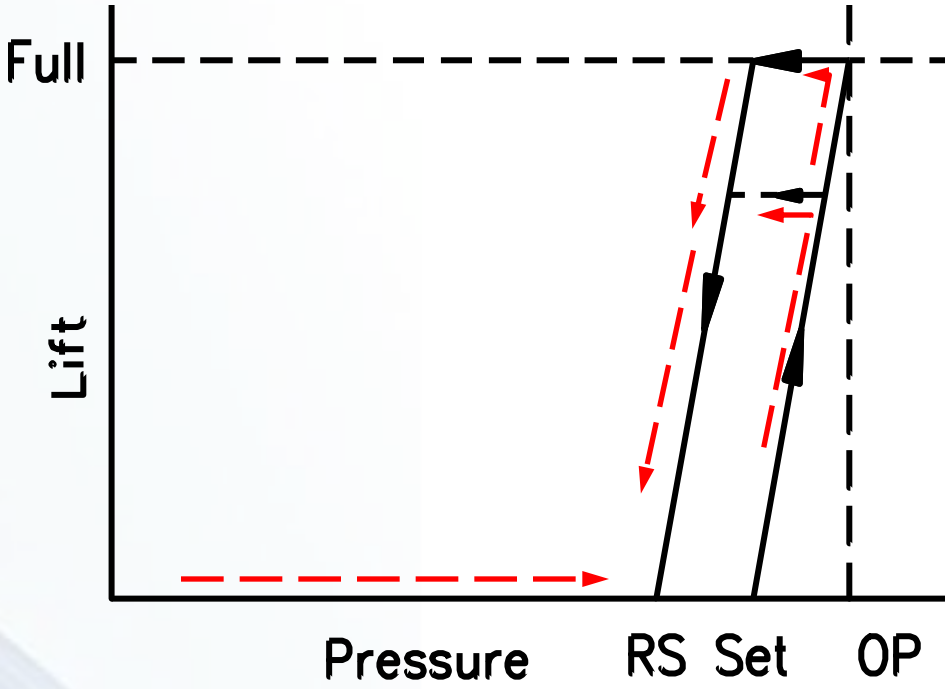
Pilot Operated Pressure Relief Valve Operation

Lifting and Closing Curves

Snap Acting



Modulating



American Society of Mechanical Engineers (ASME)

- The ASME establishes rules of safety governing the design, the fabrication and the inspection during construction of boilers and unfired pressure vessels, and interprets these rules when questions arise regarding their intent.

ASME Code Section I

- This is a construction code covering power, electric and miniature boilers and high temperature boilers used in stationary service. Above 15 PSIG.
  - 3% maximum overpressure at rated capacity.
  - Blowdown[new].
    - < 67 psi — 4 psi
    - ≥ 67 and ≤ 250 psi — 6% of set pressure
    - > 250 and ≤ 375 psi — 15 psi
    - > 375 psi — 4% of set pressure
  - Set pressure tolerance:
    - +/- 2 psi — $P_{set} \leq 70$ psig
    - +/- 3 psi — 70 psi$< P_{set} \leq 300$ psi
    - +/- 10 psi — 300 psi$< P_{set} <$1000 psi
    - +/- 1% $P_{set} \geq$1000 psi
  - Must have lifting lever.
  - Nameplate showing rated capacity in lb/hr steam.

ASME Code Section VIII

- This is a construction code covering the basic rules for the construction, design, fabrication, inspection and certification of pressure vessels (unfired). Above 15 PSIG.
  - Maximum overpressure at rated capacity:
    - 10% (or 3 psi) - single valve
    - 16% (or 4 psi) - multiple valves (non-fire)
    - 21% - overpressure due to fire.
  - No mandatory blowdown, however, adjustable blowdown valves must meet 7% test during certification. Recommend keeping operating pressure < 90% of P_{set}.
  - Set pressure tolerance:
    - +/- 2 psi $P_{set} \leq 70$ psi
    - +/- 3% $P_{set} > 70$ psi
  - Lifting lever required for water >140F, air or steam service.
  - Nameplate showing rated capacity in SCFM air, USGPM water or lb/hr steam.

