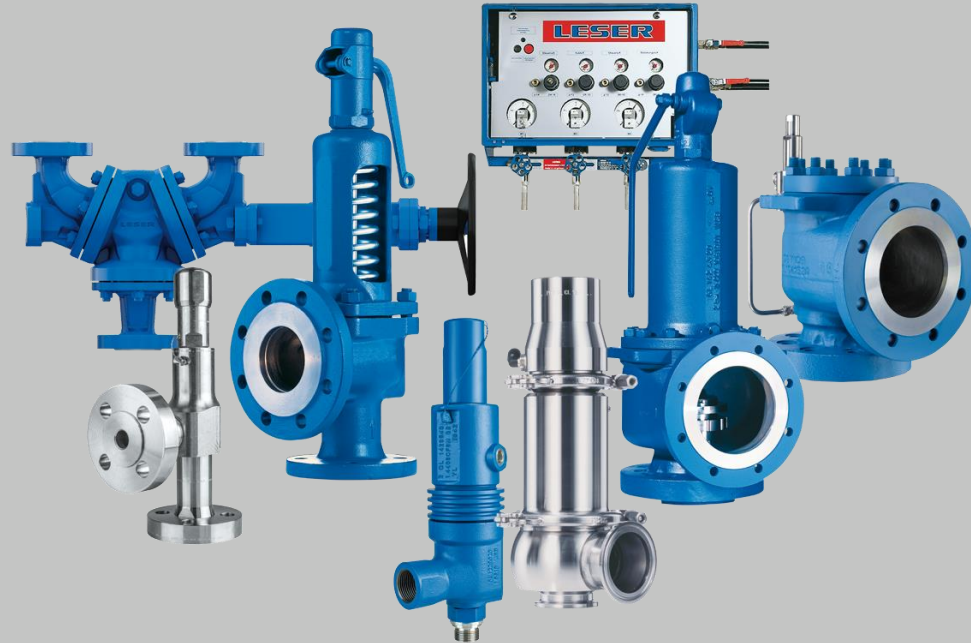


# Terminology

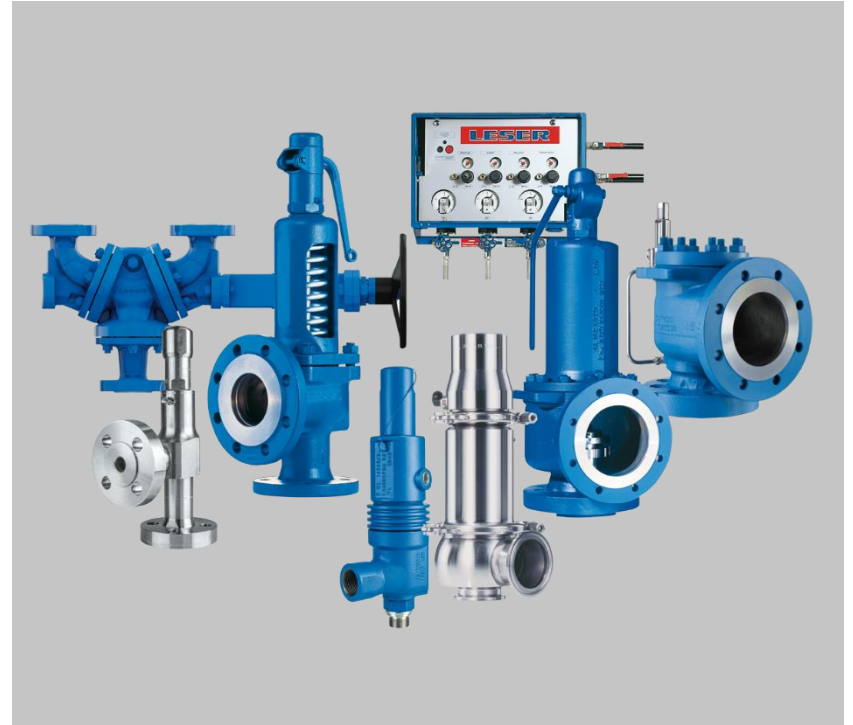


# Objectives of this Presentation. Knowledge to learn.

1. [Objectives](#) | 2. [Organizations and Associations](#) | 3. [Classifications](#) | 4. [Definitions](#) | 5. [Loading Principle](#) | 6. [Opening Characteristics](#) | 7. [Definition of Terms](#) | 8. [Back Pressure](#)

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The aim of this presentation is to explain the **most common phrases around Safety Valves**.







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# Institutions, Standards and Regulations.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

