

No Substitute for Safety

(pressure vacuum valves cannot be used as flame arresters)

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Contradiction of different standards:

- **API 2000 5th Edition 1998:**

A flame arrester is not considered necessary for use in conjunction with a pressure vacuum valve venting to atmosphere because flame speeds are less than vapor velocities across the seat of the pressure vacuum valve

- **TRbF 20 (German standard):**

clearly calls for flame arresters for tanks that contain liquids that can create an explosive atmosphere

- **Factory Mutual (Insurance and approval company)**

requires installation of flame arresters on tanks which store liquids with a flash point at or below 43 °C or on tanks which heat the stored liquid to its flash point

ISO 28300

Petroleum, petrochemical and natural gas industries –
Venting of atmospheric and low-pressure storage tanks

Goal of the ISO 28300 standard:

- **This standard covers the venting of atmospheric and low pressure storage tanks**
- **This standard shall replace API 2000 5th Edition 1998**
- **This standard shall consider all state of the art knowledge concerning tank venting and safety and provide best practice to the user**

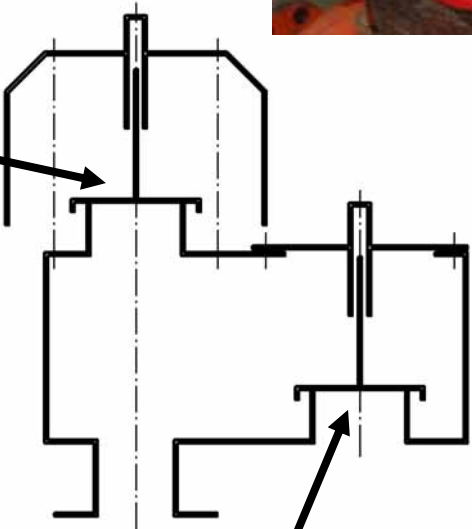
Conclusion of ISO 28300 committee regarding atmospheric explosion protection of storage tanks:

- Research work is needed due to contradicting standards and opinions on the ISO 28300 committee
- ISO 16852 shall apply as test standard
- Two types of test are needed:
 - A) atmospheric deflagration test
 - B) continuous burn test

