# PROTEGO® Braunschweiger Flammenfilter GmbH

**Excellence in Safety and Environment**

# Optimization of Terminal Safety and Operation

# by using the newest Relief Valve Technology

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# Do we need to protect storage tanks ?

# What kind of challenges are we facing ?


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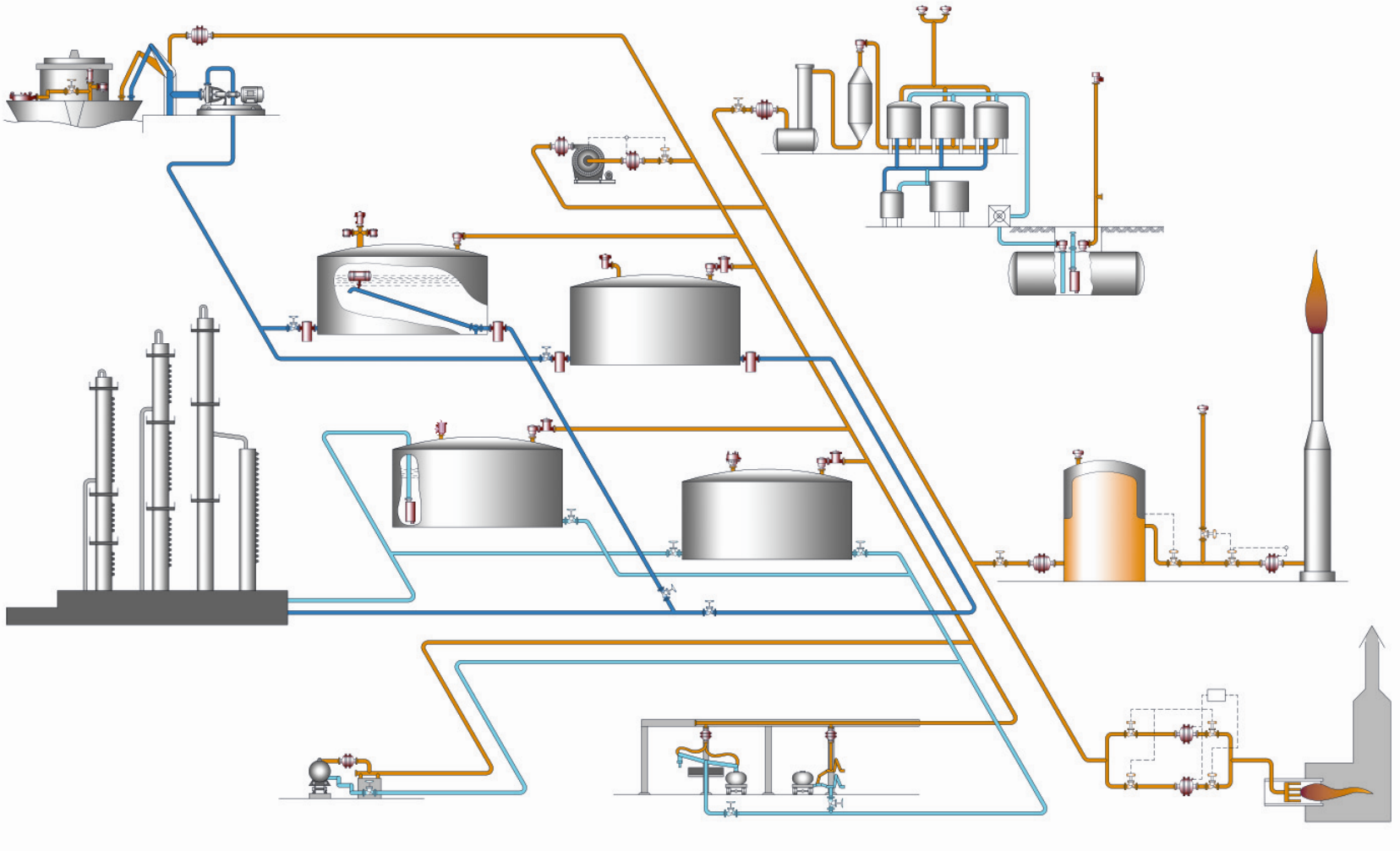
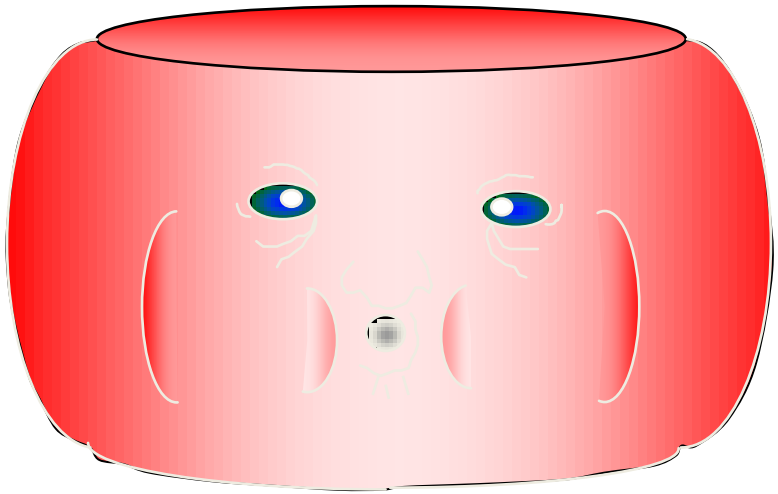
# PROTEGO® Anwendungsbeispiele / Application Examples