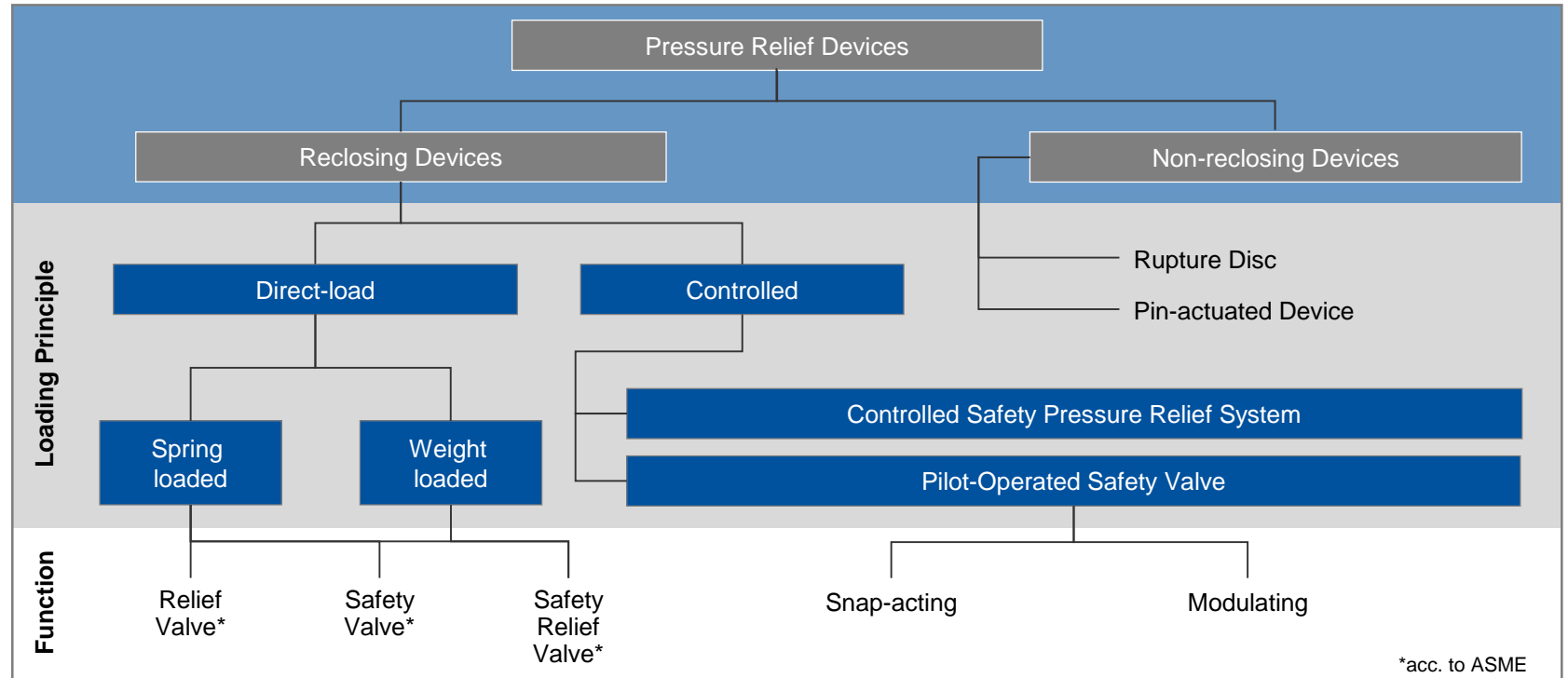
Area of application	Applicable regulations	Issuer of regulations	Symbol	Monitoring organisation
USA	ASME Section VIII Division 1	American Society of Mechanical Engineers (ASME)		National Board (NB)
Europe	Pressure Device Guideline – 97/23/EG, new from 19.07.2016: 2014/68/EU	European Council/ European Parliament		Office appointed (e.g. German Technical Inspection Association)
	ISO 4126	International Organization for Standardization		
China	GB/T 12242 and Safety Valves General Requirements GB/T 12241	General Administration of Quality Supervision, Inspection and Quarantine/ Special Equipment Licensing Office (AQSIQ SELO)		National Engineering Research Center for Special Pump & Valve (NERCSPV)
International	API 520, 526, 527	American Petroleum Institute (API)		Manufacturer

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# Classification of safety devices.

1. Objectives | 2. Organizations and Associations | 3. **Classifications** | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure



# Definition of Terms. Pressure Relief Devices.

1. [Objectives](#) | 2. [Organizations and Associations](#) | 3. [Classifications](#) | 4. [Definitions](#) | 5. [Loading Principle](#) | 6. [Opening Characteristics](#) | 7. [Definition of Terms](#) | 8. [Back Pressure](#)

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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.



# Loading Principle. Spring Loaded Pressure Relief Valves.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. **Loading Principle** | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

---

A pressure relief valve in which **the opening and closing** of the valve is **controlled by a spring**.



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# Loading Principle. Weight Loaded Pressure Relief Valve.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

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A pressure relief valve in which **the opening and closing of the valve is controlled by a weight.**



# Loading Principle. Pilot-Operated Safety Valves.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

---

A pressure relief valve in which the **main valve is combined with and controlled by an auxiliary pressure relief valve** (pilot-controlled).





# Loading Principle. Controlled Safety Valve System.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

A system consisting of a **safety valve in combination with control unit**. The control unit generates an **additional closing force** with the aid of a drive in the case of a spring-loaded safety valve.



# Loading Principle. Rupture Disc / Safety Valve Combination.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

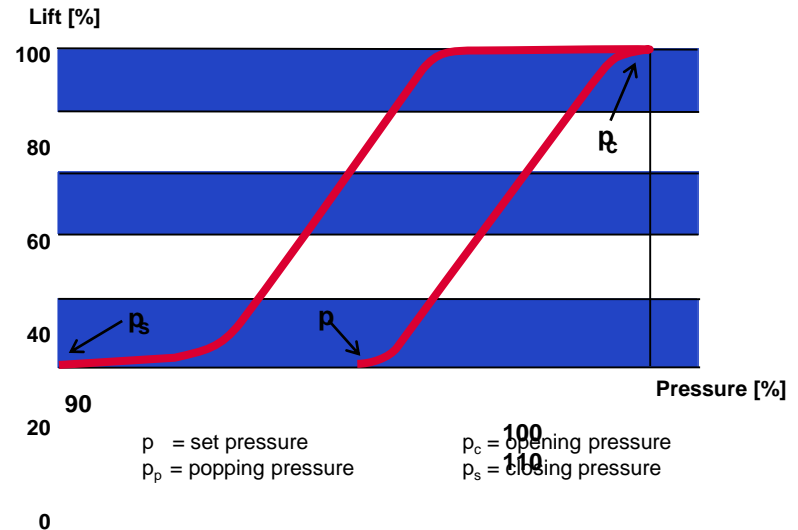
A system consisting of a main valve in combination with a **preopened rupture disc**. The bursting pressure of the rupture disc is equal to the set pressure of the safety valve.



