Associazione Italiana Strumentisti

ISA Italy Section

Associazione Termotecnica Italiana
Sezione Lombardia

Giornata di studio per Dispositivi di Sicurezza

INTRODUZIONE ALLE VALVOLE DI SICUREZZA

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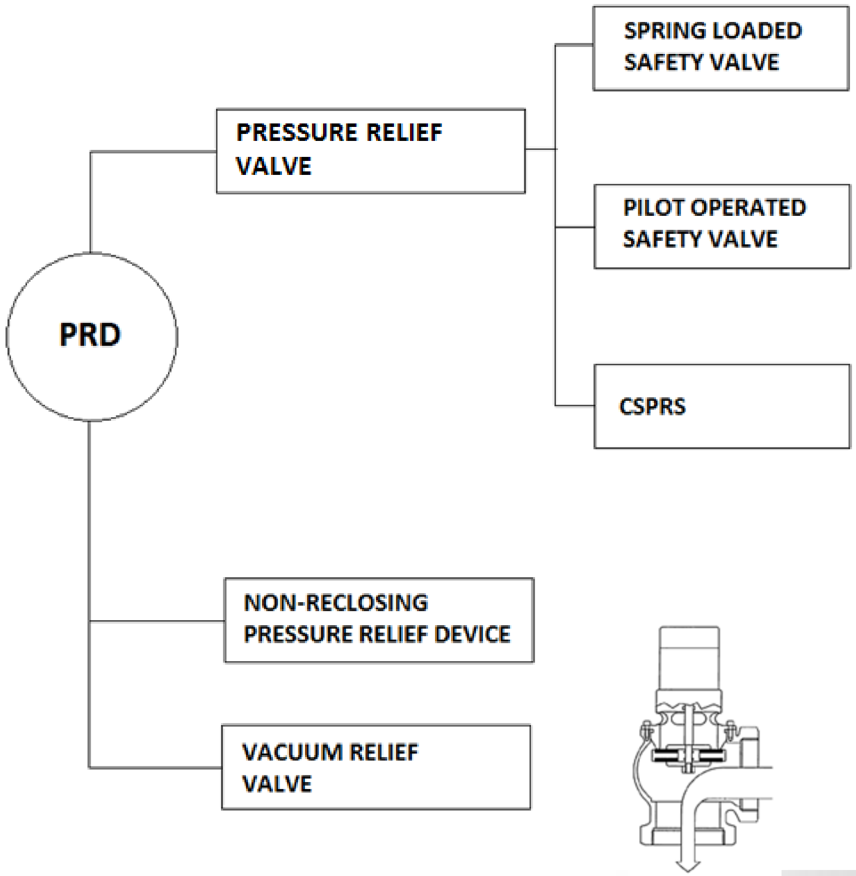
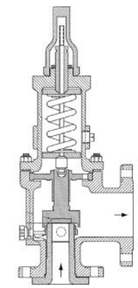
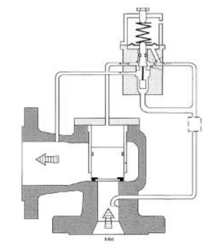
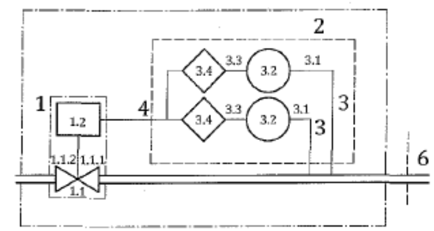
PRESSURE RELIEF DEVICE

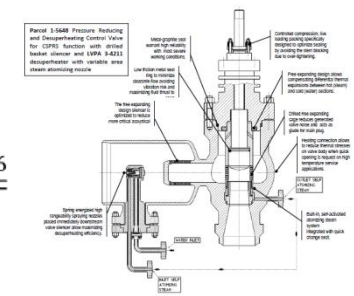
A device actuated by inlet static pressure and designed to open during emergency or abnormal conditions. to prevent a rise of internal fluid pressure in excess of a specified design value. The device also may be designed to prevent excessive internal vacuum. The device may be a **pressure relief valve**, a **non-reclosing pressure-relief device**, or a **vacuum relief valve**.
Pressure relief valve includes spring loaded safety valve, pilot operated safety valve and controlled safety pressure relief system.

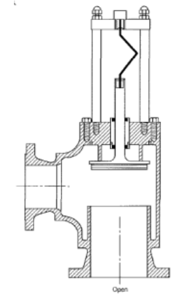












APPLICATION AND RELIEF EVENTS

HAZARD

- ✓ Despite safety precautions due to Equipment failures; Human error; External events, Increases in process <u>pressures</u> beyond safe levels.
- ✓ *OVERPRESSURE due to a RELIEF EVENT*

RELIEF EVENTS

- ✓ External fire
- ✓ Ambient heat transfer
- ✓ Flow from high pressure source
- ✓ Heat input from associated equipment
- ✓ Pumps and compressors
- ✓ Liquid expansion in pipes and surge

APPLICATION

- ✓ Power plant
- ✓ Refineries
- ✓ Oil and Gas
- ✓ Industry
- ✓ Chemistry
- ✓ Nuclear

PRESSURE RELIEF VALVE

A pressure-relief device designed to open and relieve excess pressure and to reclose and prevent the further flow of fluid after normal conditions have been restored.

SPRING LOADED SAFETY VALVE (SV)

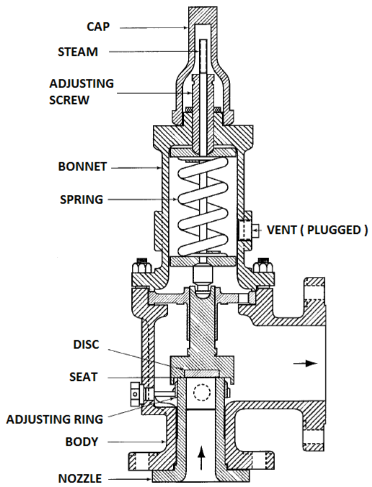
PRV is a self-actuated spring-loaded PRV that is designed to open at a predetermined pressure and protect a vessel or system from excess pressure by removing or relieving fluid from that vessel or system.

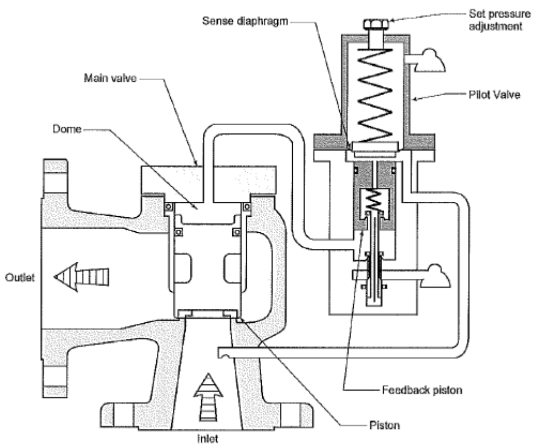
PILOT OPERATED SAFETY VALVE (POSV)

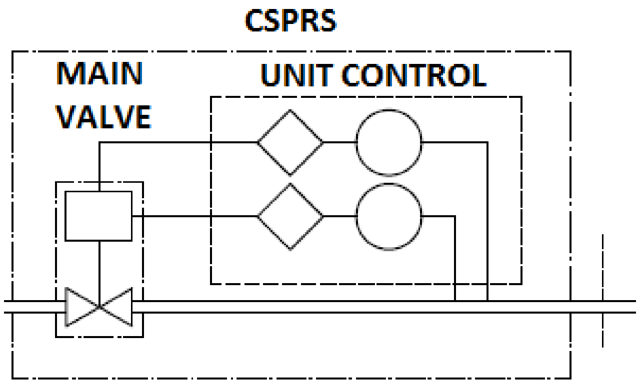
Pilot-operated PRV consists of the main valve, which normally encloses a floating unbalanced piston assembly, and an external pilot

CONTROLLED SAFETY PRESSURE RELIEF SYSTEMS (CSPRS)

System consisting of a main valve in combination with a control unit.







PRESSURE TERMINOLOGY

MAWP:
The maximum gauge pressure permissible at the top of a completed vessel in its normal operating position at the designated coincident temperature specified for that pressure. The pressure is the least of the values for the internal or external pressure as determined by the vessel design rules for each element of the vessel using actual nominal thickness, exclusive of additional metal thickness allowed for corrosion and loadings.

DESIGN PRESSURE:
Pressure, together with the design temperature, used to determine the minimum permissible thickness or physical characteristic of each vessel component as determined by the vessel design rules.

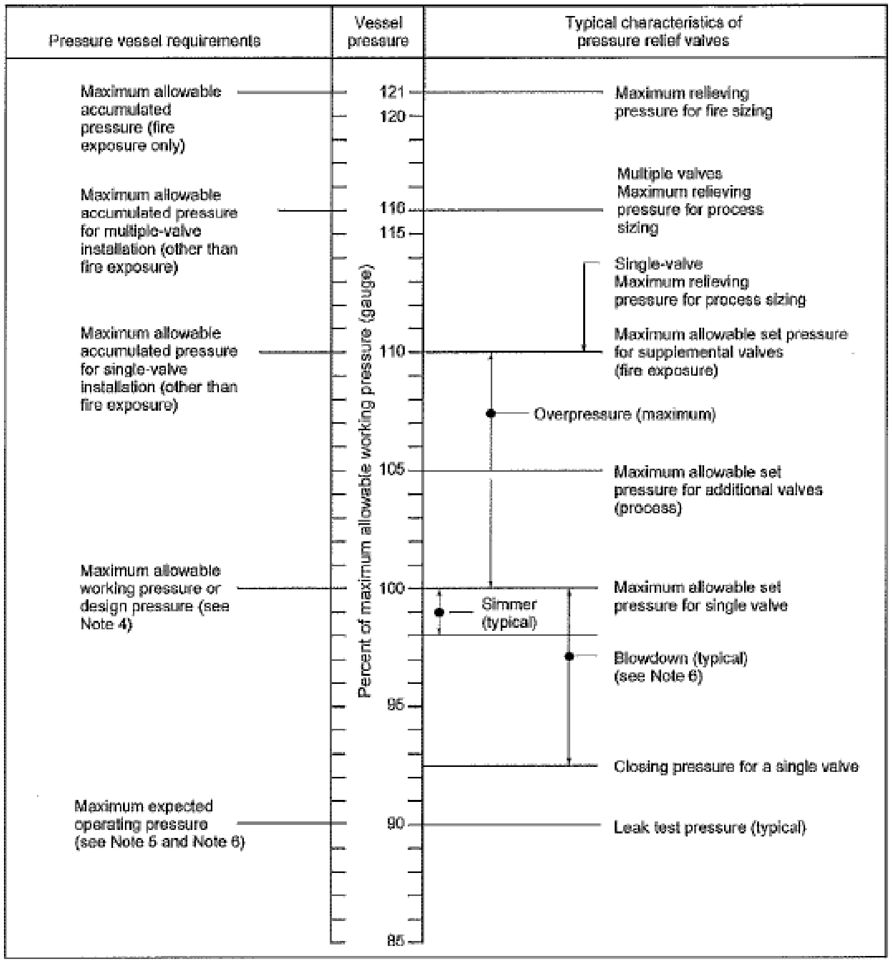
MAXIMUM OPERATING PRESSURE:
Normal operating pressure for the device.

SET PRESSURE:
The inlet gauge pressure at which the pressure-relief device is set to open under service conditions.

OVERPRESSURE:
The pressure increase over the set pressure of the relieving device. Overpressure is expressed in pressure units or as a percentage of set pressure. Overpressure is the same as accumulation only when the relieving device is set to open at the MAWP of the vessel.

RELIEVING PRESSURE:
The inlet pressure and temperature on a pressure-relief device during an overpressure condition. The relieving pressure is equal to the valve set pressure (or rupture disk burst pressure) plus the overpressure.

BLOWDOWN:
The difference between the set pressure and the closing pressure of a pressure-relief valve, expressed as a percentage of the set pressure or in pressure units.



DESIGN STANDARD

DESIGN
- ✓ PED AND EN STANDARD
- ✓ ASME AND API STANDARD
- ✓OTHER (EAC ,AQSIQ ….)