## Flammendurchschlagsicherungen und Ventile / Flame arresters and valves



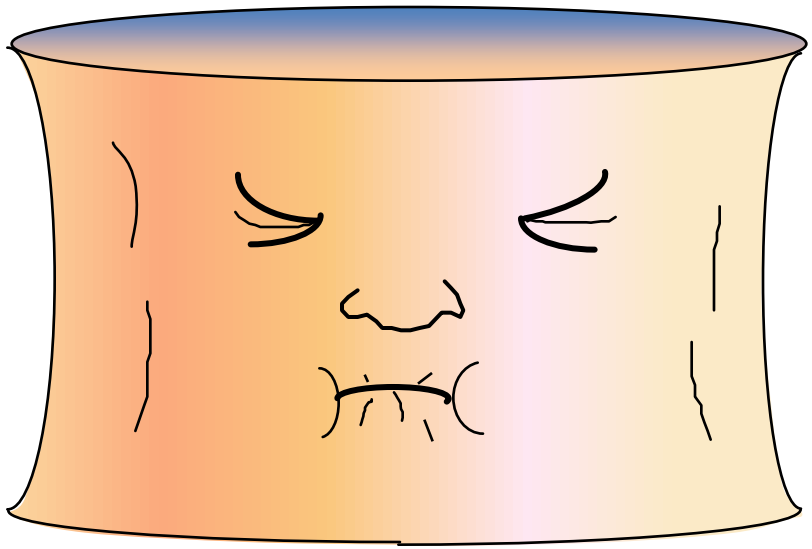
# Why Overpressure Protection ?

- Pressure rise due to filling of tank (Pump - In)
- Pressure Rise due to thermal expansion (can be significant with large tank)
- Pressure rise due to control valve failure (such as tank blanketing regulator)
- Pressure rise due to atmospheric pressure decrease
- Pressure rise due to external fire

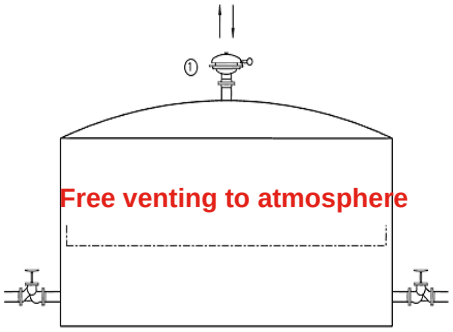


# Why Vacuum Protection?

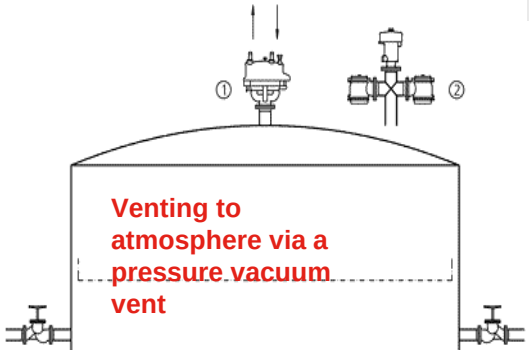
- Vacuum from tank outflow (Pump - Out)
- Vacuum from cooling (such as thunderstorm)
- Vacuum from vapour condensation
- Vacuum from atmospheric pressure increase



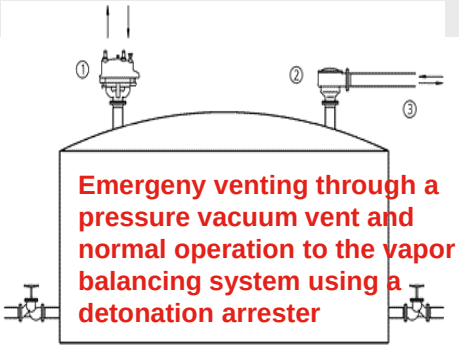
# Safeguarding Examples for Storage Tanks



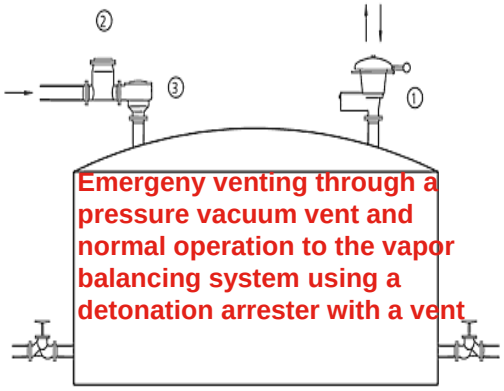
Free venting to atmosphere



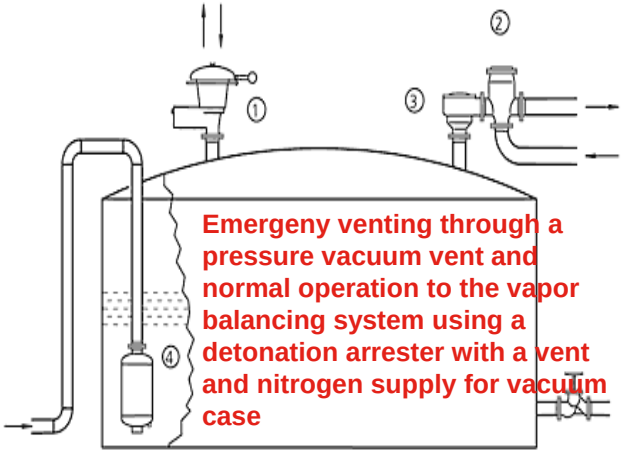
Venting to atmosphere via a pressure vacuum vent