# Opening Characteristics. Normal Safety Valve Pursuant to AD 2000 (Sheet A2).

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. **Opening Characteristics** | 7. Definition of Terms | 8. Back Pressure

A *spring loaded* pressure relief valve actuated by the **static pressure upstream** of the valve. The valve opens in proportion to the **pressure increase** over the opening pressure. Used primarily with **liquid service** (non-compressible).

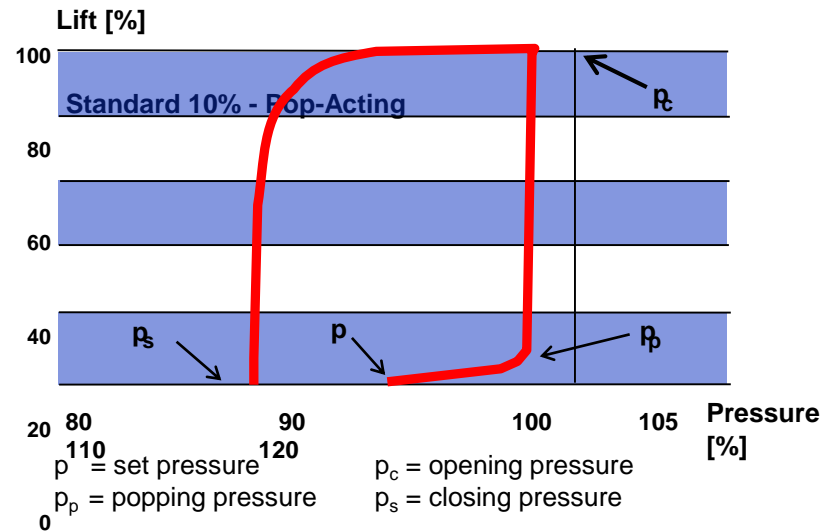


# Opening Characteristics. Normal Safety Valve Pursuant to AD 2000 (Sheet A2).

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

A spring-loaded normal safety valve opening proportionately **or** suddenly within a pressure increase of 10%.

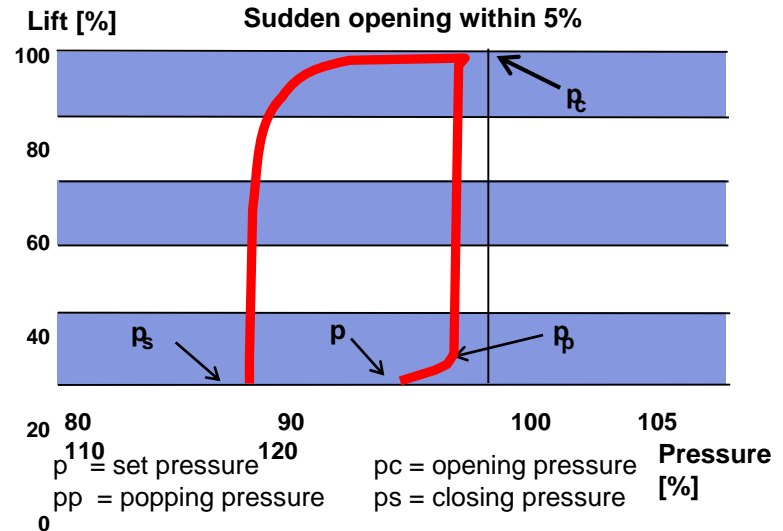
Used with all media: steam, vapour, gas and liquids.



# Opening Characteristics. Full-lift Safety Valve Pursuant to AD 2000 (Sheet A2.)

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

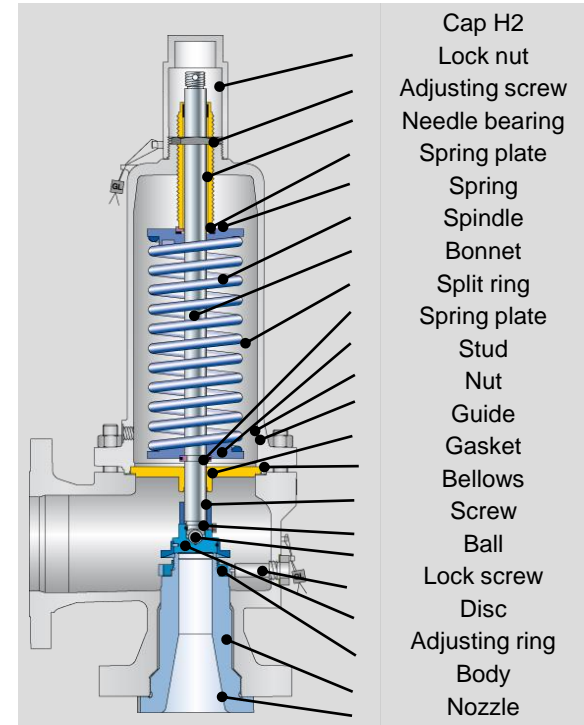
A spring-loaded full-lift safety valve opening suddenly within a pressure increase of 5%. Primarily used for gas, steam and vapour.