5 major vent manufacturers where tested



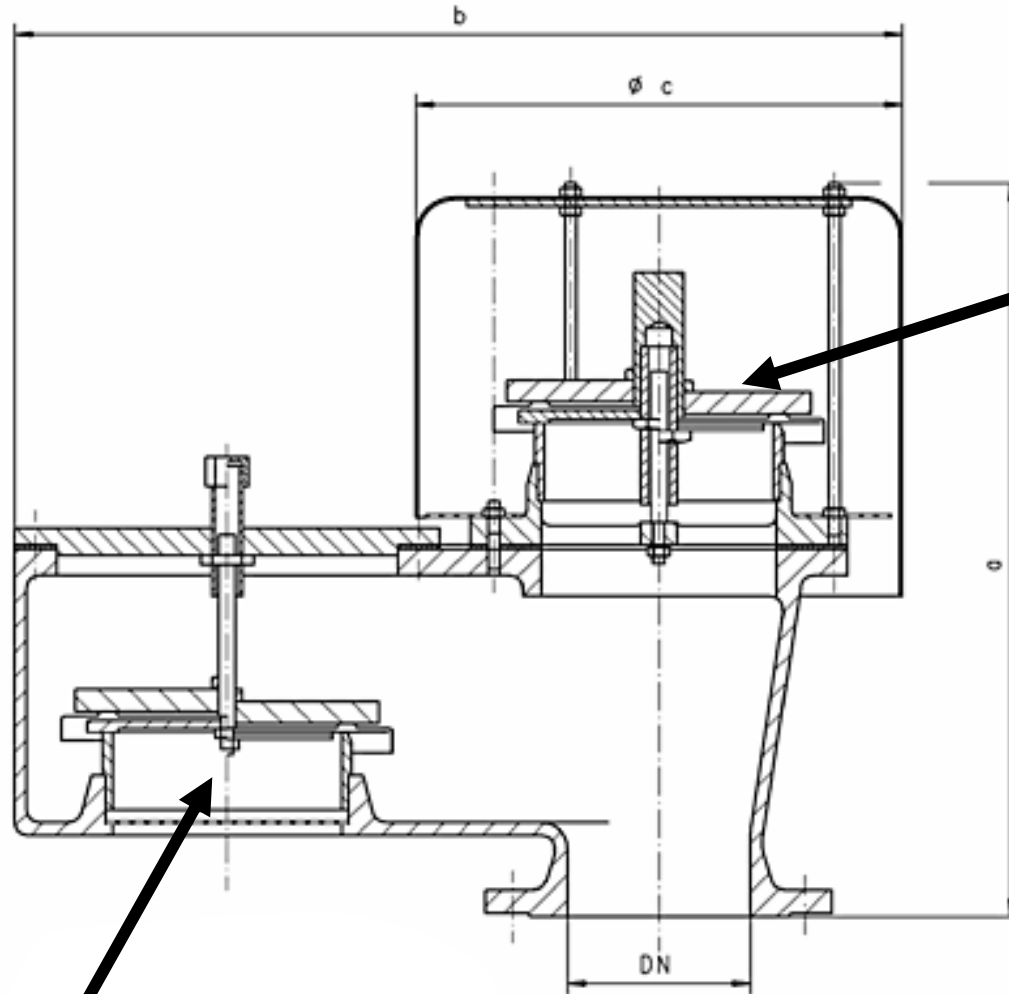
pressure
pallet



vacuum
pallet



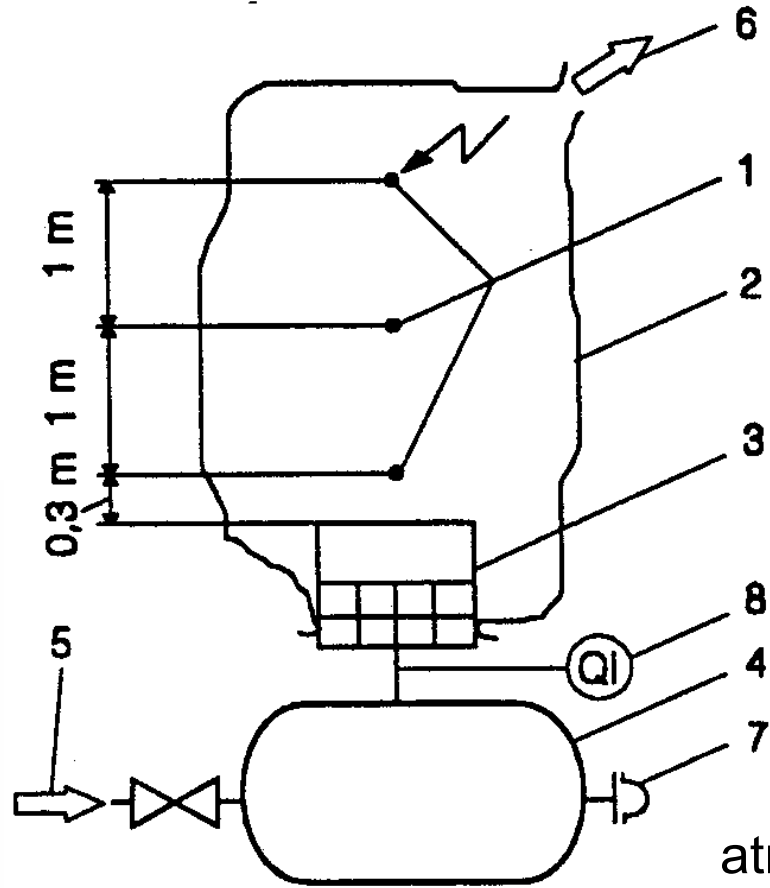
Typical settings for API 650 tanks



set pressure:
10 mbar
(4.0 in WC)

set vacuum: -2 mbar (-0.8 in WC)

Atmospheric Deflagration - Test set-up



- 1 ignition source
- 2 plastic bag \varnothing 1,2 m, length 2,5m
foil thickness $>0,05$ mm
- 3 conservation vent
- 4 explosion proof container
- 5 mixture inlet with shut-off valve
- 6 mixture outlet
- 7 bursting diaphragm

atmospheric deflagration test of end-of-line flame arrester as described in ISO 16852 part 7.3.2.1 and EN 12874 part 6.3.2.1

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Atmospheric Deflagration – Test No 1