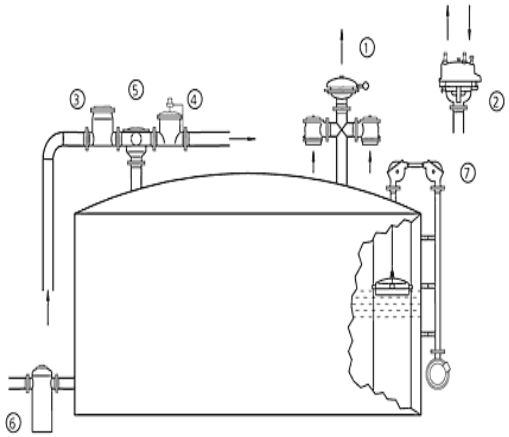
Emergeny venting through a pressure vacuum vent and normal operation to the vapor balancing system using a detonation arrester

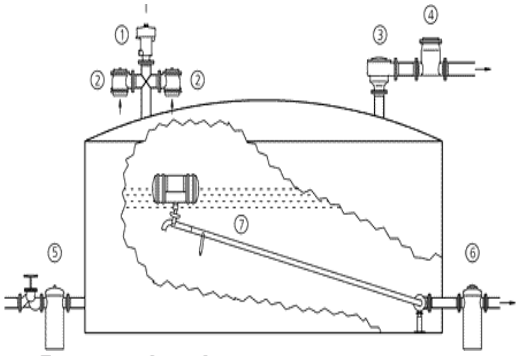


Emergeny venting through a pressure vacuum vent and normal operation to the vapor balancing system using a detonation arrester with a vent



Emergeny venting through a pressure vacuum vent and normal operation to the vapor balancing system using a detonation arrester with a vent and nitrogen supply for vacuum case