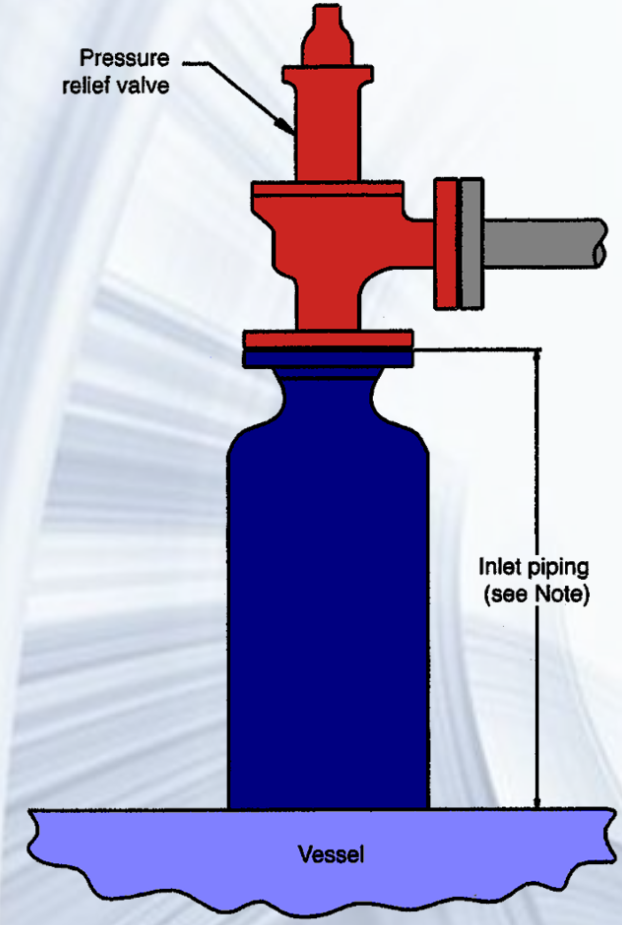
National Board of Boiler & Pressure Vessel Inspectors

- The N.B. Represents the enforcement agencies who assure adherence to provisions of the ASME boiler and pressure vessel code.
  - Sets inspection standards
  - Qualifies inspectors
  - Works for owners, insurers
  - Maintains records (“red book”)
  - Looks into violations
  - Covers repair

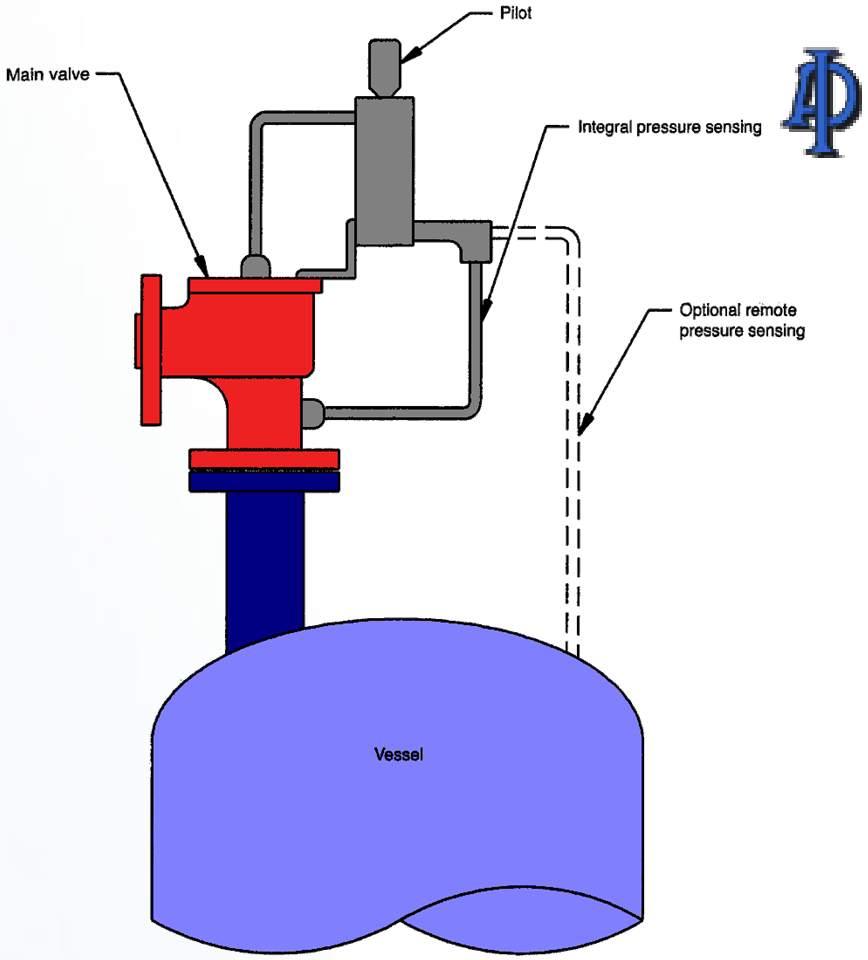
American Petroleum Institute (API)