# Definition of Terms. Conventional Pressure Relief Valve.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

A *spring loaded* pressure relief valve whose **operational characteristics** are directly affected by **changes in the back pressure** on the valve.



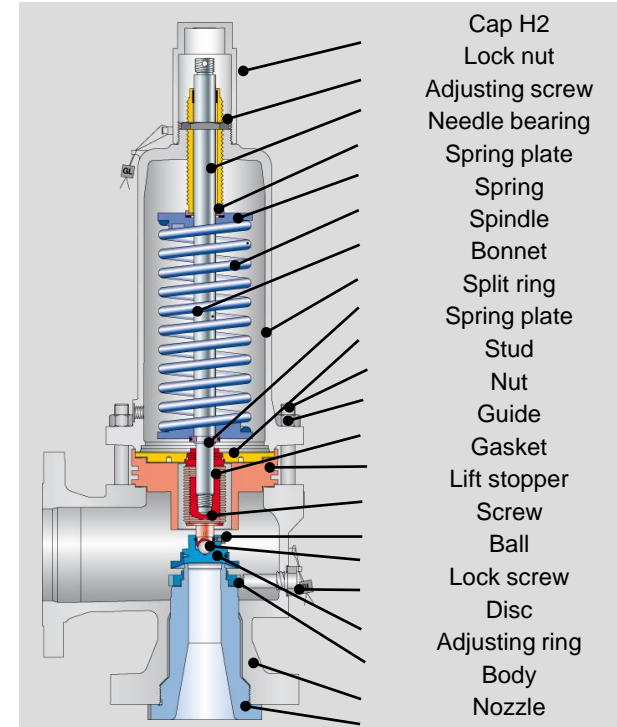
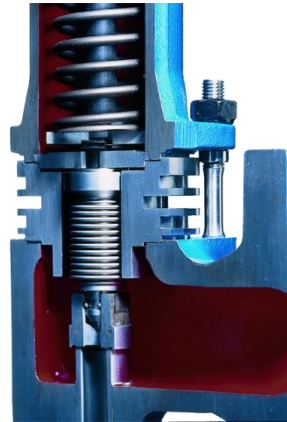
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# Definition of Terms. Balanced Pressure Relief Valve.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

A *spring loaded* pressure relief valve that **incorporates a bellows or other means** for minimizing the effect of back pressure on the operational characteristics of the valve.



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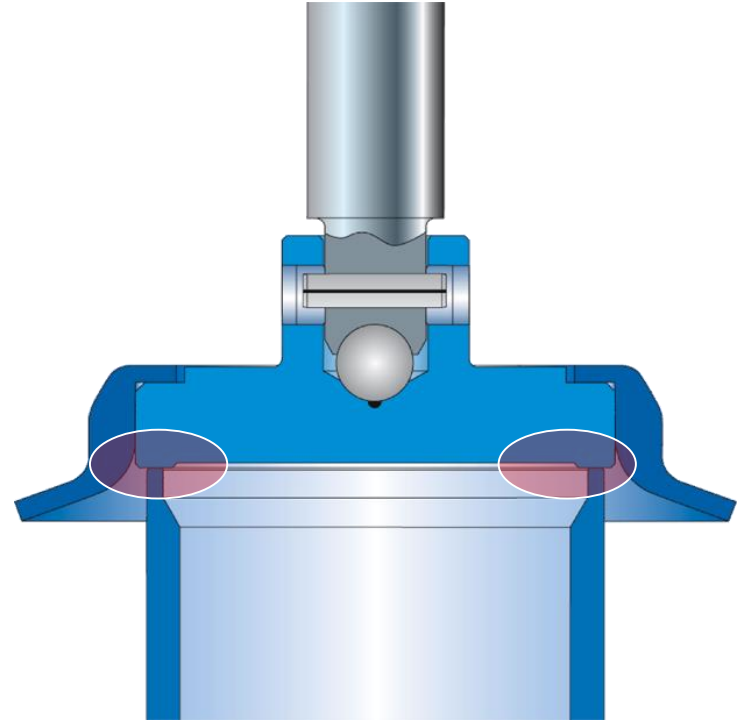
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## References. Valve Seat.

1. [Objectives](#) | 2. [Organizations and Associations](#) | 3. [Classifications](#) | 4. [Definitions](#) | 5. [Loading Principle](#) | 6. [Opening Characteristics](#) | 7. [Definition of Terms](#) | 8. [Back Pressure](#)

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The area of **contact between the valve nozzle and disc.**



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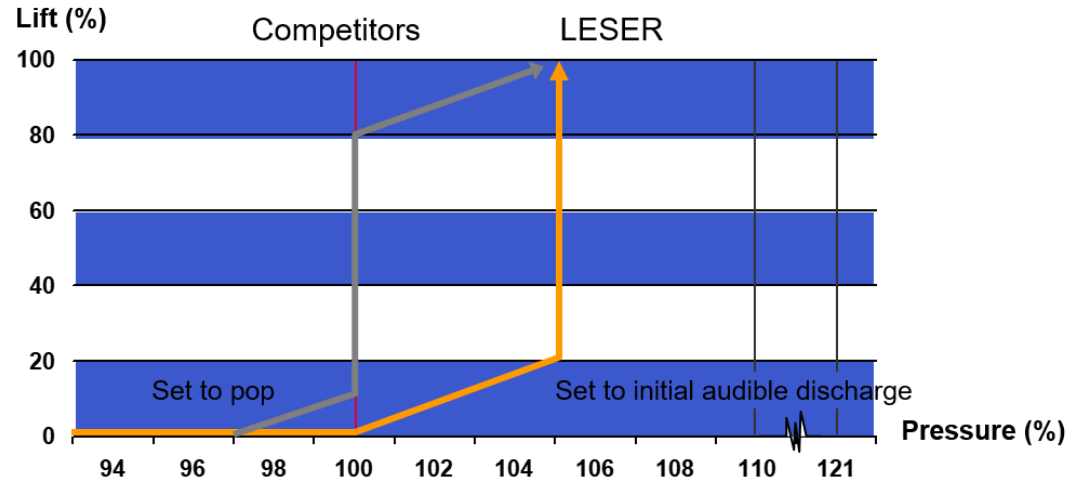