PRESSURE CONTAINING PARTS
- ✓ EN 12516-1/-2 AND EN 13445
- ✓ ASME B16.34, ASME B16.5, ASME B16.25
  ASME VIII-1 AND ASME I

FACE TO FACE DIMENSION
- ✓ API 526

MATERIAL
- ✓ EN MATERIAL
- ✓ ASTM MATERIAL
- ✓ ASME MATERIAL (ASME II-A, II-B, II-D)

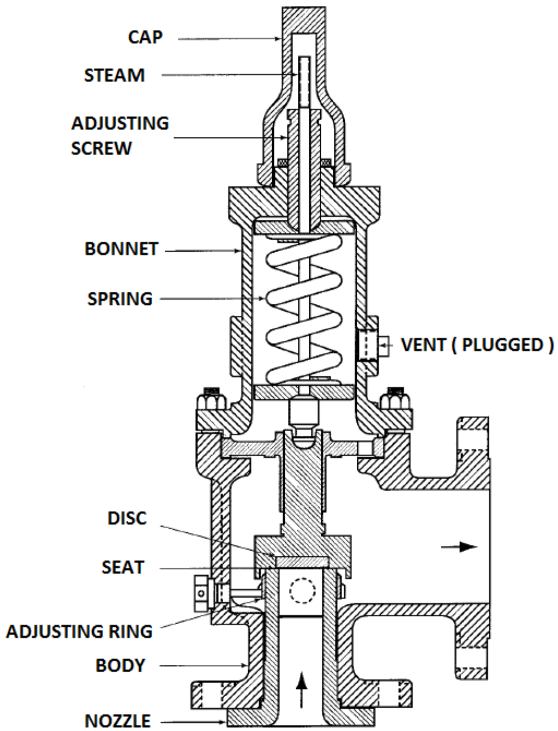
PERFORMANCE
- ✓ EN ISO 4126-1/4/5
- ✓ASME VIII-1
- ✓ASME I
- ✓ASME PTC 25
- ✓API 527

SIZING
- ✓ API 520 PART I AND II
- ✓ API 521

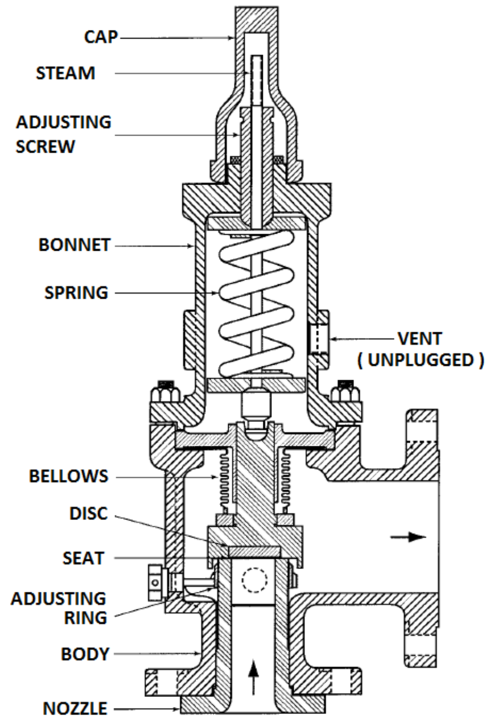
SPRING LOADED SAFETY VALVE

PRV is a self-actuated spring-loaded PRV that is designed to open at a predetermined pressure and protect a vessel or system from excess pressure by removing or relieving fluid from that vessel or system.

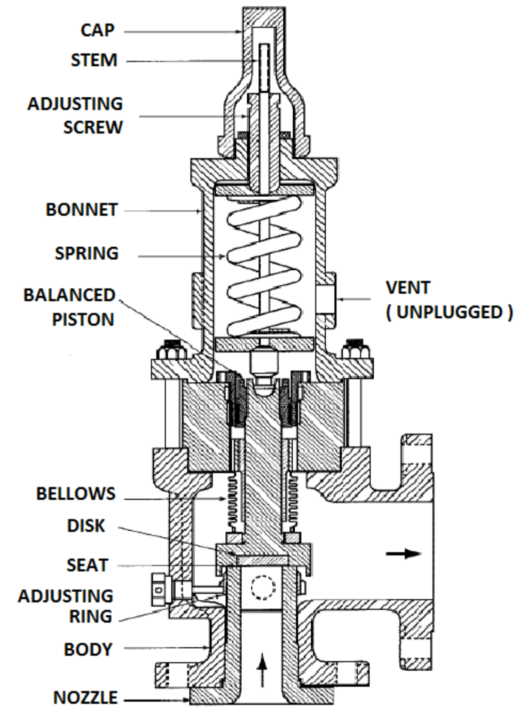
CONVENTIONAL



BALANCED

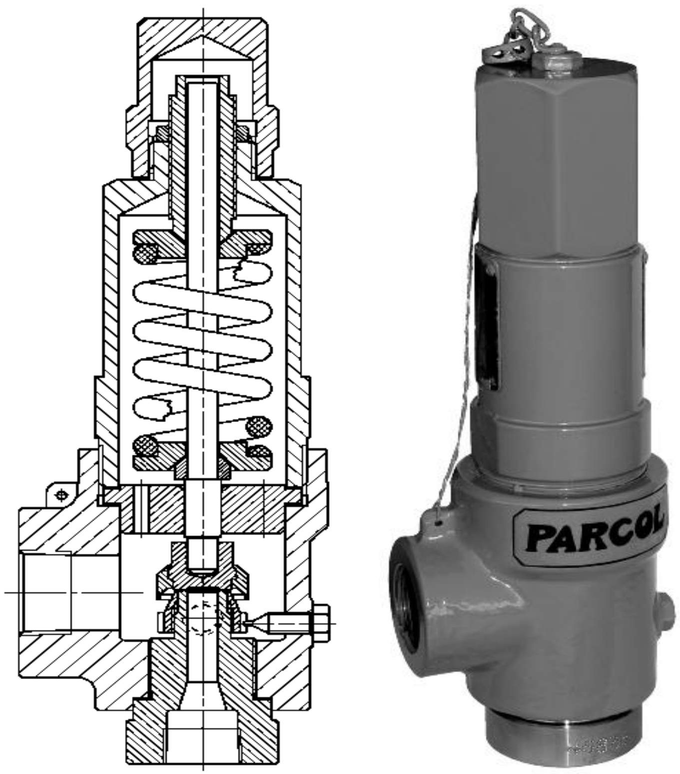


BALANCED WITH PISTION

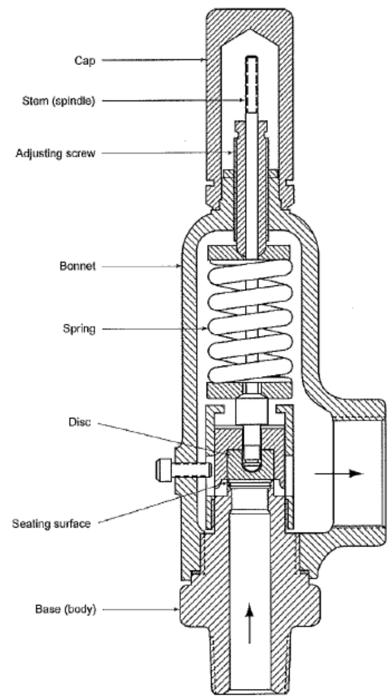


SV - COMPACT VALVE

Compact valve with threaded execution, small dimension, single ring adjustment. Usually suitable for thermal expansion. In some case the design is provided without adjusting ring and with a trim suitable for gas and liquid service.



PARCOL 3-5300 series



API 520

Connections	**Threaded**
Sizes [DN]	½" x ¾" ÷ ¾" x 1"
Body construction	FORGED CASTING
Orifices	B÷E
Areas [cm^2]	0.25÷1.40

SV - ORIFICE AND FACE TO FACE DIMENSIONS

8"	T	10"
1	2	3

1. **INLET SIZE**
2. **ORIFICE**
3. **OUTLET SIZE**

PARAMETER	COMPACT	STANDARD
SIZES [DN]	½"X¾" ÷ ¾"X1"	1"X2" ÷ 8"X12"
ORIFICES	B÷E	D÷T
AREAS [CM^2]	0.25÷1.40	0.80÷190

Designation	Effective Orifice Area (in.^{2})
D	0.110
E	0.196
F	0.307
G	0.503
H	0.785
J	1.287
K	1.838
L	2.853
M	3.60
N	4.34
P	6.38
Q	11.05
R	16.00
T	26.00

Table 1—Standard Effective Orifice Areas and Letter Designations

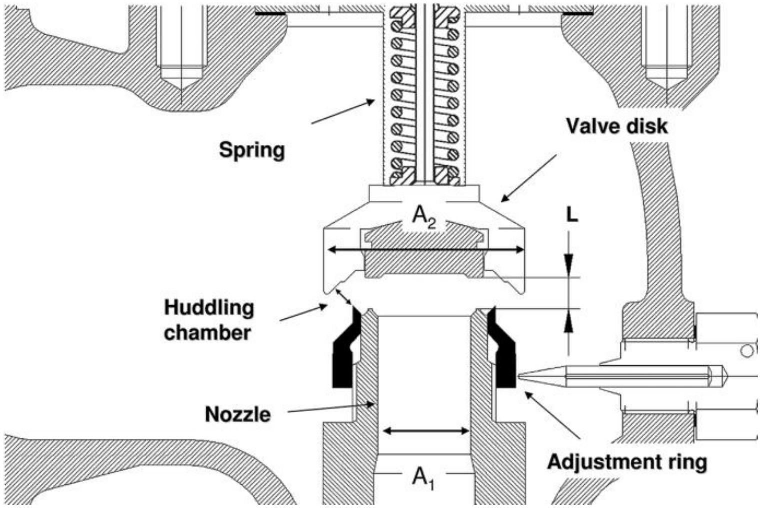
FACE TO FACE DIMENSIONS

Table 4—Spring-loaded Pressure-relief Valves "E" Orifice (Effective Orifice Area = 0.196 in.^{2})

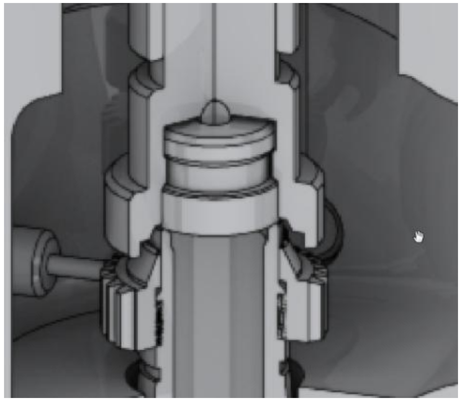
Materials [b]	Valve Size	ASME Flange Class		Maximum Inlet Flange (Set) Pressure Limit [a] (psig)						Outlet Pressure Limit [a] (psig)		Center-to-Face Dimensions (in.)	
				Conventional and Balanced Bellows Valves									
Body/ Bonnet	Inlet by Orifice by Outlet	INLET	OUTLET	–450 °F to –75 °F	–75 °F to –21 °F	–20 °F to 100 °F	450 °F	800 °F	1000 °F	Flange Rating Limit [a] 100 °F	Bellows Rating Limit [a] 100 °F	INLET	OUTLET
Temperature Range Inclusive –20 °F to 800 °F													
Carbon Steel	1E2	150	150			285	185	80		285	230	4 1/8	4 1/2
	1E2 [c]	300	150			(285)	(285)	(285)		285	230	4 1/8	4 1/2

TRIM

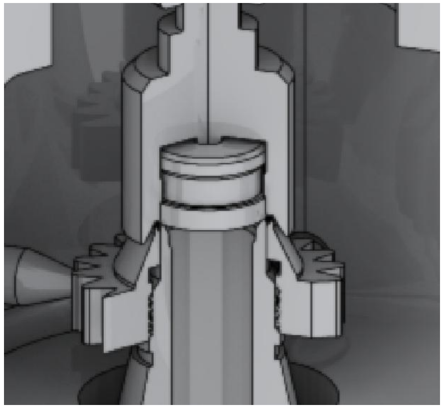
Trim is definied as the internal parts of the path flow that defines the valve fluidodynamic performances.
Trim includes nozzle, disk, disk-holder and adjustable ring or rings.
Any valve manufacturer has is own design for trim but it possible to define general rules for trim dseisgn for gas service, liquid service and steam service.



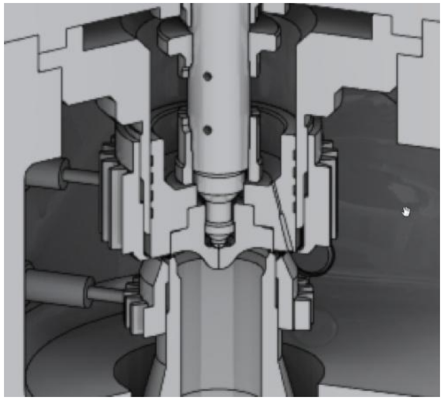
SAMPLE OF TRIM FOR GAS SERVICE



SAMPLE OF TRIM FOR LIQUID SERVICE



SAMPLE OF TRIM FOR STEAM SERVICE



SV - VALVE PERFORMANCES

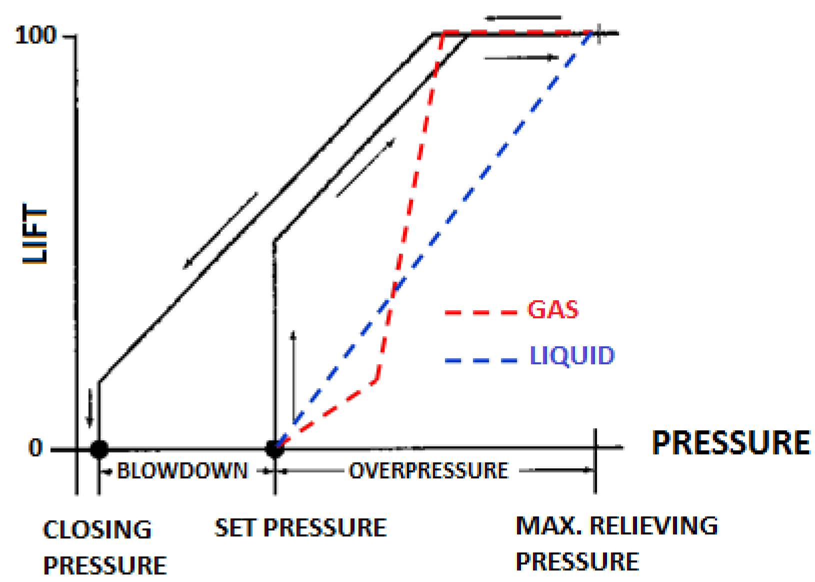
REPEATIBILITY OF SET PRESSURE
Valve has to show for at least 3 time a repeatability of set pressure within a defined tolerance.