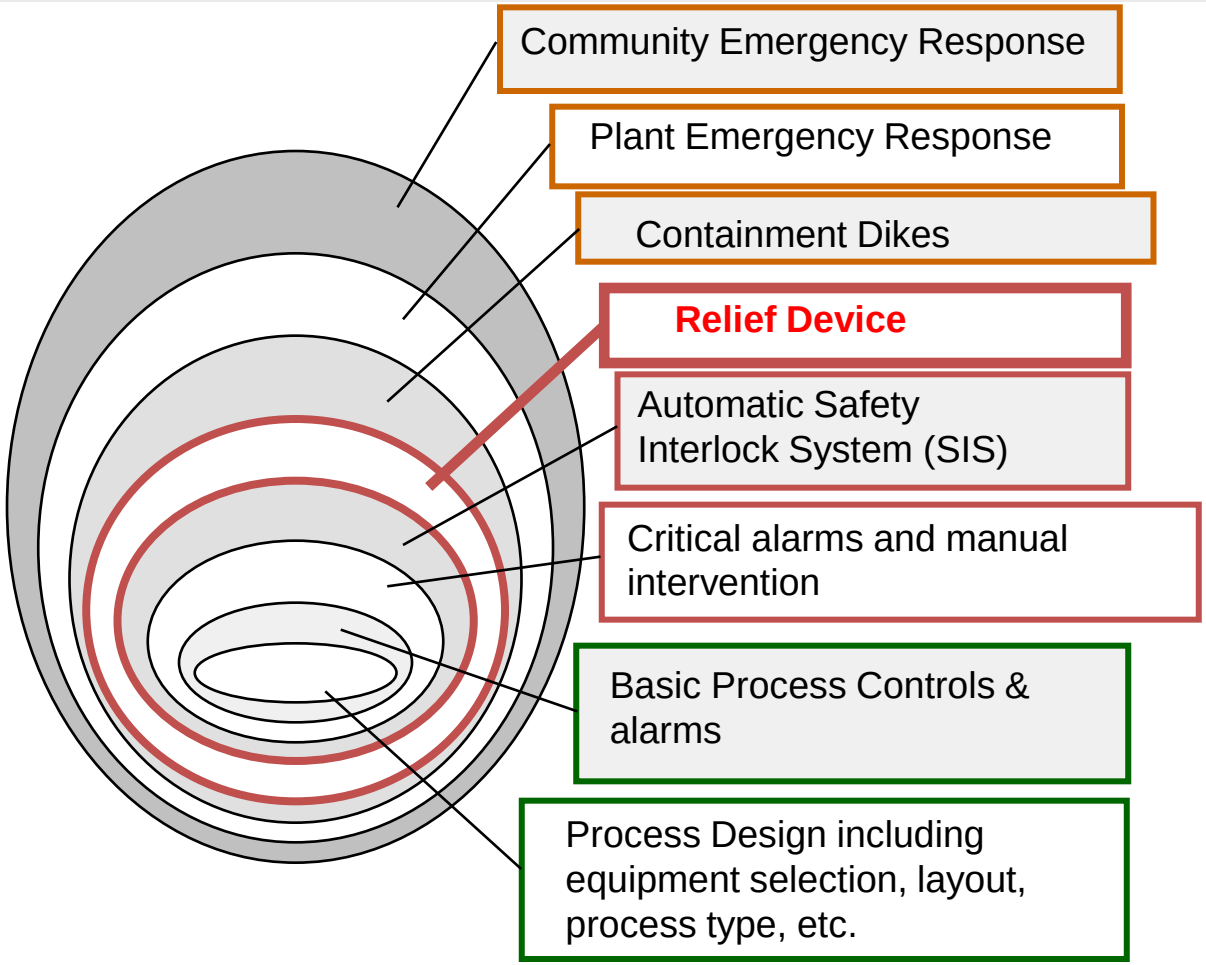




What we do to protect storage tanks depends on the operational requirements and the governing laws, standards and regulations!

# Tank Terminals need a proper protection against overpressure and underpressure

# Relief Systems are one Layer of Protection



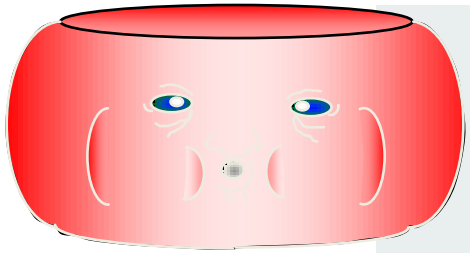
# Emission Reduction through breathing loss minimization

**“The Function of the P/V Vent is to keep the vapor space closed during variations in the atmospheric pressure and/or temperature decrease in spite of pertinent changes of gas volume and pressure, until that time when a technically admissible low or high pressure is reached”**

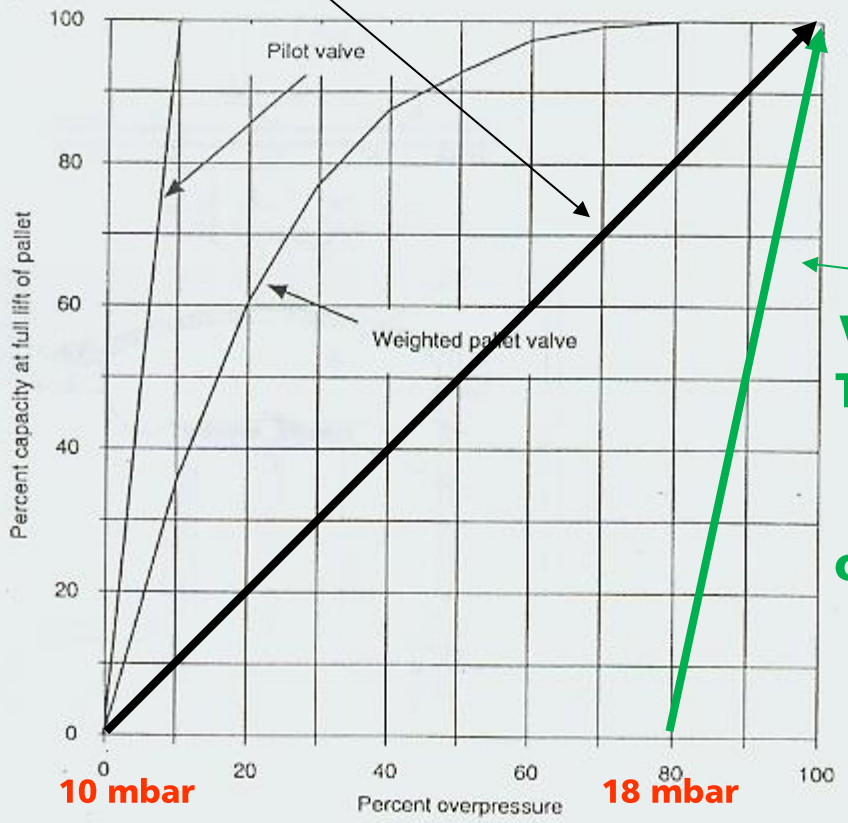
**<u>Goal:</u> avoid intake of ambient air and discharge of product/air mixture**