# Definition of Terms. Set Pressure.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

The **inlet gauge pressure** at which the Pressure Relief Valve is set to open.

- Each manufacturer defines set pressure differently
- LESER defines set pressure as:
  - Initial Audible discharge for vapor/gas/steam
  - First Steady Stream for liquids



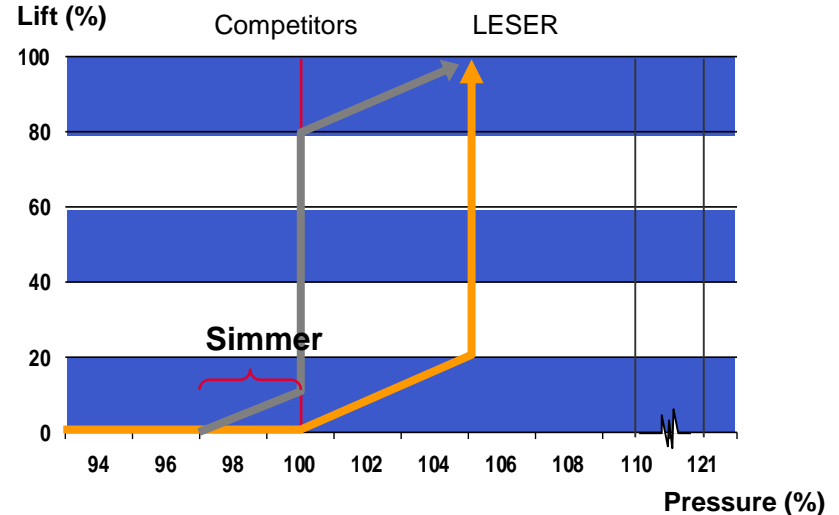
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# Definition of Terms. Simmer.

The **audible or visible escape of compressible fluid** between the seat and disc of the Pressure Relief Valve prior to set-point:

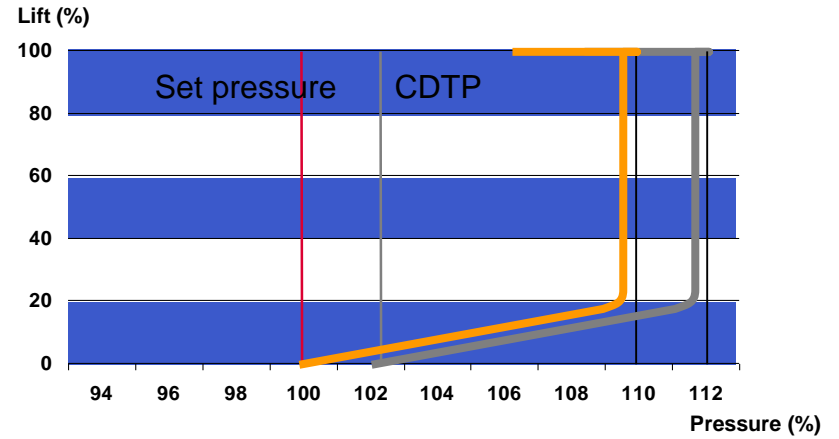
- **LESER valves do NOT simmer** before reaching the set pressure, unlike some of our competitors
- Competitor's typical values are between 93 and 98% (depending on valve design)



# Definition of Terms. Cold Differential Test Pressure (CDTP).

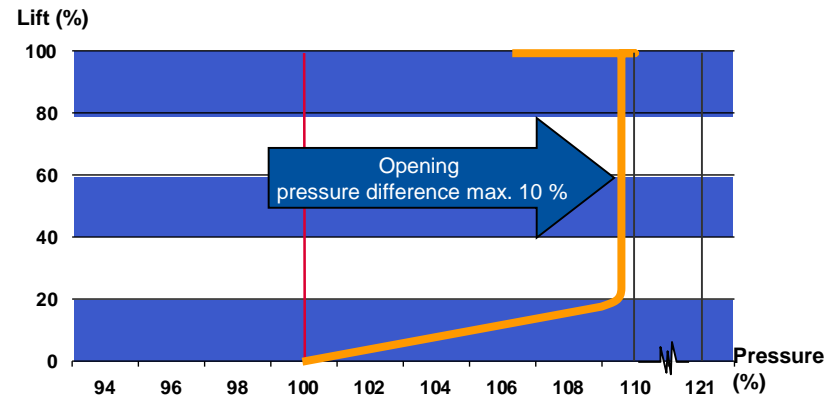
1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

The pressure at which a Pressure Relief Valve is **adjusted to open on the test stand**. It includes **corrections for the service conditions** of constant back pressure or temperature or both.