KD
The ratio of the mass flow rate in a valve to that of an ideal nozzle. The coefficient of discharge is used for calculating flow through a pressure-relief device. The Kd shall be constant for the valve series within a defined tolerance (usually +/- 5%).

LIFT
Manufacturer has to declare the nominal lift of valve, intended as the minimum lift reachable by the valve in condition of complete overpressure.

BLOWDOWN
The difference between the set pressure and the closing pressure of a pressure-relief valve, expressed as a percentage of the set pressure or in pressure units.

STABILITY
Performances shall to show stability and repeatability. No flatter and chatter phenomena are acceptable.



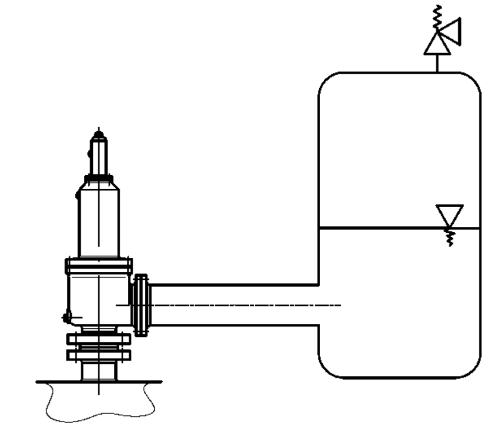
PARAMETER	STEAM			GAS & VAPOURS		LIQUID	
	ASME VIII-1	ASME I	ISO 4126-1	ASME VIII-1	ISO 4126-1	ASME VIII-1	ISO 4126-1
OVERPRESSURE	10%	3%	10%	10%	10%	10%	10%
USUAL KD	0,975	0,975	0,975%	0,975	0,975	0,65	0,65
MAX. BLOWDOWN	7% or FIXED	4%	15%	7% or FIXED	15%	FIXED	20%

SV - BACKPRESSURE

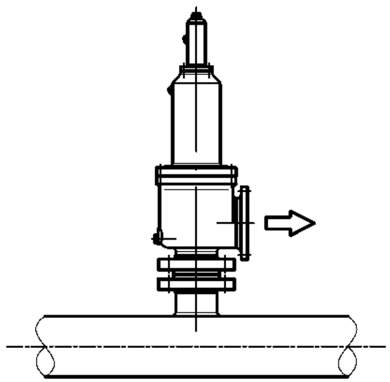
DEFINITION:
The pressure that exists at the outlet of a pressure-relief device as a result of the pressure in the discharge system. Backpressure is the sum of the superimposed and built-up backpressures.

BUILT-UP BACKPRESSURE
The increase in pressure at the outlet of a pressure-relief device that develops as a result of flow after the pressure relief device opening.

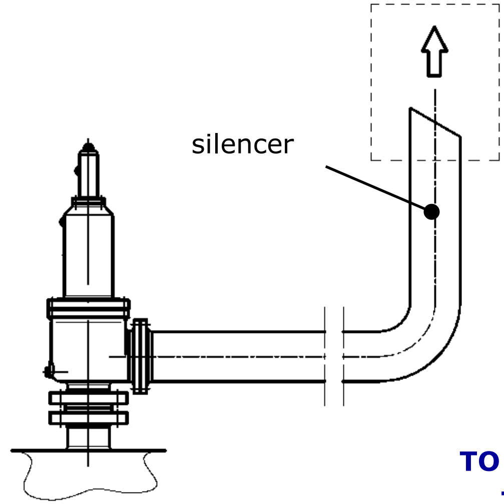
SUPER-IMPOSED BACKPRESSURE:
The static pressure that exists at the outlet of a pressure-relief device at the time the device is required to operate. Superimposed backpressure is the result of pressure in the discharge system coming from other sources and may be constant or variable.



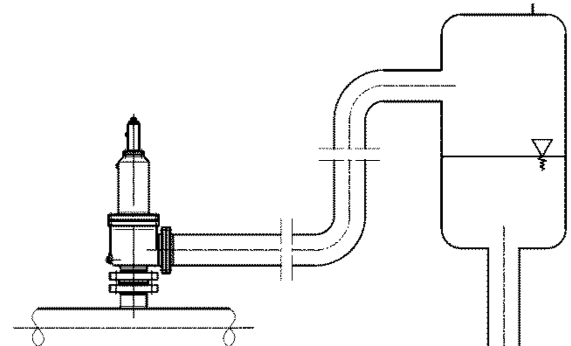
TO A PRESSURIZED TANK
(super-imposed back pressure)

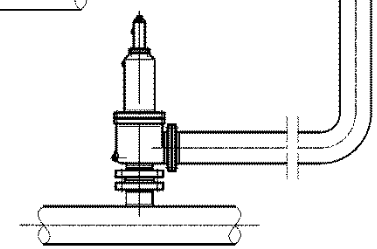


DIRECTLY TO ATMOSPHERE
(built-up back pressure
<u>approximately</u> negligible)



TO ATMOSPHERE
THROUGH A PIPING
(built-up back pressure)

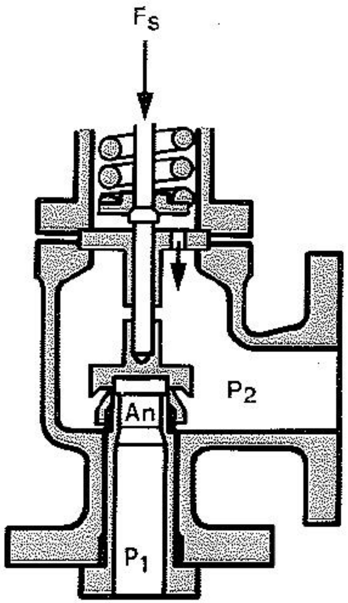




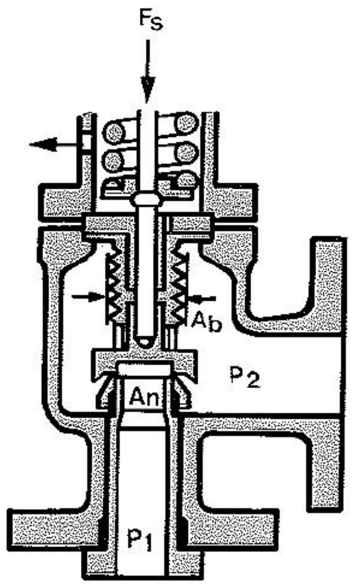
TO A PRESSURIZED TANK
THROUGH A PIPING
WITH MULTIPLE DISCHARGE
(super-imposed + built-up back pressure)

SV - SOLUTIONS AGAINST BACKPRESSURE

TRIM FOR GAS OR LIQUID SERVICE



$$P1 \cdot An = Fs + P2 \cdot An$$

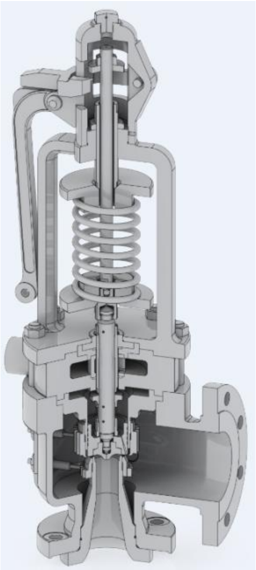


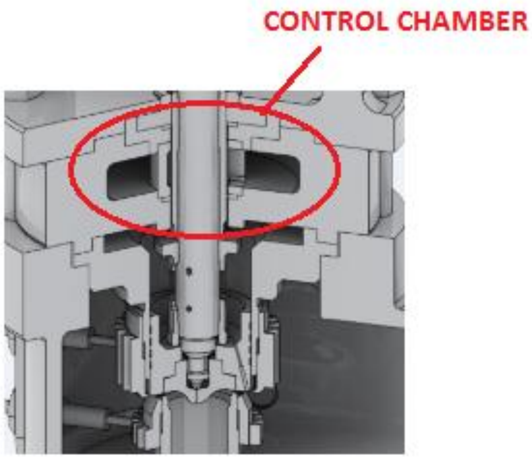
$$P1 \cdot An = Fs$$
$$(Ab = An)$$

CRITICAL ISSUE:

I. BELLOWS RATE
II. LOW PRESSURE APPLICATION
III. HIGH PRESSURE APPLICATION
IV. LOW TEMPERATURE

TRIM FOR STEAM SERVICE





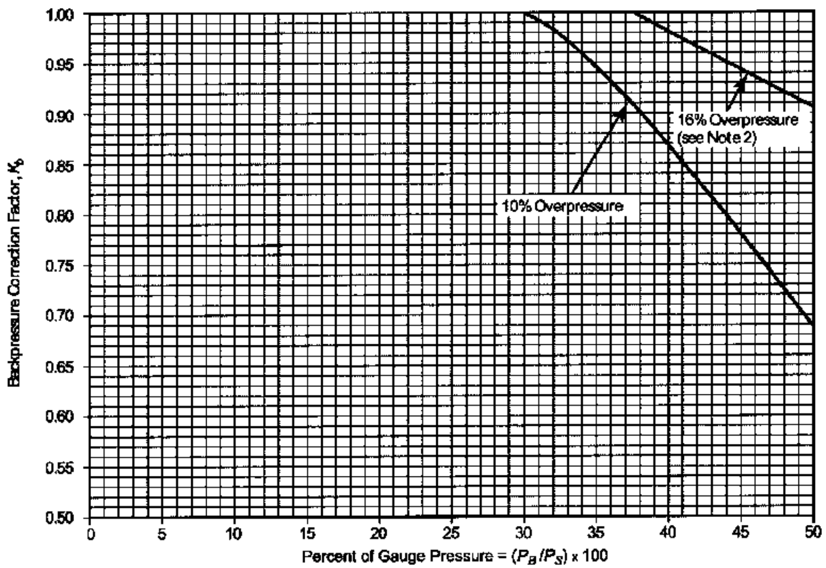
CRITICAL ISSUE:

I. REGULATION ON FIELD

SV - BACK PRESSURE CORRECTION FACTORS

Note: The curves of API 520 Part I are a compromise of the values recommended by various PRV manufacturers and may be used for a preliminary sizing only. **PRV manufacturers should be consulted for the effective correction factors**.

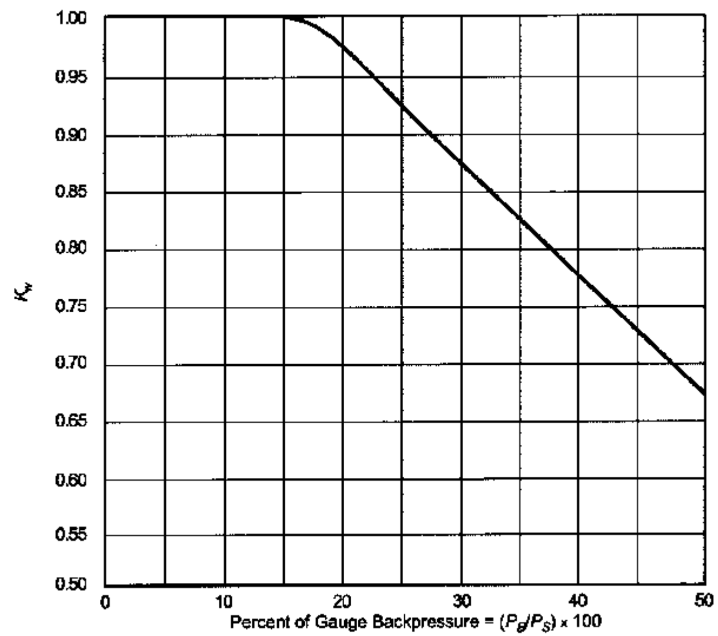
SHALL



P_B = back pressure, in psig.
P_S = set pressure, in psig.

NOTES
1. The curves above represent a compromise of the values recommended by a number of relief valve manufacturers and may be used when the make of the valve or the critical flow pressure point for the vapor or gas is unknown. When the make of the valve is known, the manufacturer should be consulted for the correction factor. These curves are for set pressures of 50 psig and above. They are limited to back pressure below critical flow pressure for a given set pressure. For set pressures below 50 psig or for subcritical flow, the manufacturer must be consulted for values of K_b.
2. See 5.3.3.
3. For 21 % overpressure, K_b equals 1.0 up to P_B/P_S = 50 %.