# Selection of Pressure Relief Valve

**Vent valves in acc. to API Standard 2000 with 100% overpressure**



**20 mbar** Opening pressure




**10 mbar** **18 mbar**

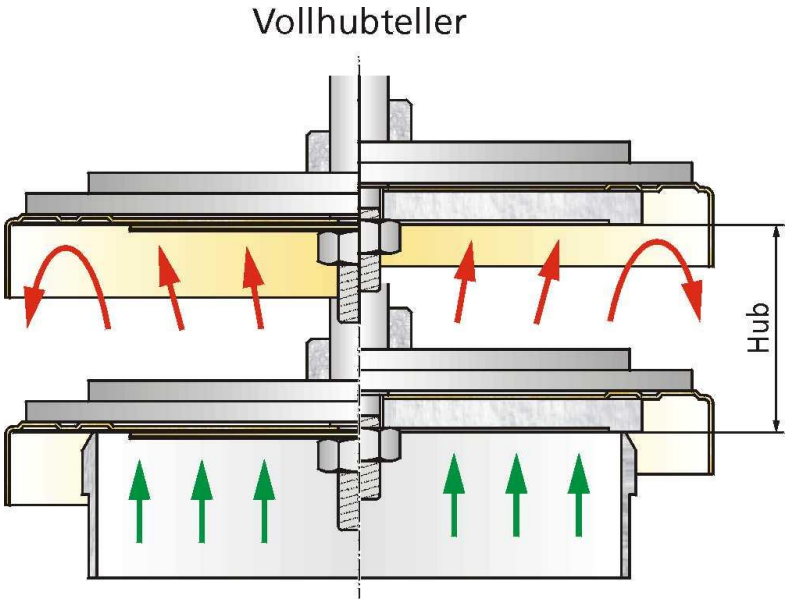
Figure C-5—Capacity/Overpressure Characteristic of Vent

**Vent Valves with 10% Technology difference from set pressure (Start open) to opening pressure (full open)**

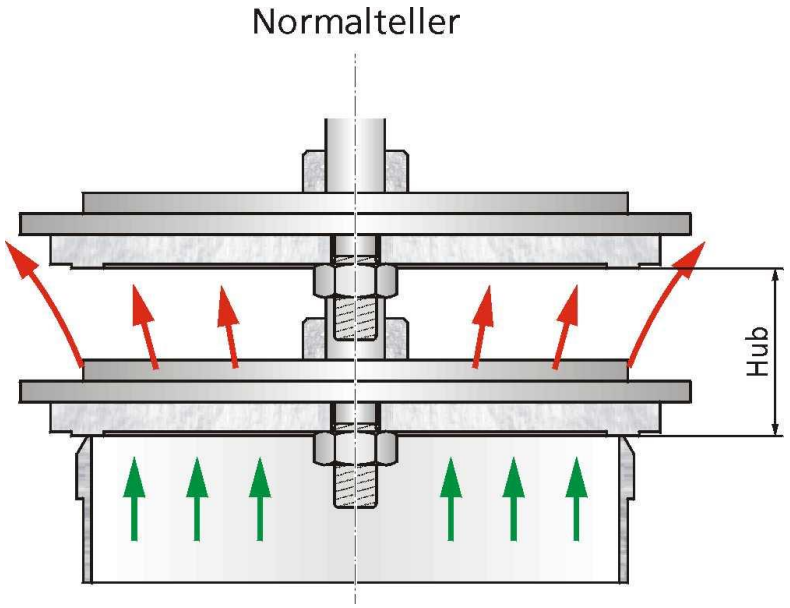
**Valve set pressure to be adjusted**

# Difference between 10% and 100%- Technology

Difference between Full lift and proportional pallet




Function with lifting cover

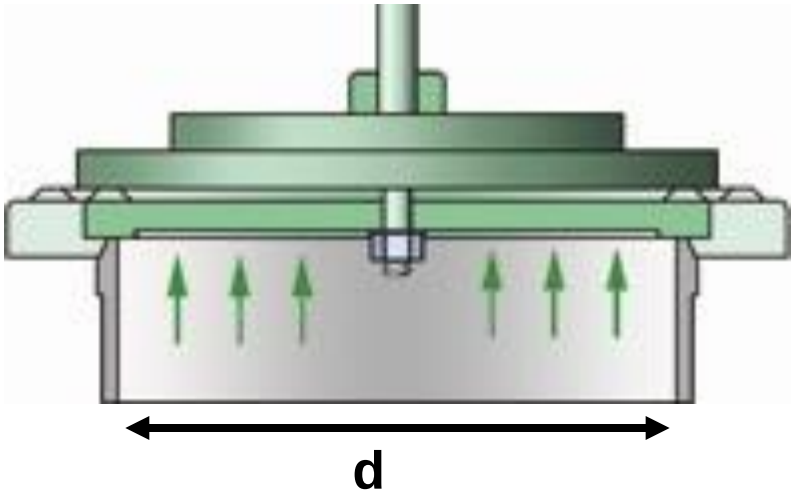


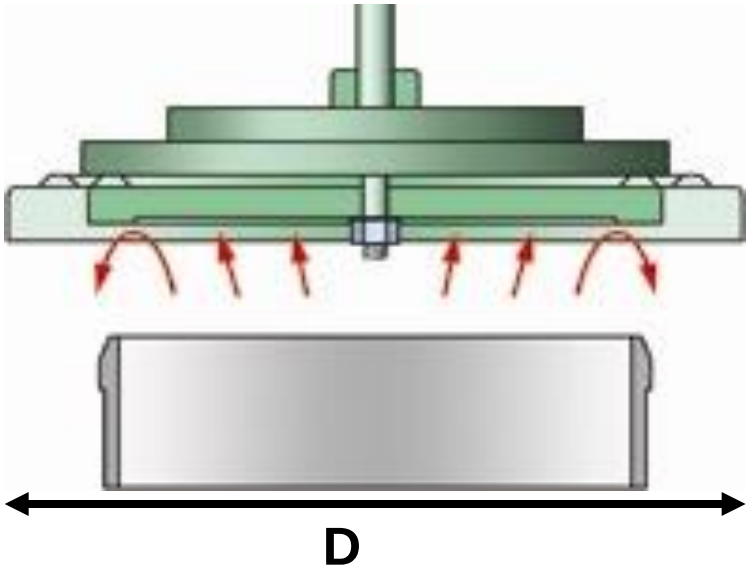

Function without lifting cover

# Proportional Valve

# Full lift type valve (Safety Relief Valve)

# Blow Down needs to be considered when sizing




**d < D**

$$p_{set} = \frac{F}{A} = \frac{F}{\frac{\pi \cdot d^2}{4}}$$

$$p_{reseat} = \frac{F}{A} = \frac{F}{\frac{\pi \cdot D^2}{4}}$$

$$p_{set} > p_{reseat}$$

# Opening pressure versus closing pressure

(by using 10% technology)