# Definition of Terms. Opening Pressure Difference.

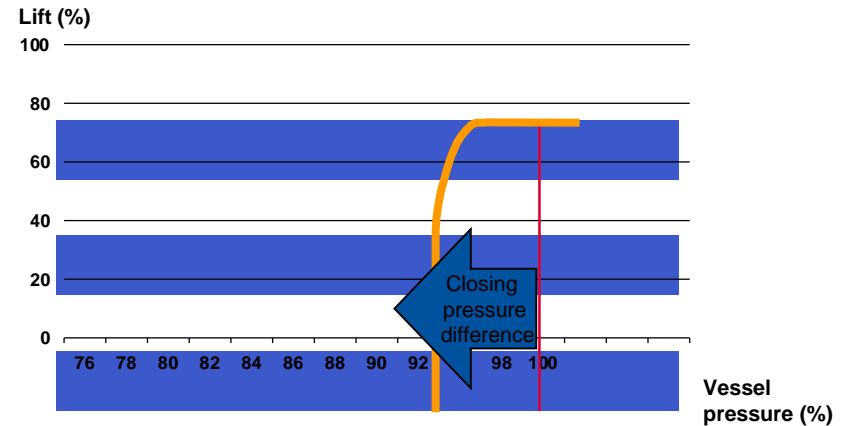
The **pressure increase over the set pressure** of the safety valve that thus allows the rated flow to be achieved.



# Definition of Terms. Closing Pressure Difference.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

The **difference between the set pressure and the closing pressure** of a safety valve (expressed as a percentage of set pressure).



# Definition of Terms.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

## ■ Maximum Allowable Working Pressure (MAWP)

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

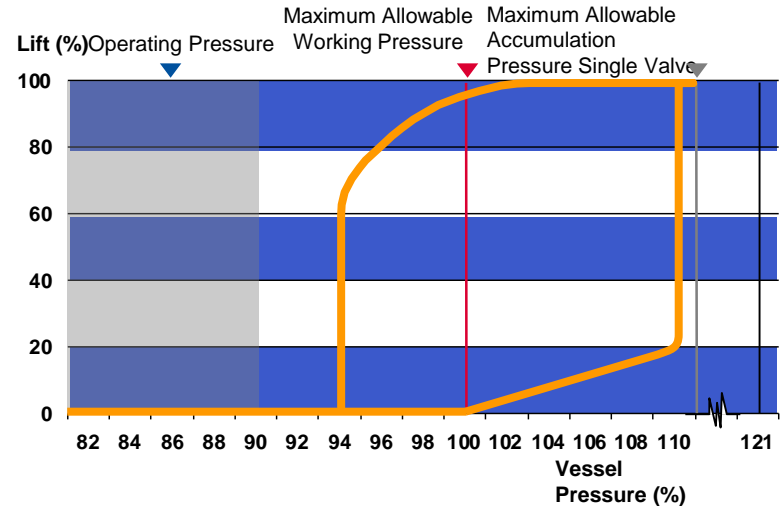
Design pressure may be used instead of MAWP in all cases where the MAWP has not been established. Design pressure is equal to or less than MAWP.

## ■ Accumulation

The pressure increase over the MAWP of the vessel allowed during discharge through the Pressure Relief Valve (governed by applicable codes).

## ■ Maximum Allowable Accumulated Pressure

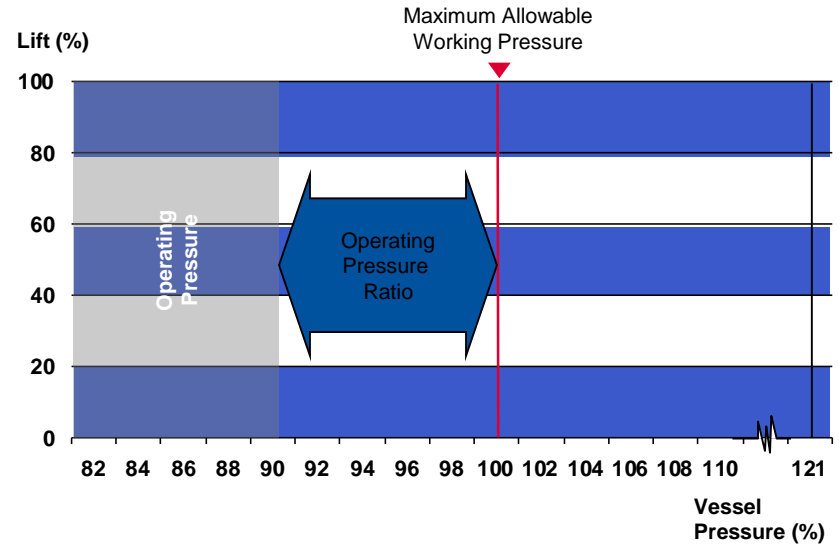
The sum of the MAWP and the accumulation.



# Definition of Terms. Operating Pressure Ratio.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

The **ratio of operating pressure** to set pressure.  
90% should not be exceeded.



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# Definition of Terms.