Figure 30—Backpressure Correction Factor, K_b, for Balanced-bellows PRV (Vapors and Gases)

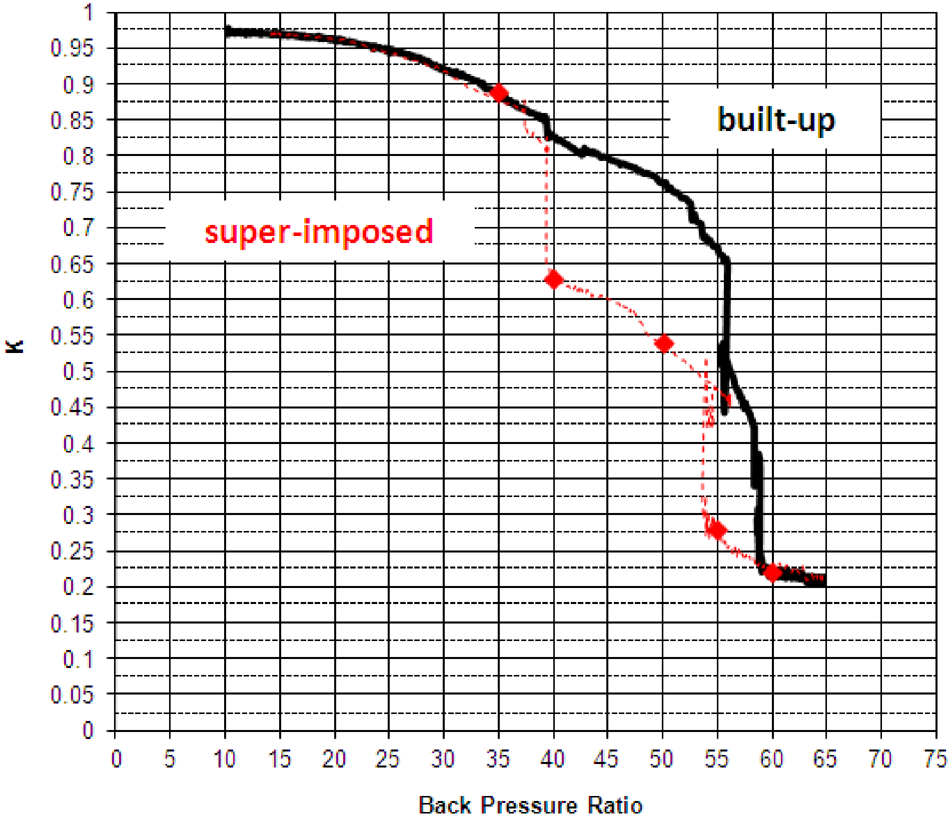


K_w = correction factor due to back pressure.
P_B = back pressure, in psig.
P_S = set pressure, in psig.

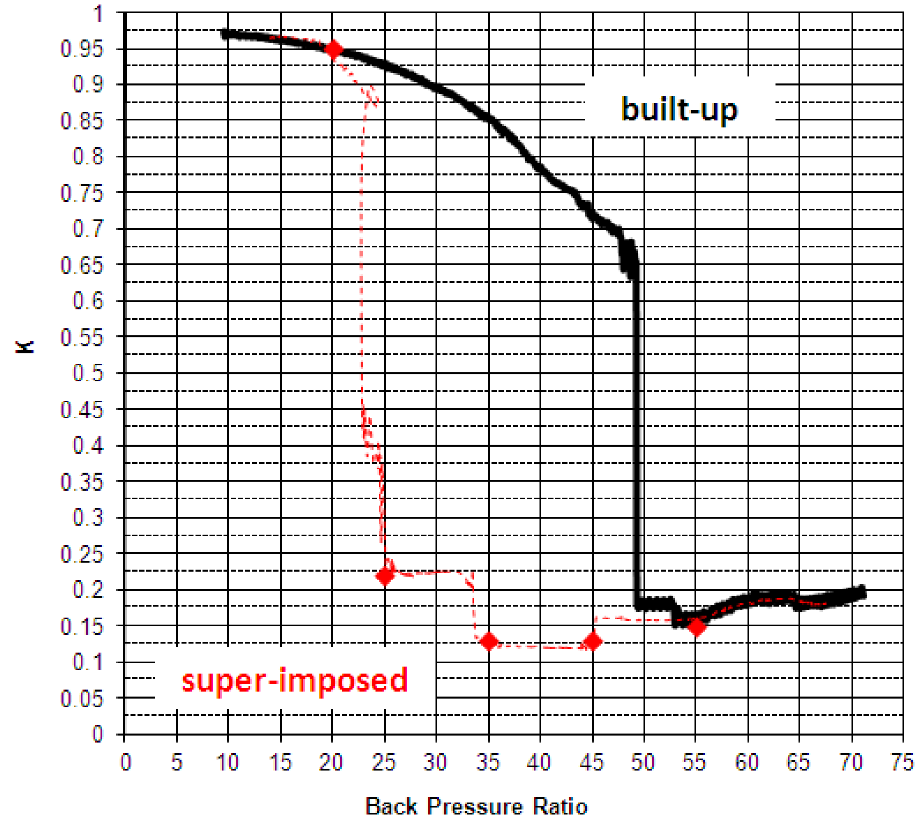
NOTE The curve above represents values recommended by various manufacturers. This curve may be used when the manufacturer is not known. Otherwise, the manufacturer should be consulted for the applicable correction factor.

Figure 31—Capacity Correction Factor, K_w, due to Backpressure on Balanced-bellows PRVs in Liquid Service

SV - BUILT-UP AND SUPERIMPOSED BACKPRESSURE EFFECTS ON Kd

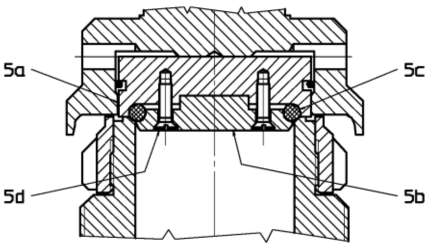


valve = Parcol DN 1½" H 3" trim "A"
pset = 8 barg @ Tamb
fluid = air
overpressure = 10%

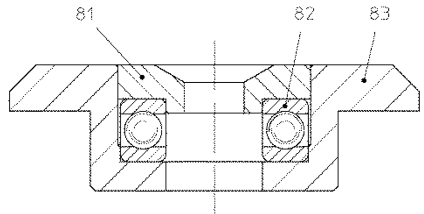


valve = Parcol DN 1½" H 3" trim "B"
pset = 8 barg @ Tamb
fluid = air
overpressure = 10%

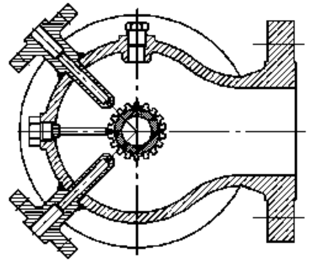
SV -ACCESSORIES



SOFT SEAL

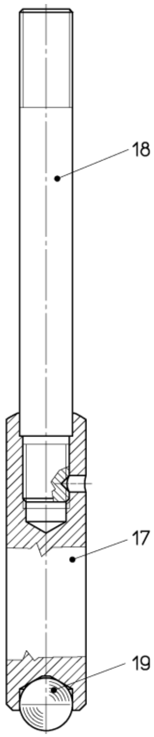


UPPER SPRING SEAT WITH THRUST BEARING

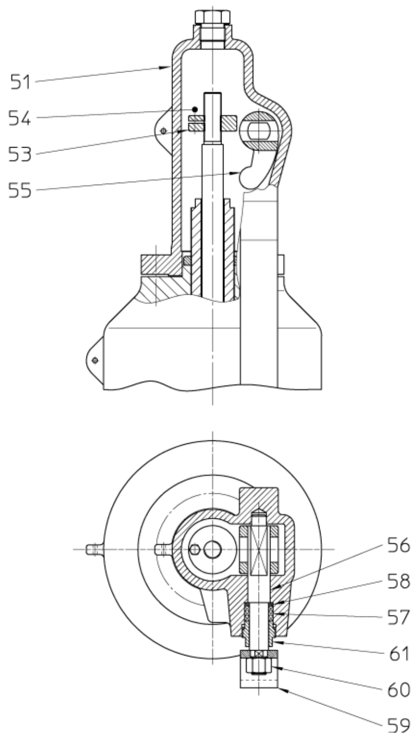


NOZZLE FLUSHING DEVICE

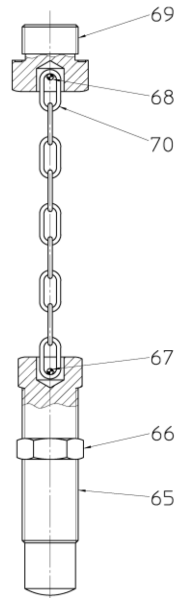
STEM ASSEMBLY



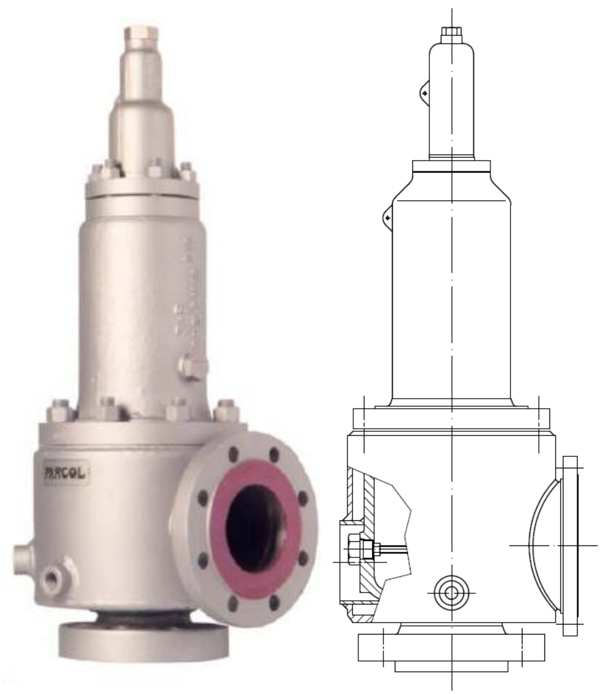
LIFTING LEVER



TEST GAG

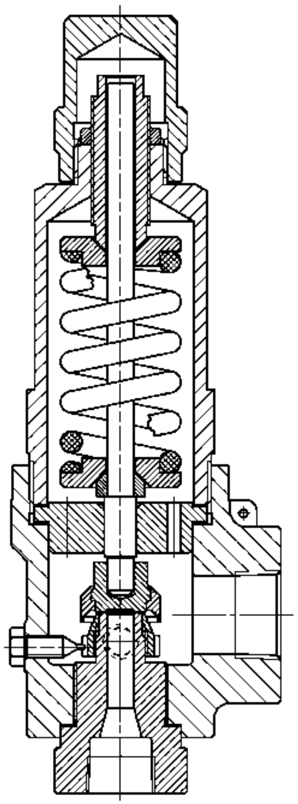


STEAM JACKETING

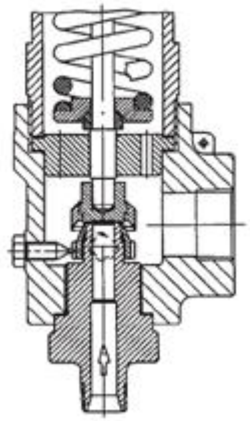


Item	Part name
	Soft seal
5a	Disk
5b	Ring locking disk
5c	Sealing ring
5d	Screw
	Stem assembly
17	Spindle
18	Stem
19	Ball
	Lifting lever
51	Cap for lifting lever
53	Stop disk
54	Screw
55	Fork
56	Driving shaft
57	O-Ring seal
58	Bottom ring
59	Lever
60	Nut
61	Adjusting ring nut
	Test gag
65	Test gag
66	Nut
67	Screw rivet
68	Plug rivet
69	Plug
70	Chain
	Special upper spring seat
81	Guide ring
82	Thrust bearing
83	Upper spring seat

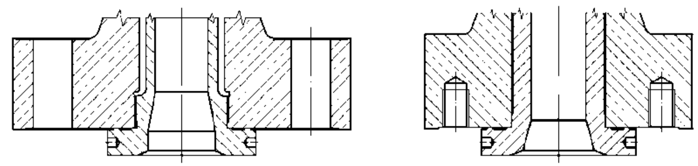
SV - CONNECTIONS



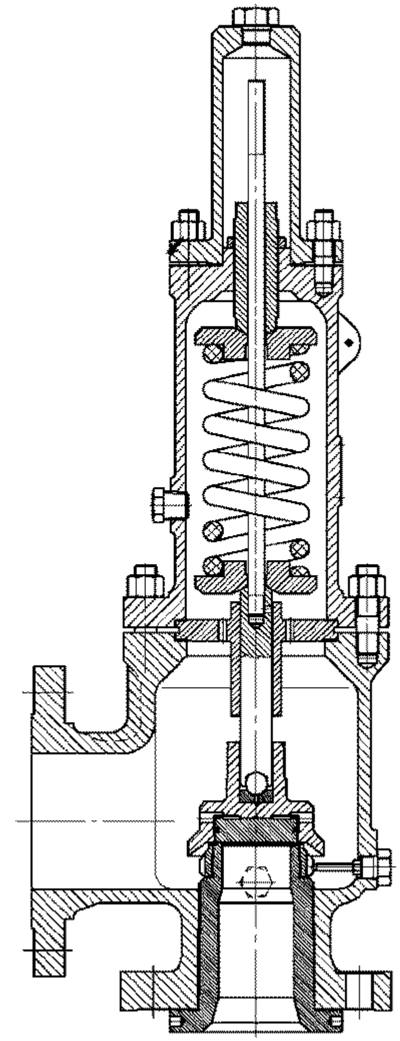
THREADED
(FEMALE – FEMALE)



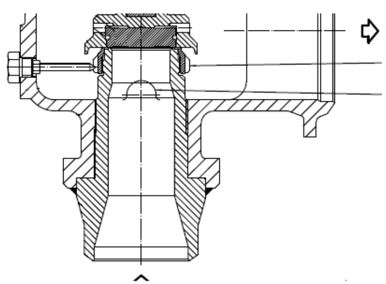
THREADED
(MALE – FEMALE)



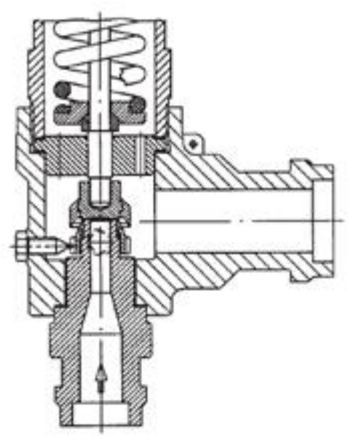
CUSTOMIZED ON CLIENT SPECIFICATION
(UREA SERVICE)