Pset,PV = 14,9 mbarg

Popen,PV = 16,4 mbarg

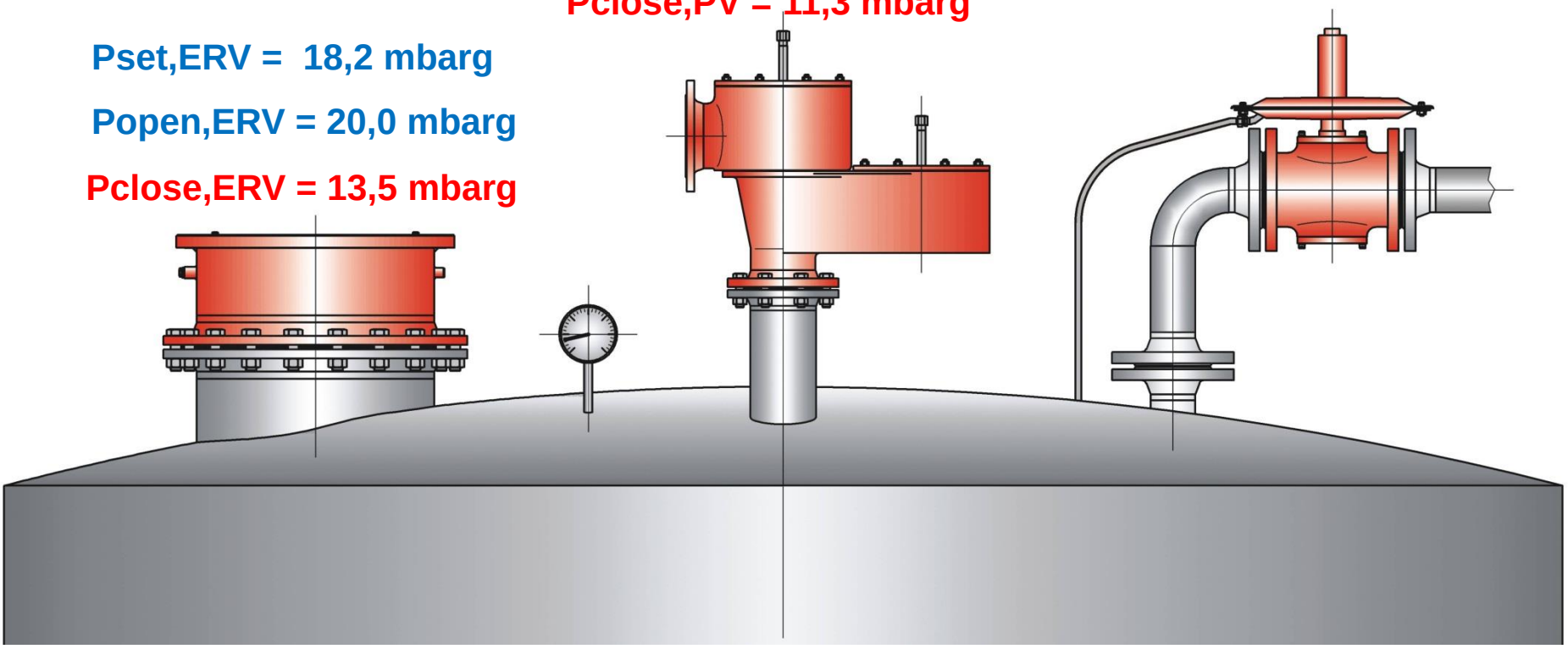
Pclose,PV = 11,3 mbarg

Pset,N2 = 10,4 mbarg

Pset,ERV = 18,2 mbarg

Popen,ERV = 20,0 mbarg

Pclose,ERV = 13,5 mbarg



**Example:** **API 650 / EN 14015 Tank with a design pressure of +20 mbarg**

# Opening pressure versus closing pressure

(by using 100% technology)