P/V VALVE

4,2 vol% propane
in air

28.03.2007



Atmospheric Deflagration – Test No 2

P/V VALVE

5,5 vol%
propane in air

28.03.2007



Braunschweig
Flamme



for safety and environment

Atmospheric Deflagration – Test No 3

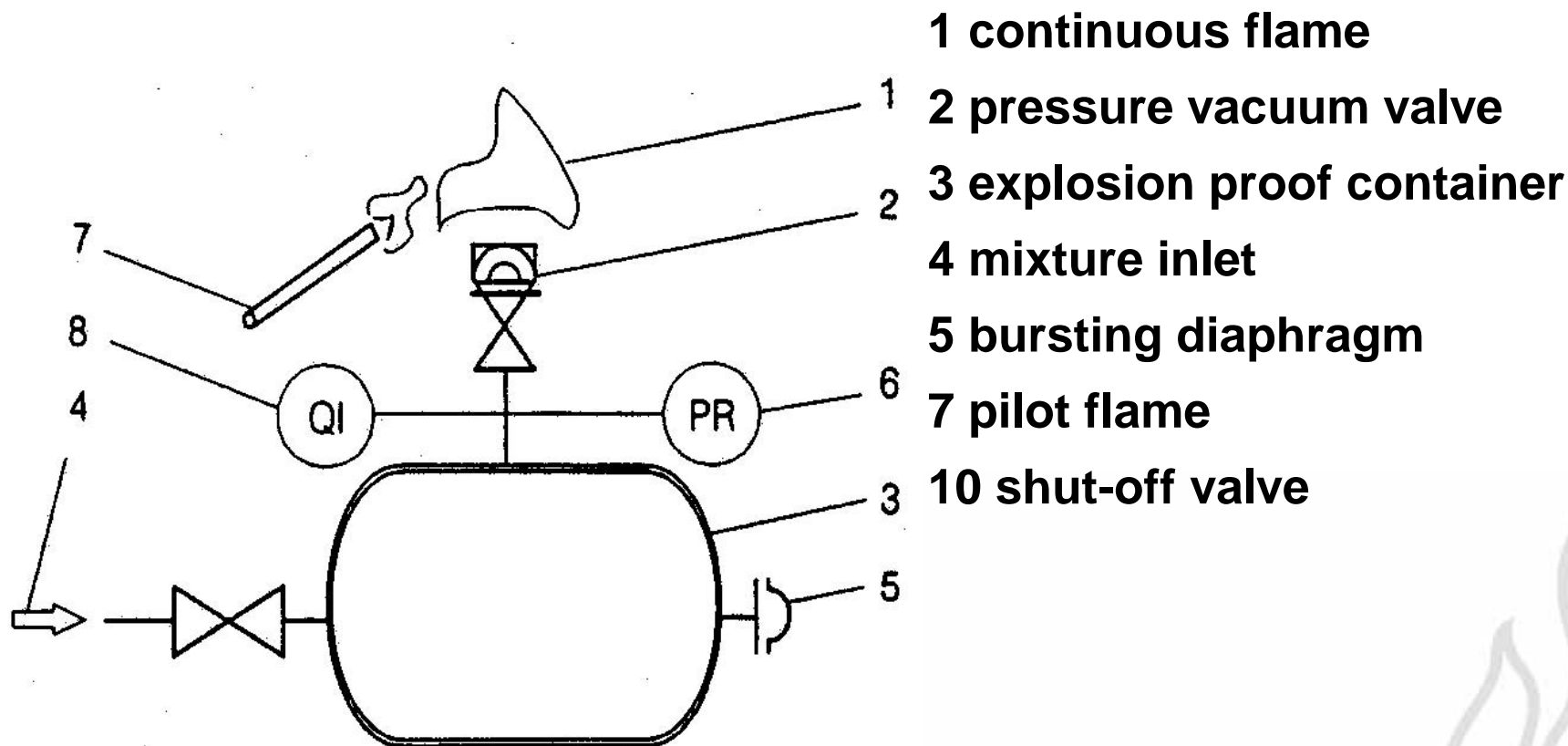
P/V VALVE

6,0 vol%
propane in air

28.03.2007



High Velocity Burning - Test set-up



Flame transmission test for high velocity vent valves as described in ISO 16852 part 9.2. and EN 12874 part 9.2.