- API 520 Part I- Sizing & Selection of Pressure Relief Devices
- API 520 Part II-Installation
- API 521- Guide for Pressure-Relieving & Depressurizing Systems
- API 526 - Flanged Steel Safety Relief Valves
- API 527 - Seat Tightness of Pressure Relief Valves

Valve Installation



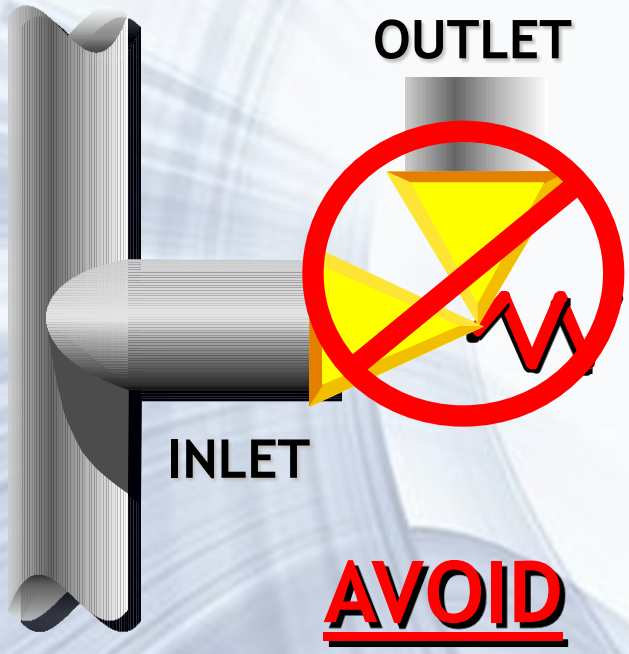
Typical Pressure-Relief Valve Mounted on Long Inlet Pipe



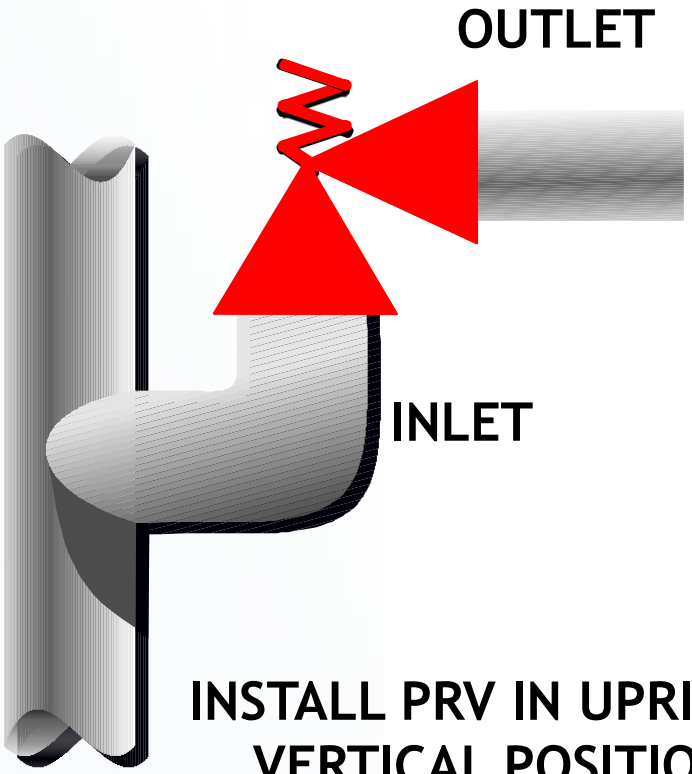
Typical Pilot-Operated Pressure-Relief Valve Installation