Pset,PV = 3,8 mbarg

Popen,PV = 7,6 mbarg

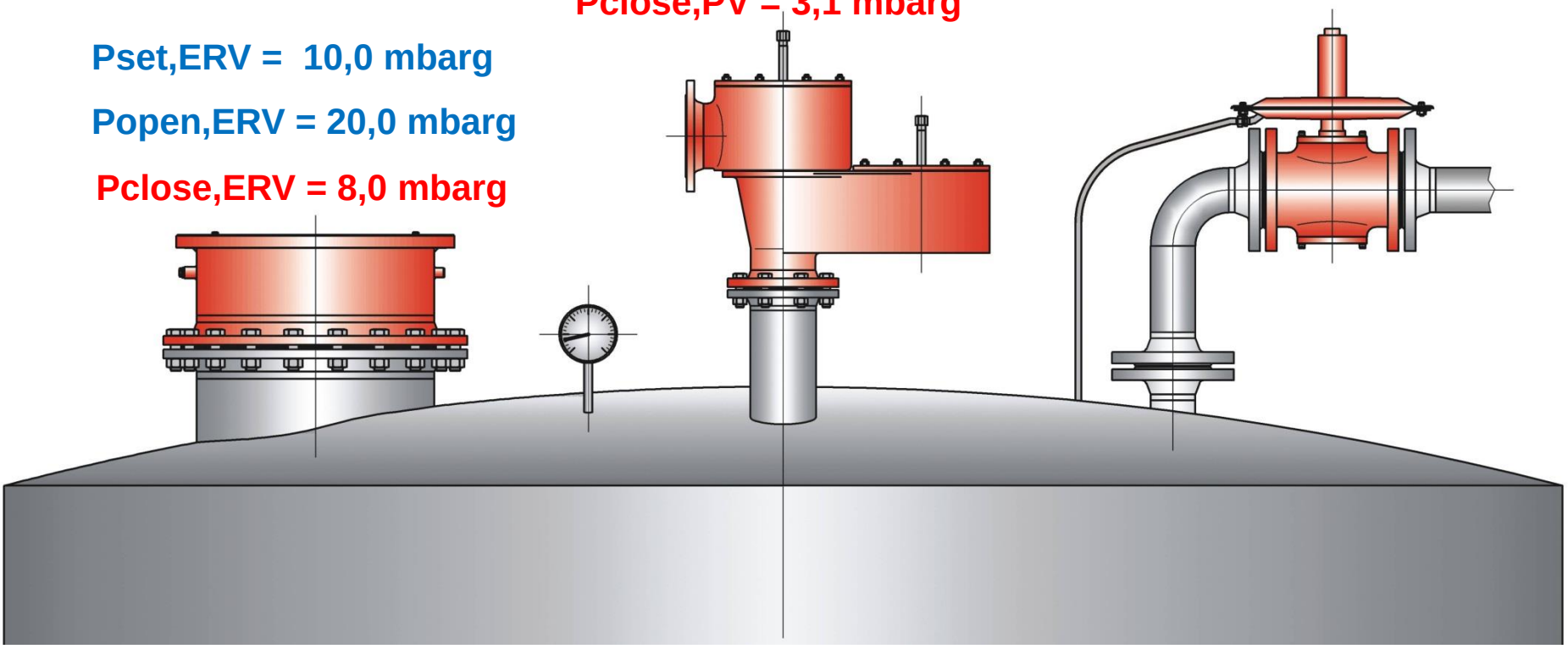
Pclose,PV = 3,1 mbarg

Pset,N2 = 2,6 mbarg

Pset,ERV = 10,0 mbarg

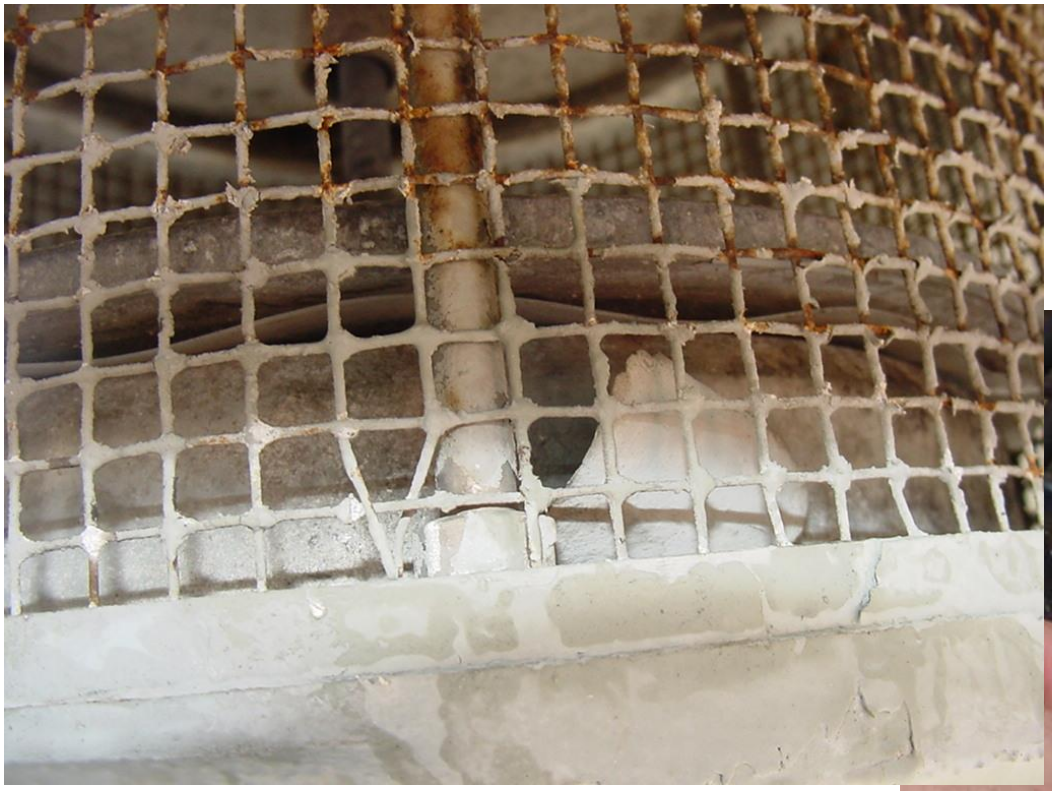
Popen,ERV = 20,0 mbarg

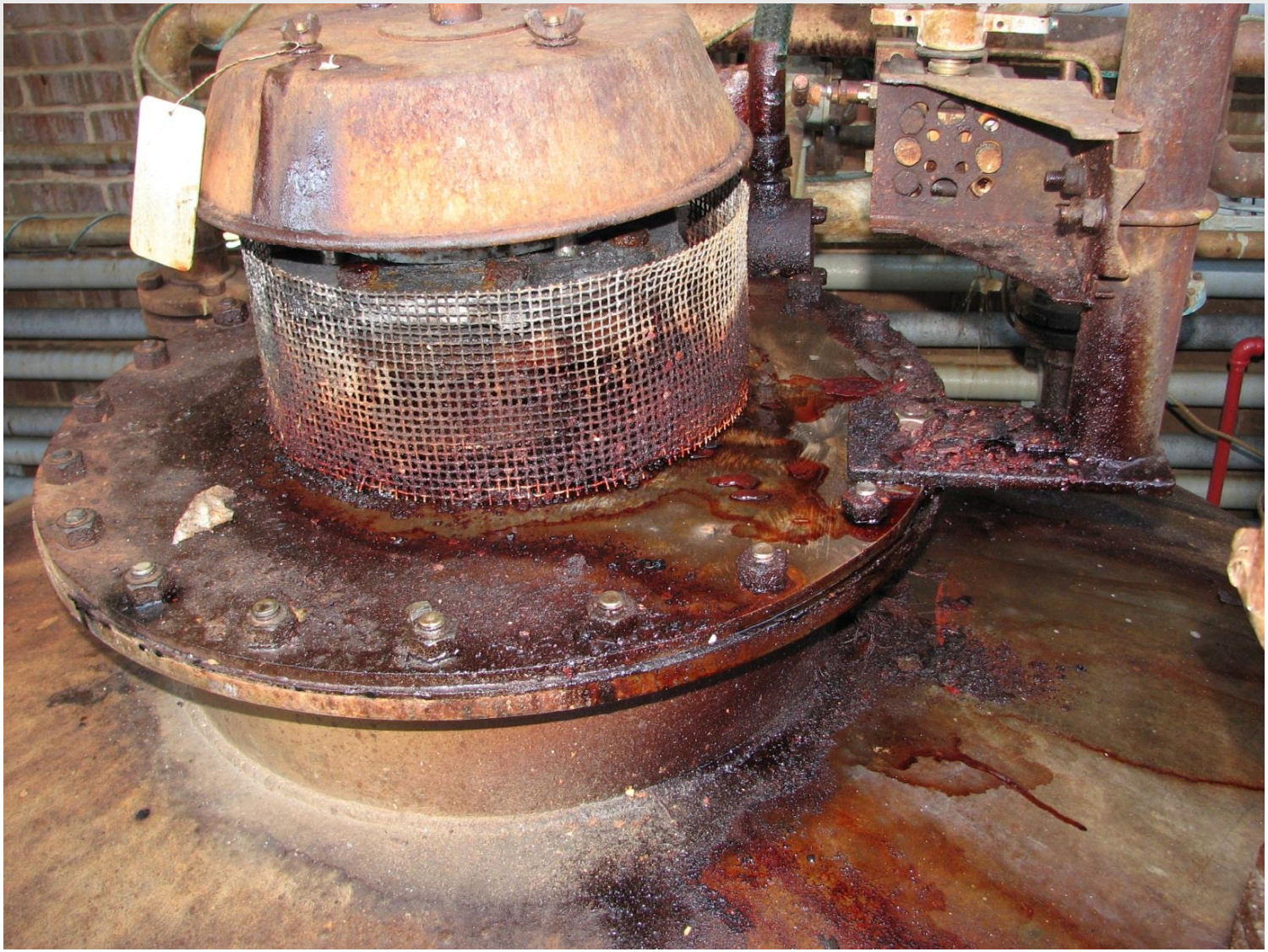
Pclose,ERV = 8,0 mbarg



**Example:** **API 650 / EN 14015 Tank with a design pressure of +20 mbarg**

# Influence of Quality to Explosion protection and Emission reduction?





# Avoid secundary damage!

**High leakage rates will result in safety issue!**

**Movie with infrared camera**

# A large test facility is required to determine true operational behavior of valves

max. volume flow :
15000 m³/h

max. pressure:
1300 mbarg

min.  pressure:
500 mbarg

connections:
DN 25 … 1000

# A large test facility is required to determine true operational behavior of valves

# Testing of valves under extreme conditions

# Testing Pilot-Operated Valves for cryogenic service to the extreme – Cryogenic relief -

# Thank you for your attention

**Trust in Quality !!**

**Trust in Safety !!**