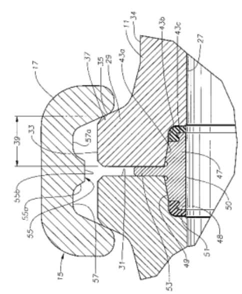
FLANGED
(MALE – FEMALE)



BUTT-WELDED



SOCKET-WELDED

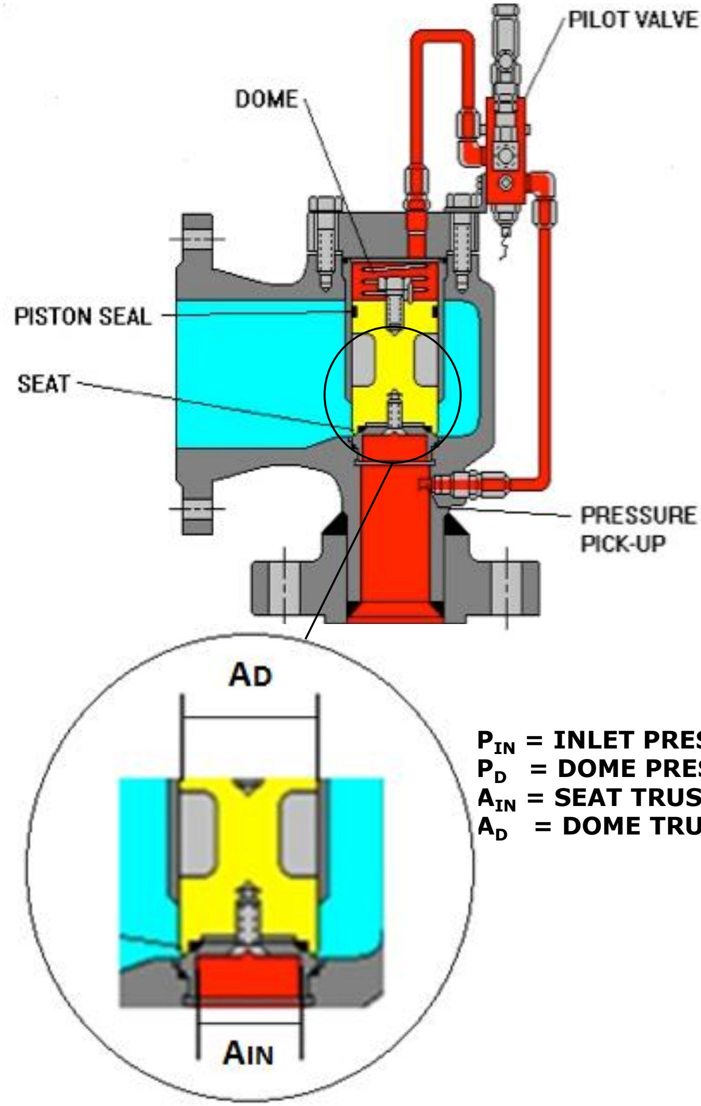


GRAYLOCK CONNECTION

PILOT OPERATED SAFETY VALVE (POSV)

DEFINITIONS:

- **POSV (PILOT OPERATED SAFETY VALVE):**
  Safety valve composed by a main-valve and a pilot. main valve is actuated by pilot that regulates the dome pressure in function of inlet pressure.
- **PILOT VALVE:**
  Valve that actuates the main valve regulating the pressure inside dome chamber
- **DOME CHAMBER:**
  Upper accumulation chamber. its pressure is regulated by pilot action. the trust area of dome chamber is oversized respect of the trust seat area.
- **SET PRESSURE:**
  Static pressure at which the posv initially opens.
- **CRACKING PRESSURE:**
  Usually also called pilot set pressure, is the pressure at which pilot initially discharges the pressure inside the dome chamber.
- Upper piston area (dome chamber) is in communication with pilot dome port. Nozzle is in communication with pilot inlet port through a pitot.
- $a_{in} < a_d$
  The ratio could be not the same for all the valve sizes
  [$\mathbf{0,65 < A_{IN} / A_D < 0,75}$]
- if $p_{IN} * A_{IN} < p_D * A_D$ ---> valve is **close**
  if $p_{IN} * A_{IN} > p_D * A_D$ ---> valve is **open**



P_{IN} = INLET PRESSURE
P_D = DOME PRESSURE
A_{IN} = SEAT TRUST AREA
A_D = DOME TRUST AREA

POSV - MAIN VALVE FEATURES

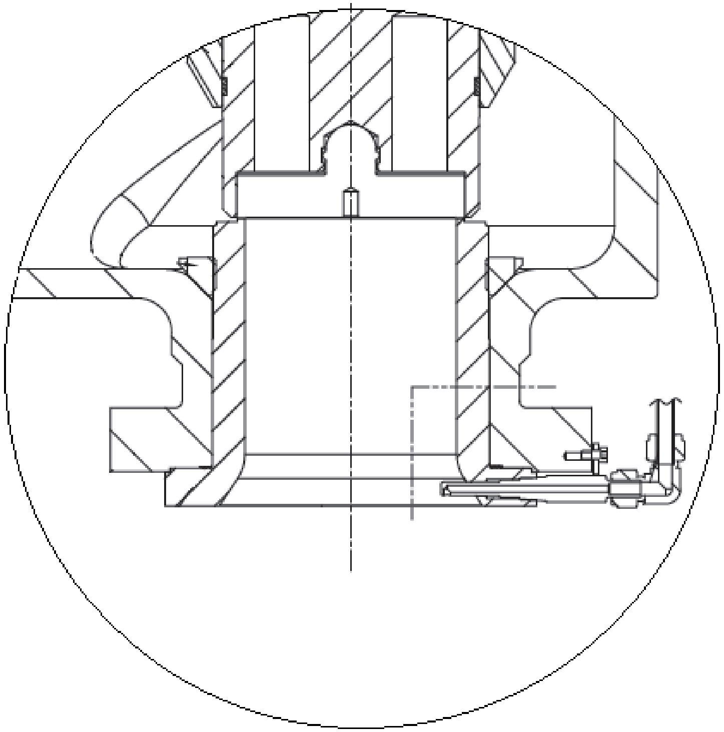
FULL-NOZZLE / SEMI-NOZZLE

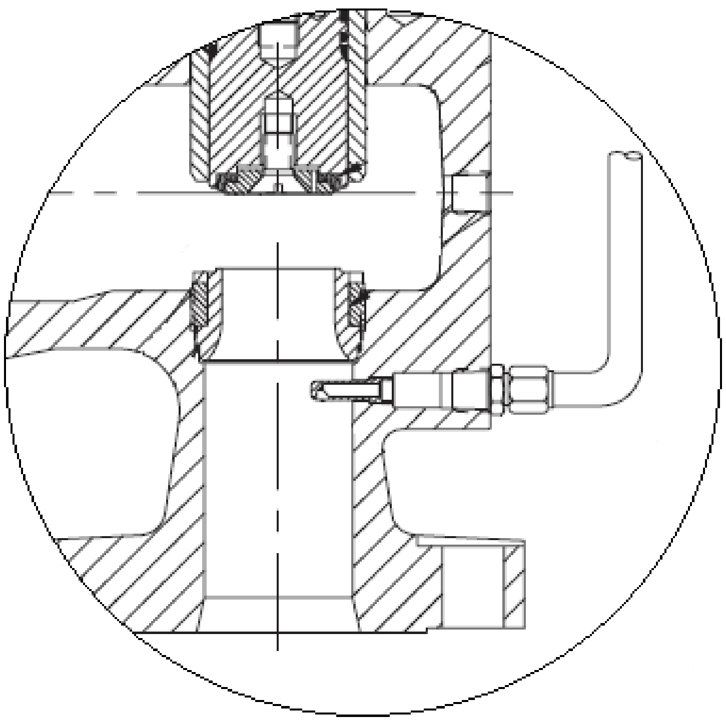
- **FULL-NOZZLE:**

  When valve is close, process medium is completely enveloped only by nozzle.

- **SEMI-NOZZLE:**

  When valve is close, process medium is in contact also with the body.





POSV - MAIN VALVE FEATURES

ORIFICE API 526 / ORIFICE FULL-BORE

ORIFICE API 526:

- standard orifice with designation in accordance with api 526.
- inlet rounded profile.
- kd higher than full bore.

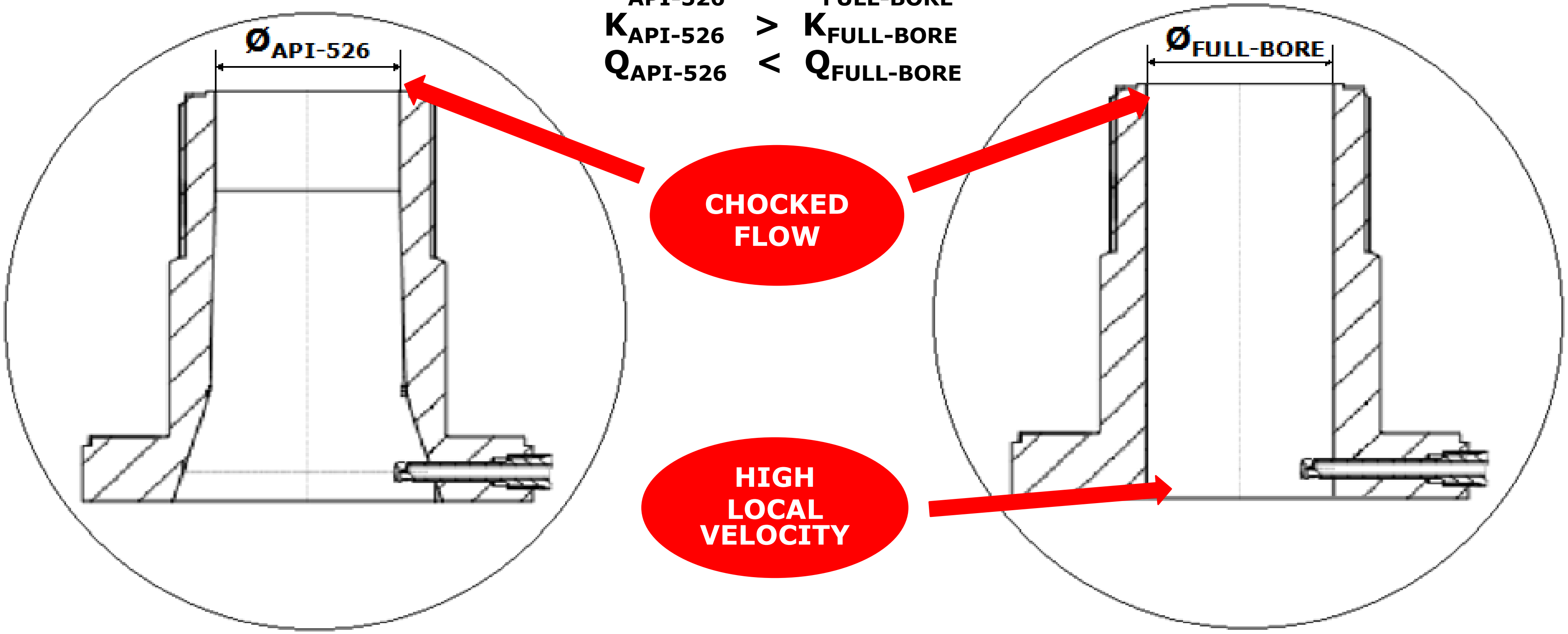
ORIFICE FULL BORE:

- orifice bore equal to pipeline bore.
- larger area than api 526.
- high local velocity.
- higher capacity.

$A_{API\text{-}526} < A_{FULL\text{-}BORE}$

$K_{API\text{-}526} > K_{FULL\text{-}BORE}$

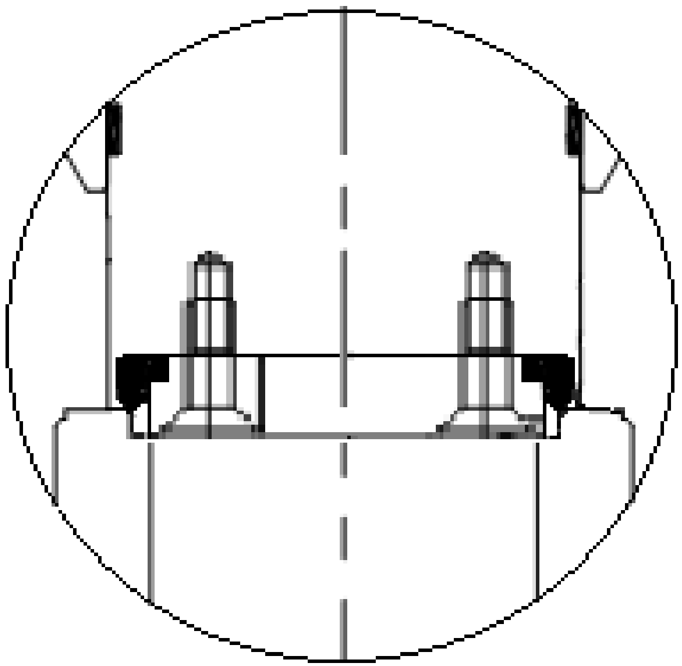
$Q_{API\text{-}526} < Q_{FULL\text{-}BORE}$



POSV - MAIN VALVE FEATURES

TIGHTNESS TYPE

- **METAL TO METAL SEAT:**
  - standard and high temperature applications.
  - cryogenic applications.
  - suitable for any kind of process.