## ■ Flutter

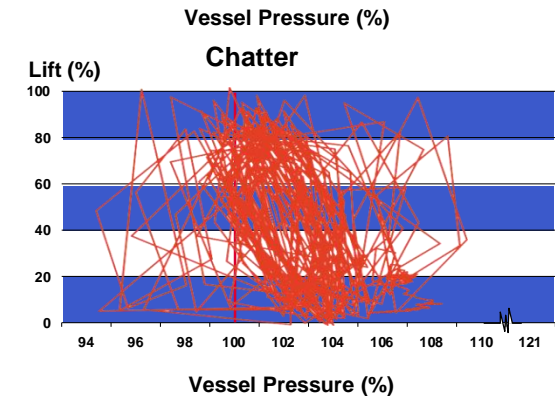
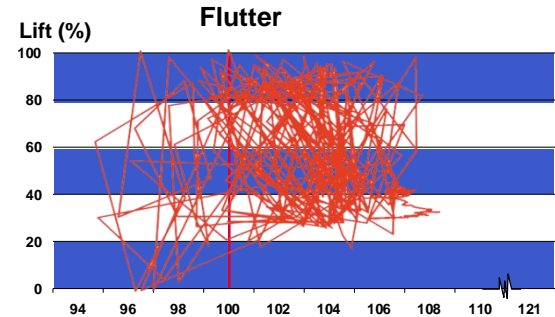
The **abnormal, rapid reciprocating motion of the movable parts** of a pressure relief valve in which the disc does **NOT** contact the nozzle

## ■ Chatter

The **abnormal, rapid reciprocating motion of the movable parts** of a pressure relief valve in which the disc **contacts** the nozzle

Possible causes for the above include:

- Inlet pressure drop too high
- Excessive back pressure
- Oversized valve

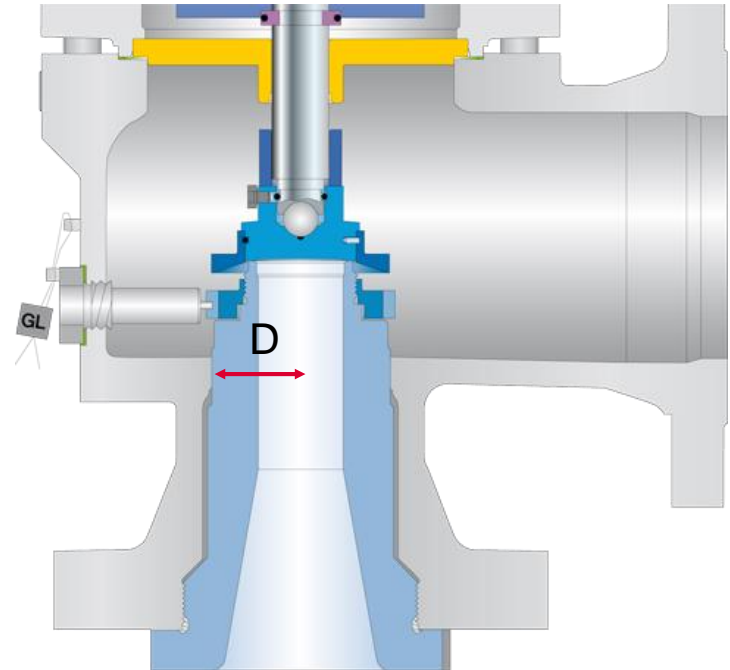




## Definition of Terms. Actual (ASME) Discharge area.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

The **minimum net area** that determines **the flow** through the valve.



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# Definition of Terms.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

## ■ Effective Discharge Area

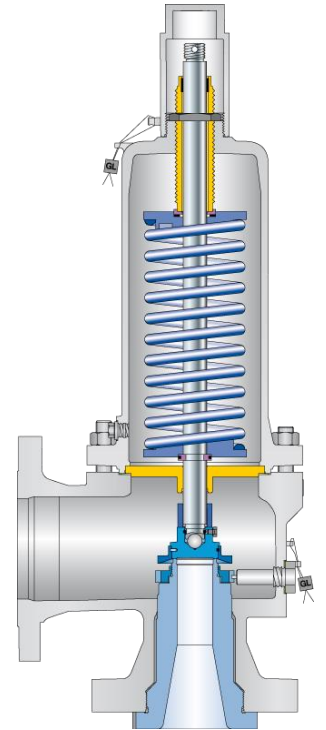
The theoretical area of flow through a pressure relief valve, as defined in API 526:

- independent of any specific valve design or manufacturer
- Used in API sizing calculations for orifice selection

## ■ Effective Coefficient of Discharge

The nominal value used with an effective discharge area to calculate the minimum required relieving capacity of a pressure relief valve:

- 0.975 vapor/gas/steam
- 0.65 liquids



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# Definition of Terms.

1. [Objectives](#) | 2. [Organizations and Associations](#) | 3. [Classifications](#) | 4. [Definitions](#) | 5. [Loading Principle](#) | 6. [Opening Characteristics](#) | 7. **Definition of Terms** | 8. [Back Pressure](#)

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- **Coefficient of Discharge ( $K_d$ )**

The actual discharge flow divided by the theoretical discharge flow

- **Rated Reduced Coefficient of Discharge ( $K_{dr}$ )**

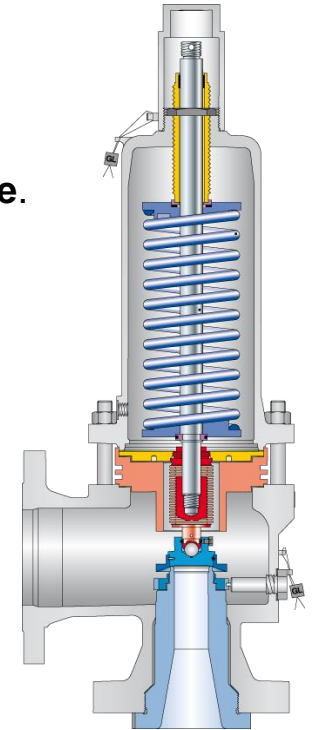
The product of the coefficient of discharge ( $K_d$ ) x 0.9.