- Note: Inlet piping sized so that non-recoverable pressure losses from vessel to pressure relief valve inlet flange do not exceed 3 percent of set pressure.

Valve Installation



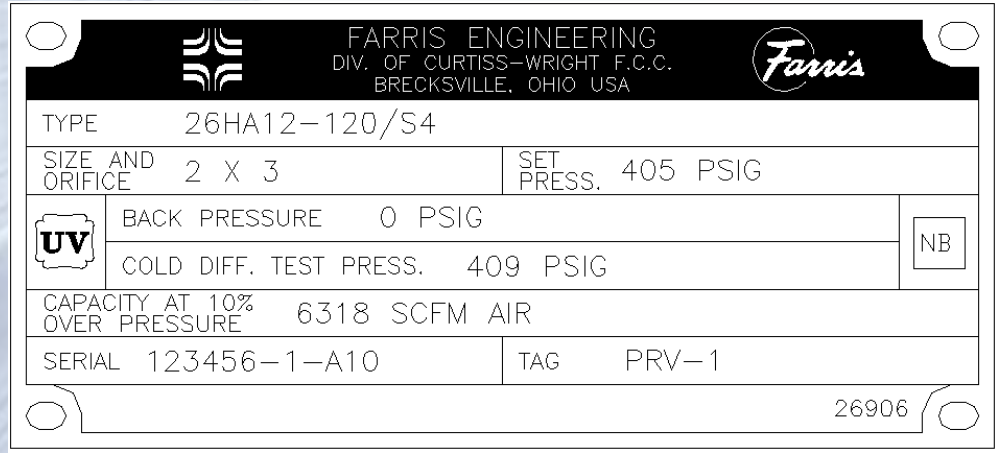
AVOID



INSTALL PRV IN UPRIGHT VERTICAL POSITION

Pressure Relief Valve Nameplate Data

Nomenclature	Description
Manufacturer's Name	Identification of Manufacturer
Size	Nominal pipe size, inlet x outlet
Type, style or model	Manufacturer's designation
Capacity	lb/hr of saturated steam, SCFM or air at 60°F and 14.7 psia or U.S.GPM of water at 70°F
Serial Number	Manufacturer's identification
Set Pressure	Valve inlet pressure at which the valve is adjusted to open
Back Pressure	Constant and/or Variable
Cold Differential Test Pressure	Pressure at which the valve is adjusted to open on the test stand
Tag Number	Valve tag number



PRODUCT SCOPE

PRV provides solutions serving many industries

- hydrocarbon processing
- refinery
- petrochemical
- fossil and nuclear power generation
- natural gas production and transmission
- pharmaceutical
- general processing

MARKET DEMAND TO PRV

- Full range of service applications (air, steam, vapor and liquid services).
- Superior nozzle design – high capacity,
- Balanced bellows design
- Balanced piston design
- O-ring design
- Integral sleeve guide for positive alignment, corrosion resistance and protection from foreign particles.
- Positive connection of parts – secure assembly.
- Convertibility of design.
- Steam jacketing available.
- Maximum interchangeability of parts affords easy maintenance and lower costs.

Video di 6 minuti realizzato in laboratorio che simula il funzionamento delle "Farris SmatPRV"

CONCLUSION

Thank you for your attention and patience

QUESTIONS?

Davide Chierichetti
LIRA Srl
Via San Cristoforo, 74
20090 Trezzano Sul Naviglio (MI)
Tel. 024451031 - Fax. 024450932
E-mail davide.chierichetti@lirasrl.it
Web www.lirasrl.it

Associazione Italiana Strumentisti

ISA Italy Section