- **SOFT SEAT WITH ORING:**
  - zero leakage.
  - very low pressure applications.
  - temperature limits.
  - chemical compatibility required.

- **SOFT SEAT WITH PLASTIC MATERIALS**
  - zero leakage.
  - large chemical range applications.
  - temperature limits.
  - special design for low pressure.

POSV - MAIN VALVE FEATURES

FULL LIFT / RESTRICTED LIFT

- Restricted lift in accordance with asme viii-1.
- Reducing of number of actual orifices.
- Flexibility in area definition.
- Asme viii-1 requirements:

$$H_{RESTRICTED} = Max(0{,}3 \cdot H_{FULL\ LIFT}\ ; 2\ mm)$$
$$k_{RESTRICTED} \geq k_{FULL\ LIFT} \cdot H_{FULL\ LIFT} / H_{RESTRICTED}$$

UG-131 (e)(1)

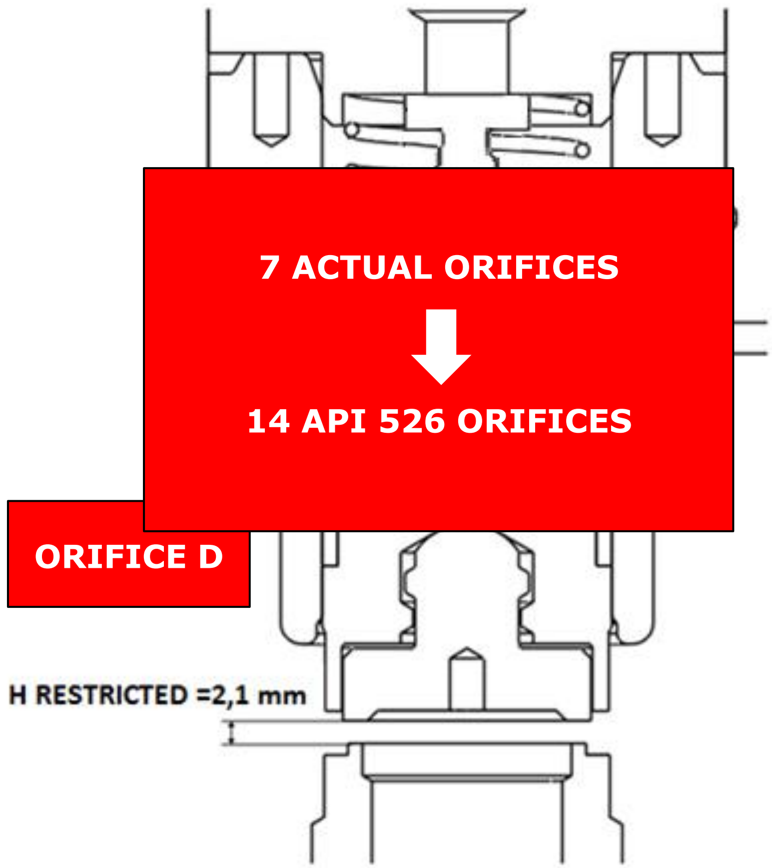
points. Each of the three test valves shall be set at a different pressure.

For each restricted lift valve tested, it shall be verified that actual measured capacity at restricted lift will equal or exceed the ASME rated capacity at full rated lift multiplied by the ratio of measured restricted lift to full rated lift.

UG-136 (a)(11)(e)

that, if adjustable, the adjustable feature can be sealed. Seals shall be installed by the valve Manufacturer or Assembler at the time of initial adjustment.

(-e) Valves shall not have their lifts restricted to a value less than 30% of full rated lift, or less than 0.080 in. (2 mm).



POSV - PILOT FEATURES

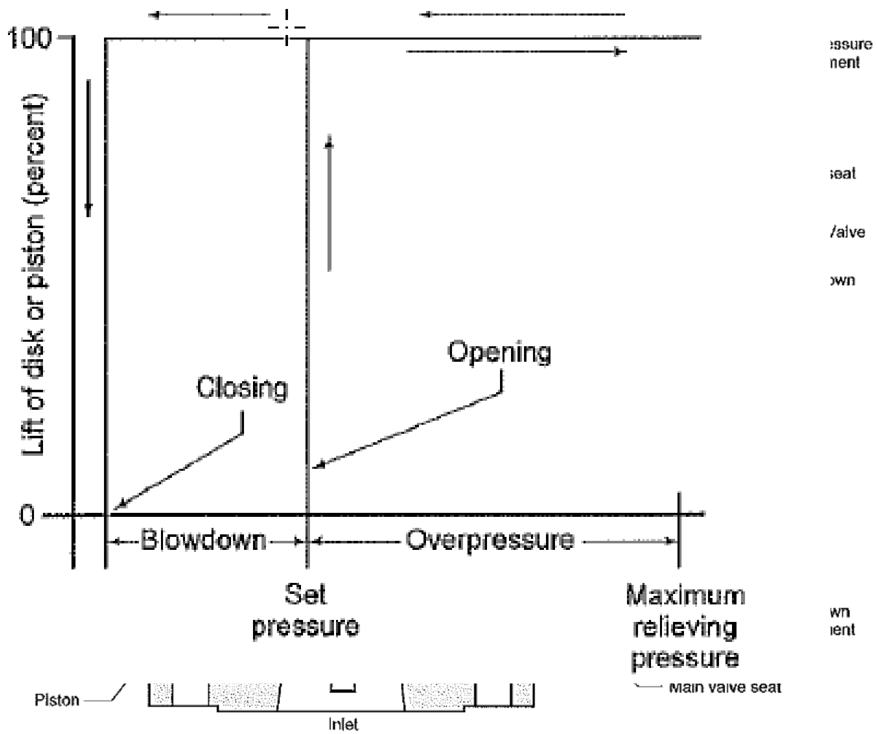
POP ACTION / MODULATING ACTION

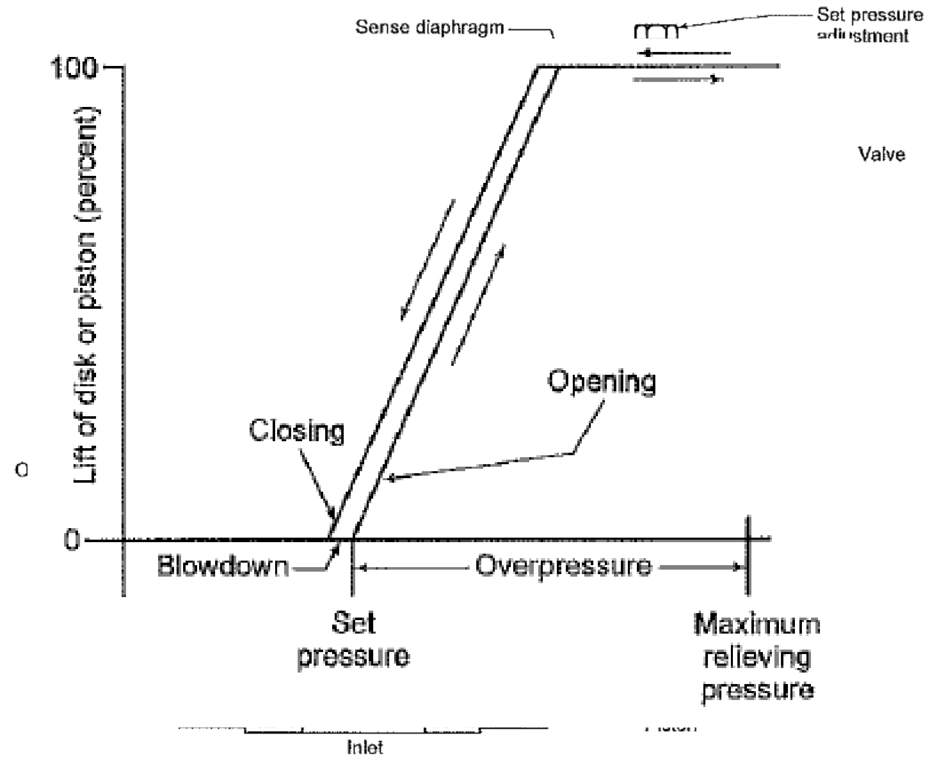
POP ACTION:

- fast opening (3% o.p)
- gas/ steam service only
- blowdown adjustment (3% ÷ 7%)
- lng applications

MODULATING ACTION:

- modulating opening (5% o.p)
- gas/ steam and liquid service
- blowdown fixed (usually < 7%)





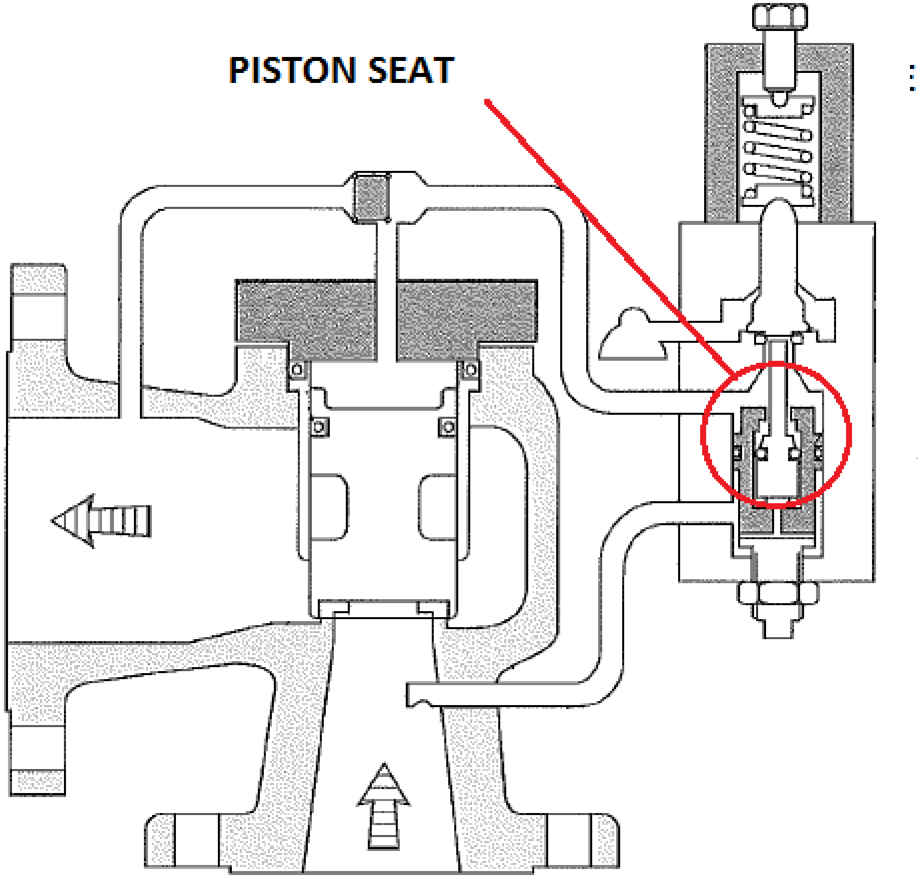
POSV - PILOT FEATURES

- **FLOWING**
  During posv opening and closing the pilot has a continuous flowing of process medium through its inner grooves.

- **NON-FLOWING**
  Pilot is designed in order to minimize the flowing of process medium through its inner grooves. this design reduces the dragging of solid and dirty particles and the thermal exchange (minimizes the formation of hydrates in the pilot).

- **PISTON PILOT**
  The sensitive part of pilot is realized with a piston. this design is the standard design and has a large pressure application (from 5 ÷ 600 barg).

- **DIAPHRAGM PILOT**
  For low pressure applications (from 1 ÷ 7 barg) the sensitive part inside the pilot is realized with a diaphragm in order to reduce the effects of friction and weights.



NON-FLOWING PILOT

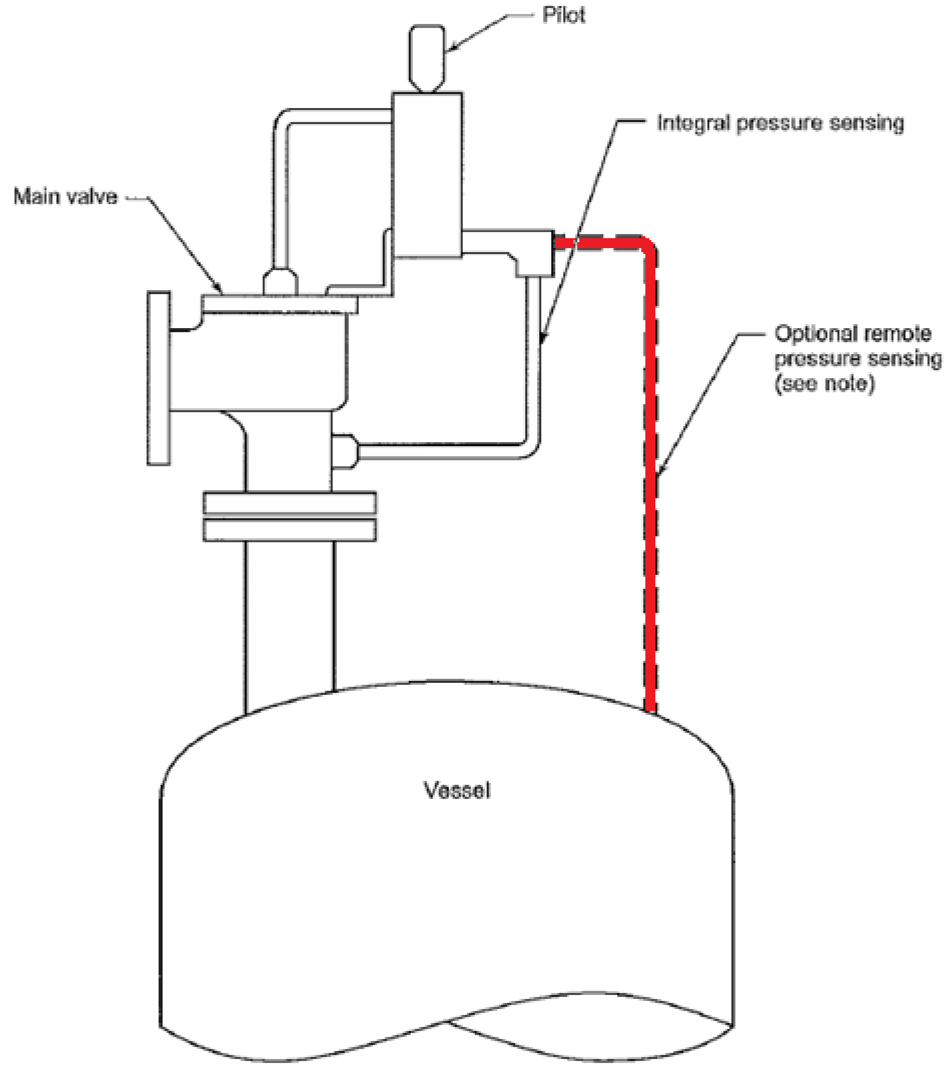
POSV - PILOT SENSING POINT

➢ INTEGRAL PRESSURE SENSING

- Usually made with a pitot
- Inlet line pressure loss < 3%.
- Pitot location could be a problem with small orifices.