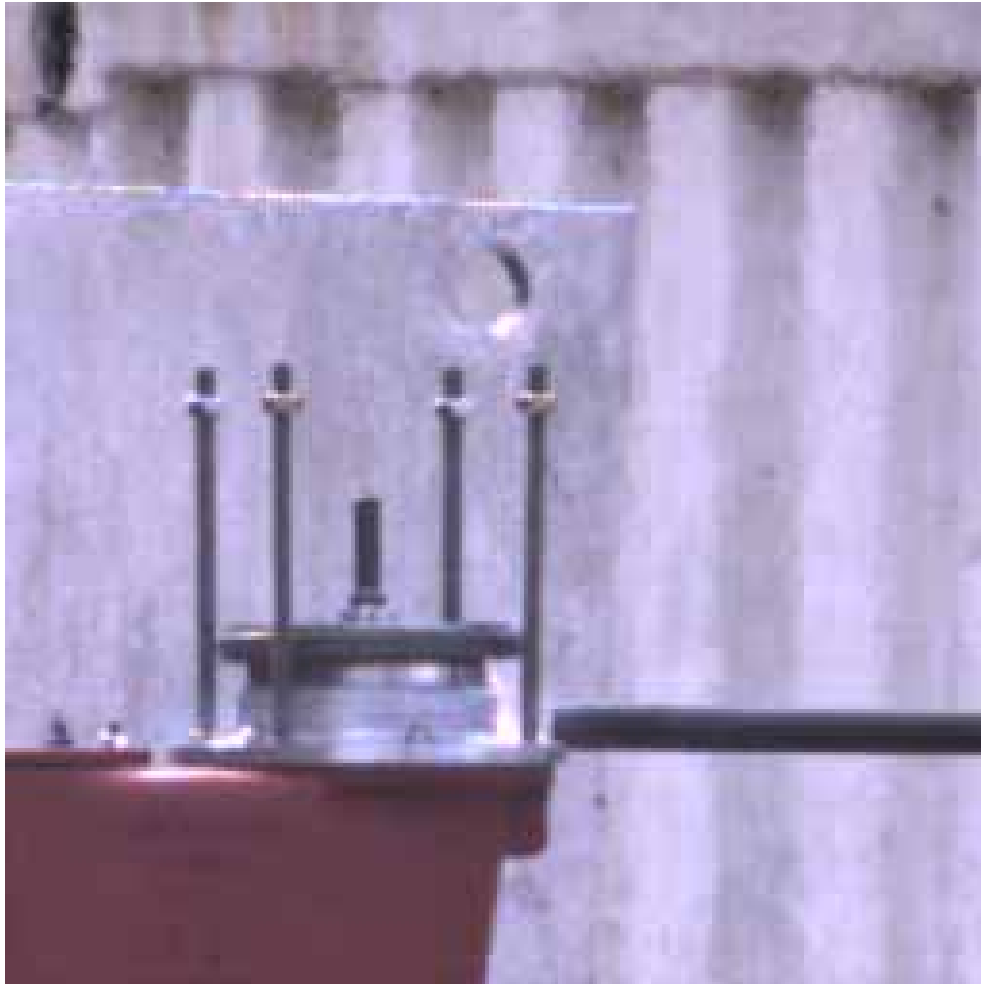
High Velocity Burning – Test No 4

P/V VALVE

**stoichiometric
propane air mixture**

$V = 85 \text{ m}^3/\text{h}$

28.03.2007



High Velocity Burning – Test No 5

P/V VALVE

**stoichiometric
propane air mixture**

$V = 100 \text{ m}^3/\text{h}$

28.03.2007

Recommendation of ISO 28300 regarding explosion prevention:

- Different tank selection
- Inert gas blanketing
- Flame arresters
- **Pressure vacuum valves**

Testing has demonstrated that a flame can propagate through a pressure vacuum valve and into the vapour space of the tank. Tests have shown that ignition of a PV's relief stream (possibly due to a lightning strike) can result in a flash back to the PV with enough overpressure to lift the vacuum pallet causing the flame to enter the tank's vapour space. Other tests have shown that under low flow conditions a flame can propagate though the pressure side of the PV, ..

Final Conclusion

- p/v valves cannot stop an atmospheric deflagration
- p/v valves are not able to stop a flame by dynamic effects

hence:

- p/v valves cannot substitute flame arresters
- p/v valves are not high velocity vent valves
- only devices approved according flame arrester standards* are flame arresters

* ISO 16852, EN 12874, USCG 33 CFR part 154, CSA Z343-98

**Thank you
for the opportunity to present !**

Questions?

Example Methanol:

(ignitable temperature range is within normal storage conditions)

- Vapor pressure: 30 kPa LFL: 5.5 vol% UFL: 26.5 vol%

Explosion hazard of Methanol