The rated reduced coefficient of discharge is to be used for all sizing calculations.

# Definition of Terms. LESER Effective Orifice (LEO) area.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

- Pressure relief devices may be initially sized using the **API effective coefficient of discharge** (S/G 0.975, L 0.650) **and effective areas** (acc. to API Std. 526), which are independent of any specific valve design.
- In this way the engineer can **determine a preliminary pressure relief valve size**. By using the **LESER Effective Orifice (LEO)**, the engineer can conveniently select a LESER safety relief valve after calculating the API required orifice area.
- **Where:**
  - **LEO<sub>S/G</sub>** = LESER Effective Orifice (for steam, gas and vapor) [inch<sup>2</sup>]
  - **LEO<sub>L</sub>** = LESER Effective Orifice (for liquid) [inch<sup>2</sup>]
  - **K** = de-rated coefficient of discharge, taken from Red Book Pressure Relief Device Certifications (NB-18)
  - **A<sub>0</sub>** = actual orifice [in<sup>2</sup>]



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# Definition of Back Pressure.

1. Objectives | 2. Organizations and Associations | 3. Classifications | 4. Definitions | 5. Loading Principle | 6. Opening Characteristics | 7. Definition of Terms | 8. Back Pressure

## ■ Back Pressure

The pressure that exists at the outlet of a Pressure Relief Valve as a result of the pressure in the discharge system. It is the sum of the superimposed and built-up back pressures.

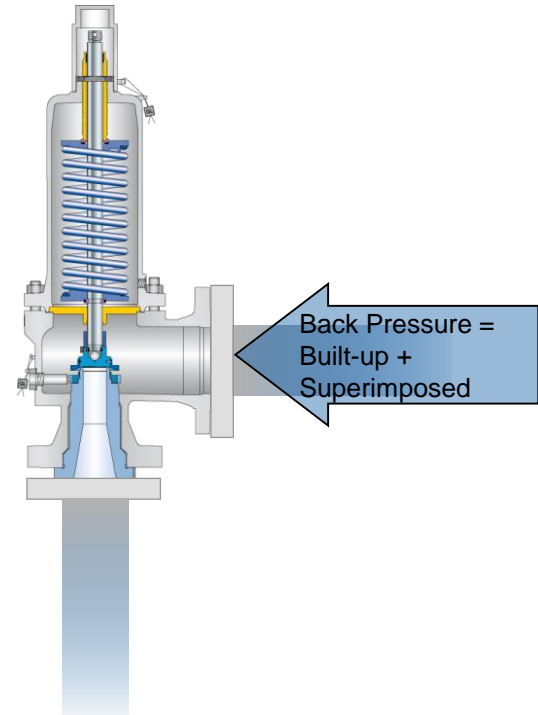
## ■ Built-up Back Pressure

The increase in pressure at the outlet of a Pressure Relief Valve that develops as a result of flow after the Pressure Relief Valve opens. Always variable!

## ■ Superimposed Back Pressure

The static pressure that exists at the outlet of the Pressure Relief Valve at the time the valve is required to operate. It is the result of pressure in the discharge system coming from other sources and may be constant, variable or both.

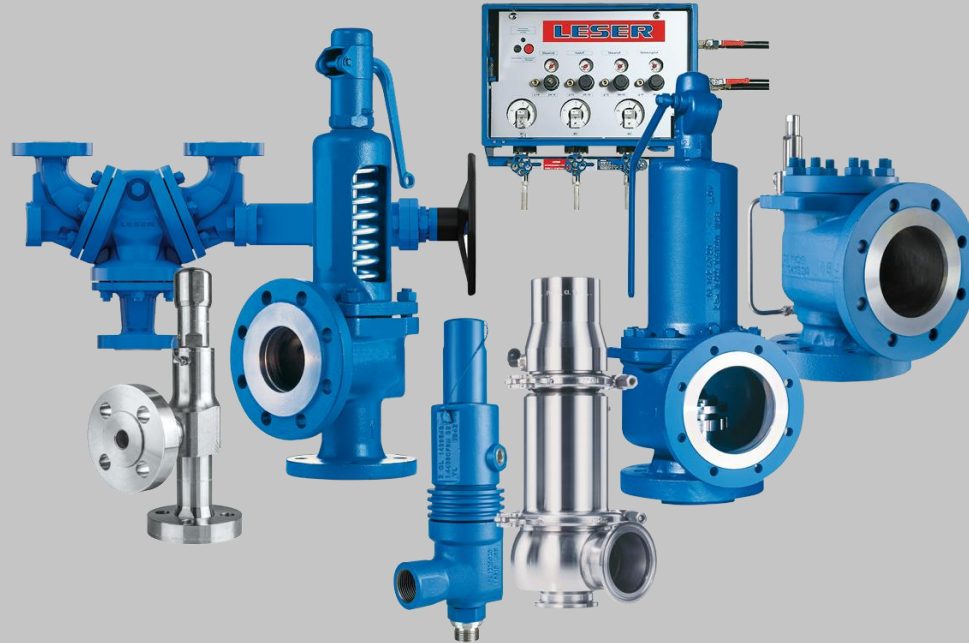
Note: The variable portion of the back pressure should not exceed the allowable accumulation; otherwise, a bellows or Pilot-Operated Safety Valve should be used.



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**Terminology**  
Thank you for your attention.



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