➢ REMOTE PRESSURE SENSING

- Location of sensing point
- Inlet line pressure loss could be higher than 3%.
- Flowing pilot – sensing line shall be sized by manufacturer.
- Non-flowing pilot – sensing line with area > 45 mm^2



POSV - PILOT ACCESSORIES

FILTER

The pilot supply filter protects the pilot from the presence of excessive particulate matter in the flow stream.

BACKFLOW PREVENTER

When backpressure is higher than the inlet operating pressure, the main valve lifts allowing reverse flow from the outlet to the inlet ports. the backflow preventer prevents any accidental reverse flow through the pilot operated safety valve to occur.

FIELD TEST CONNECTION

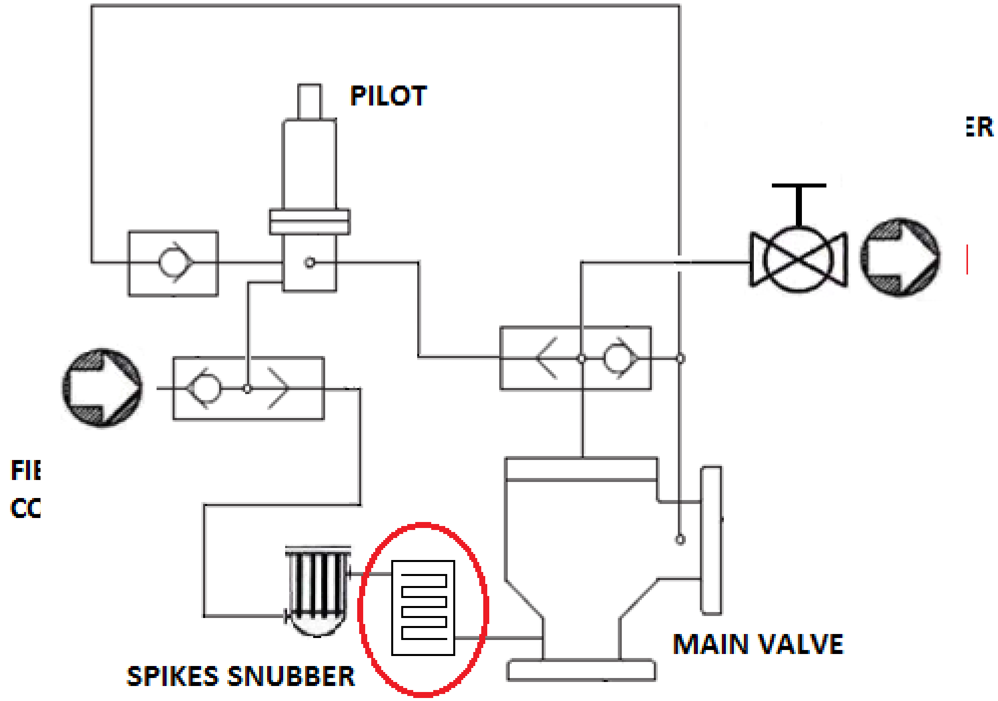
This device allows to verify the pilot integrity on field. the field test connection can be used in alternative to the lever in accordance with asme viii-1 ug-133 (a)(3).

MANUAL UNLOADER

This devices enables the main valve to be opened remotely. whenever a remote operation is called, a pneumatic or electrical signal opens the exhaust vent of the spool valve and vents the dome, allowing the main valve to open.

SPIKES SNUBBER

Minimizes the pressure spikes. usually required for pump applications.



POSV VS SPRING LOADED SAFETY VALVE

ADVANTAGES

- **TIGHTNESS QUALITY** (HIGHER OPERATING PRESSURE).
- **SAVING WEIGHTS** AND **DIMENSIONS**.
- **SAVING COSTS** FOR HIGH PRESSURE APPLICATIONS.
- **HIGHER PERFORMANCES** THAN PSV (OVERPRESSURE / BLOWDOWN / STABILITY).
- **REDUCTION** OF **PROCESS LOSS** (VERY LOW BLOWDOWN).
- HIGHER KD FOR LIQUID SERVICE.
- HIGHER **BACKPRESSURE** LIMITS THAN PSV
- QUICK VERIFICATION OF PILOT AND MAIN VALVE FUNCTIONALITY ON FIELD.
- **INCREASING OF MAXIMUM SET PRESSURE**.
- APPLICATION WITH INLET **PRESSURE LOSS HIGHER THAN 3%** (REMOTE SENSE CONNECTION).

DISADVANTAGES

- **HIGHER DESIGN COMPLEXITY**.
- HIGHER COST FOR LOW SIZES AND RATINGS.
- **TEMPERATURE** LIMITATIONS. (300°C).
- HIGH **VISCOSITY**, HEAVY **DIRTY** AND ENCRUSTING MEDIUM ARE NOT ALLOWABLE.
- FIELD OPERATIONS WITH LOW DIFFERENTIAL PRESSURE.

CONTROLLED SAFETY PRESSURE RELIEF SYSTEM - CSPRS

DEFINITION:

System consisting of a main valve in combination with a control unit. On reaching the set pressure, the operating forces on the main valve are by means of the control unit automatically applied, released or so reduced that a main valve discharges a specified quantity of the fluid so as to prevent the predetermined pressure being exceeded. The system is so designed that the main valve recloses and prevents a further flow of fluid after normal pressure conditions of service have been restored.

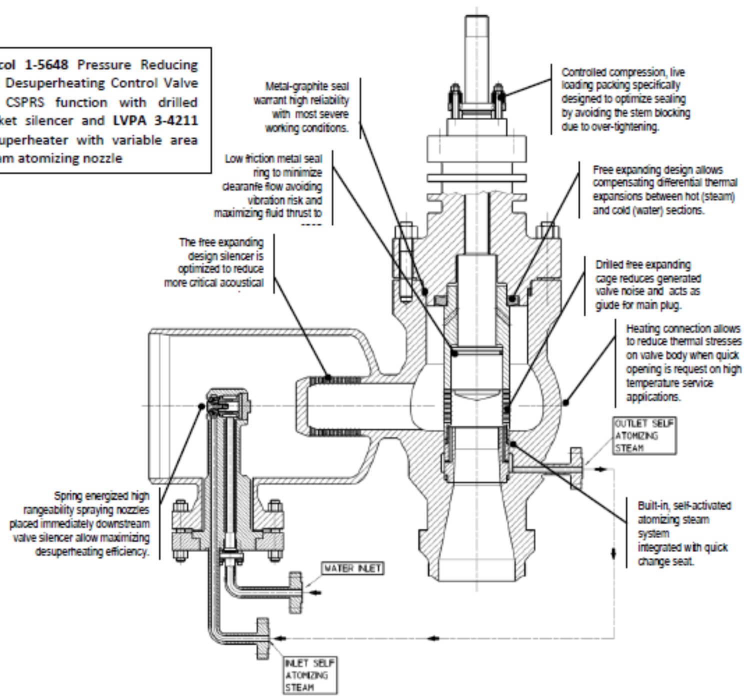
MAIN VALVE:

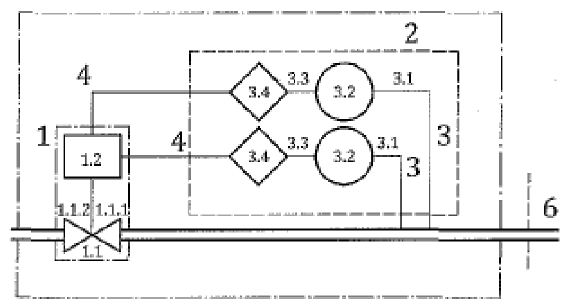
Valve consisting of the parts of a CSPRS through which the discharge capacity is achieved, and the actuator.

CONTROL UNIT:

Unit which establishes the opening and closing of the main valve. The arrangement shall consist of redundant individual control paths in operation.

Parcol 1-5648 Pressure Reducing and Desuperheating Control Valve for CSPRS function with drilled basket silencer and **LVPA 3-4211** desuperheater with variable area steam atomizing nozzle





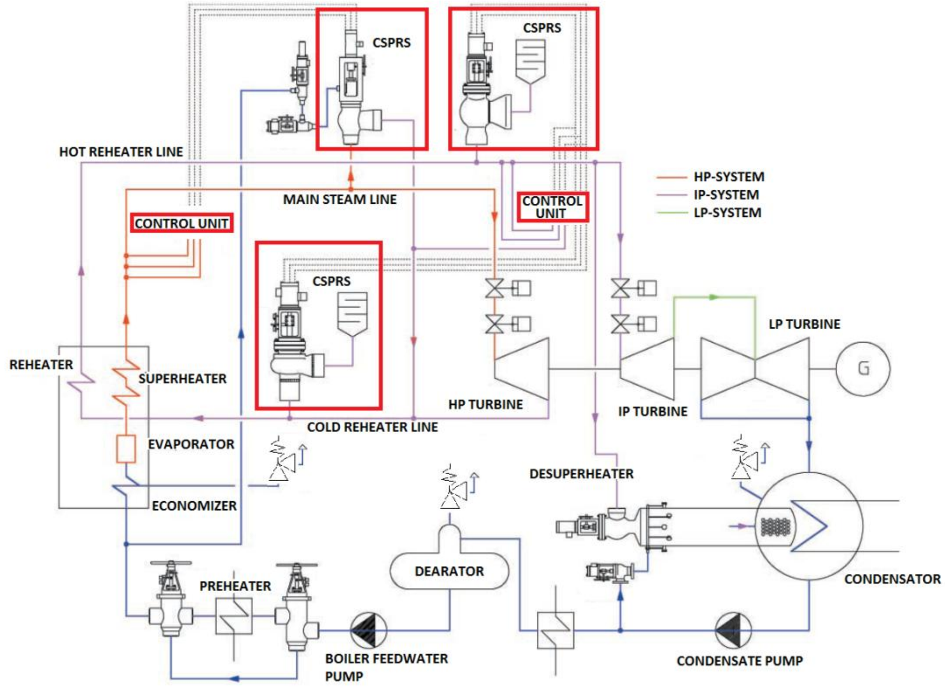
a) Two control lines, relieving principle

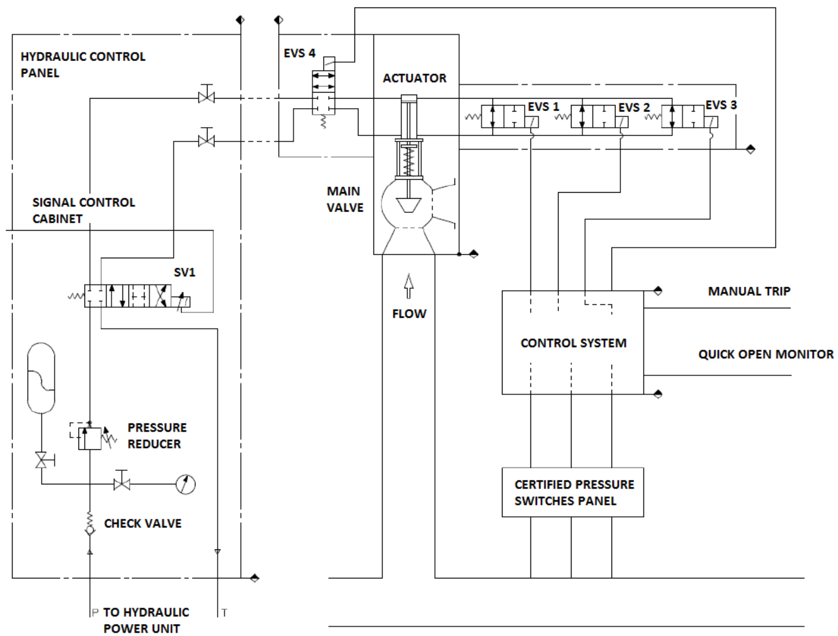
CSPRS – APPLICATION AND LAYOUT

Equipped with a hydraulic actuator and the necessary safety control devices, **1-5600 PARCOL** valve can operate as combined turbine steam bypass and superheater safety valve. When steam pressure rises up to the set value of one switch, it de-energize the corresponding solenoid valve, which opens a duct connecting the two chambers of the actuator, causing the bypass valve opening under the combined steam pressure and spring thrust to open.

I. 3 set of safety switches.

II. The redundancy of pressure switches and solenoid valves guarantees the safety of the system.



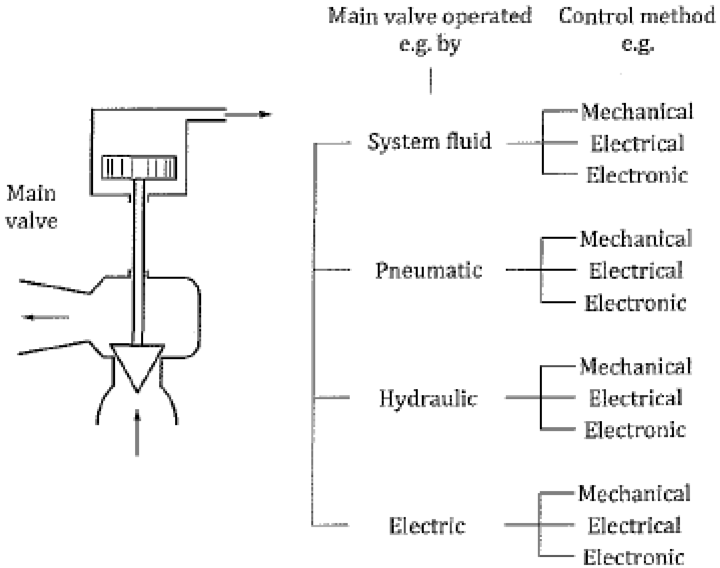


CSPRS – LOADING PRINCIPLES

Principle in which a main valve opens when the operating force is applied, and in which the main valve closes when the operating force is removed (according to EN IS0 4126-5).

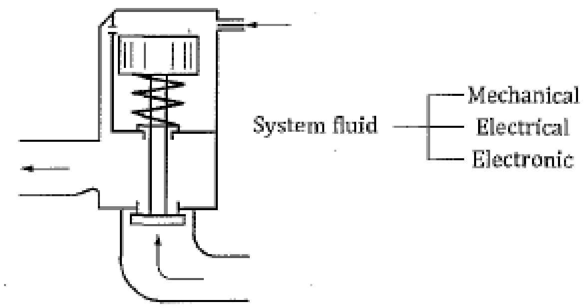
RELIEVING PRICIPLE

System opens main valve relieving the pressure inside actuator.



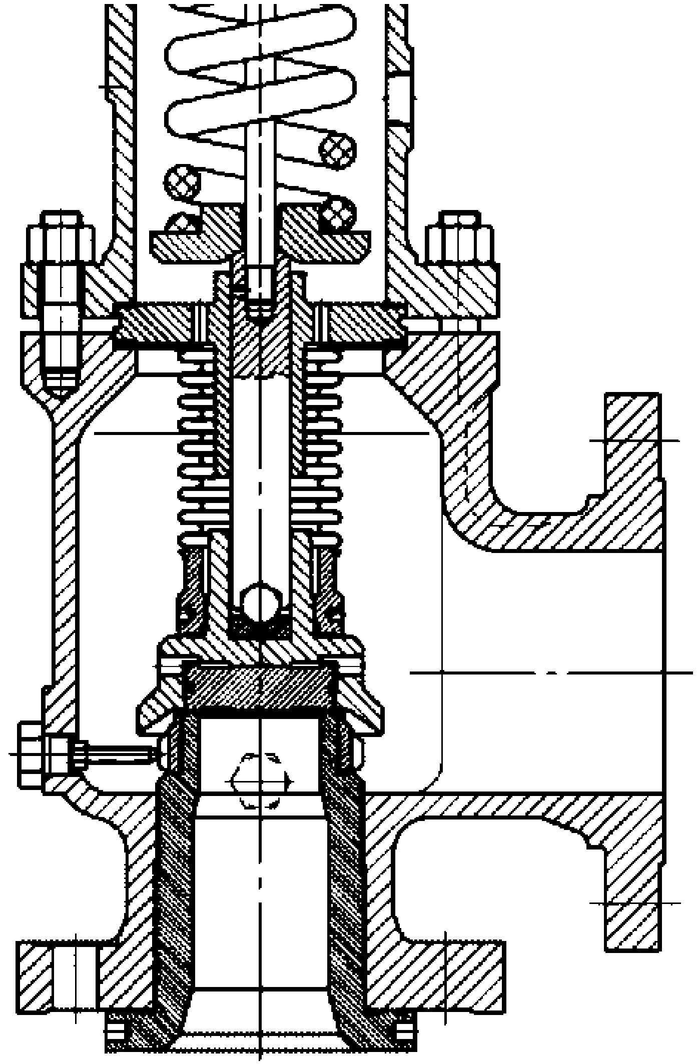
LOADING PRINCIPLE

System opens main valve loading the pressure inside actuator.



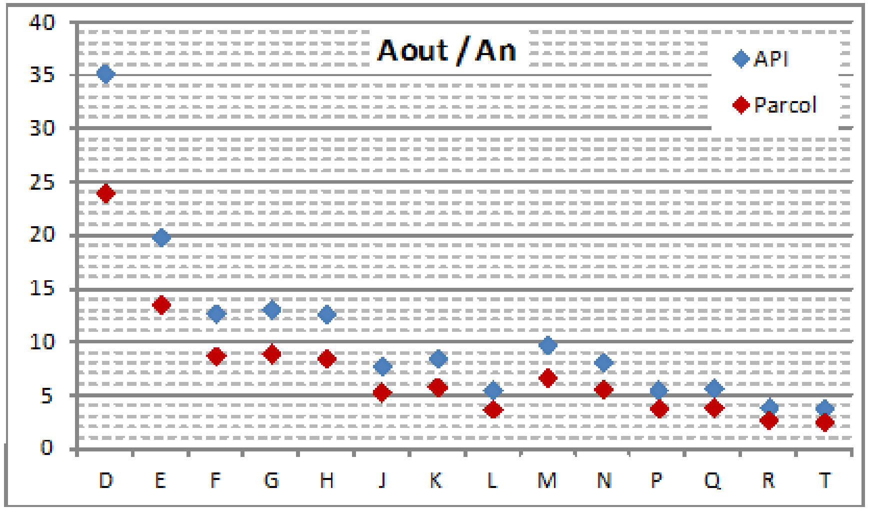
MATERIALS

- **Standard materials**
  - carbon steels;
  - alloy steels (Cr-Mo);
  - stainless steels
- **Special materials**
  - duplex stainless steels (SAF 2205, SAF 2507)
  - non ferrous materials (Hastelloy, Monel, Inconel)
  - Ti-alloys
- **Welding overlays (sealing surfaces)**
  - Stellite
  - Tribaloy
  - HVD1
  - Hastelloy
  - Monel
  - Inconel



SAFETY VALVE - GEOMETRIES INTRINSIC LIMITS

orifice	dout	API 526		Parcol 3-5402 series		
		dn	Aout / An	dn	Aout / An	
-	mm	mm	API	mm	-	
D	50	9.51	35.2	10.2	24.0	
E	50	12.7	19.8	13.6	13.5	
F	50	15.9	12.6	17	8.7	
G	65	20.3	13.0	21.8	8.9	min:
H	80	25.4	12.6	27.5	8.5	5.3
J	80	32.5	7.7	34.8	5.3	
K	100	38.9	8.4	41.7	5.8	
L	100	48.4	5.4	51.9	3.7	
M	150	54.4	9.7	58.2	6.6	
N	150	59.7	8.0	63.9	5.5	
P	150	72.4	5.5	77.6	3.7	
Q	200	95.3	5.6	102	3.8	
R	200	114.6	3.9	123	2.6	
T	250	146.1	3.7	157	2.5	



Valve Size Influence on the Discharge Capacity of Spring Loaded Safety Valves

Prof. Vincenzo Dossena

Valve World Asia Conference, 2007, Shanghai

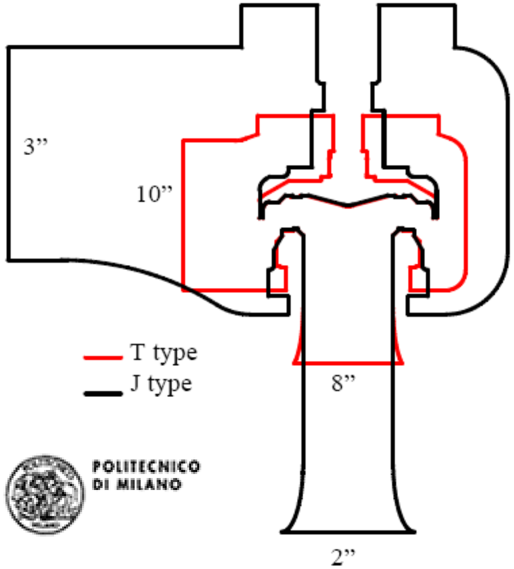
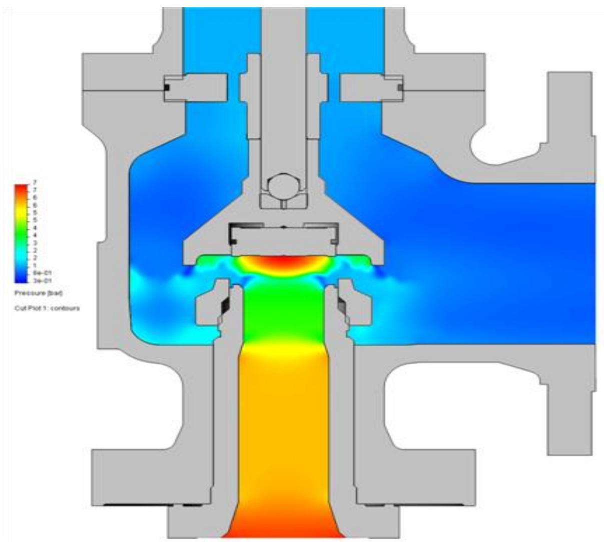


Figure 7. Non dimensional comparison of T and J types valves scaled to the same orifice diameter

SAFETY VALVE - DESIGN DEVELOPMENT

CFD



PRESSURE CONTOURS

DN 8" T 10"

R&D TEST

3-5400 DN 2" J 3"

FLUID DYNAMIC CONSIDERATIONS

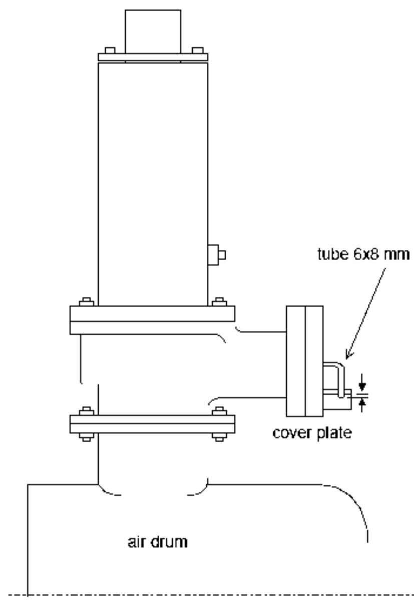
I. HIGH PRESSURES.
II. LOW AND HIGH TEMPERATURES.
III. LARGE SIZE.
IV. EFFECTS OF CHOCKED FLOW.

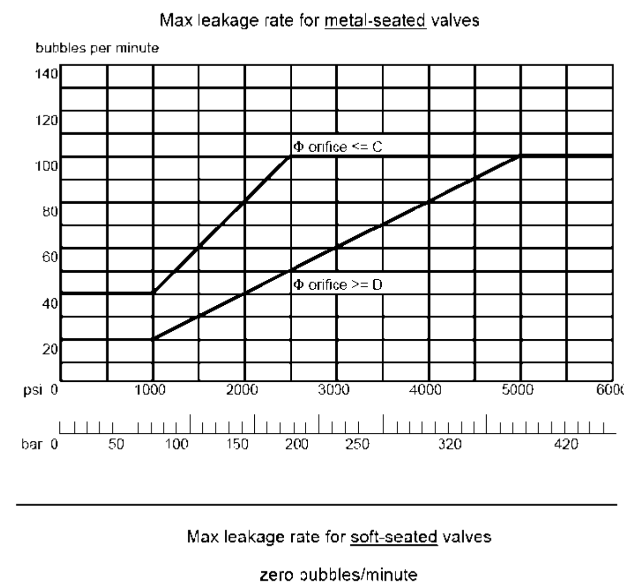
SAFETY VALVE – FACTORY TEST

- **Hydrostatic pressure test** (of pressure containing parts)
- **Set pressure** (cold differential test pressure included)
- **Seat leakage** (bubbles/minute for vapor/gas; drops/minute for liquids)
- **Adjustment of regulation devices, if any** (i.e. adjusting ring)
- **Plumbing**
- **Check of valve nameplate**
- **Issue of test report** (valve certificate)

$$P_{HPT\_PED} = \max\begin{cases} 1.43 \cdot PS \\ 1.25 \cdot PS \cdot \left(\dfrac{S_{@Tamb}}{S_{@TS}}\right) \end{cases}$$

OPERATION TEMPERATURE °C	CORRECTION FACTOR
T ≤ 100	/
100 < T ≤ 250	+ 2%
250 < T ≤ 500	+ 3%
T > 500	+ 5%





THANKS

FOR

YOUR ATTENTION