

History _____ 1

Timeline _____ 2

Rupture Discs ____ 8

Rupture Pin _____ 8

Relief Concepts _____ 3,4,5

ESV Concepts _____ 6

Buckling Pin _____ 9

Relief Concepts _____ 6,7

ESV Concepts _____ 7

**Advantages Over
Rupture Discs** ____ 10,11

General Info _____ 12

Tinius-Olsen Test _____ 13

Euler's Formula _____ 13

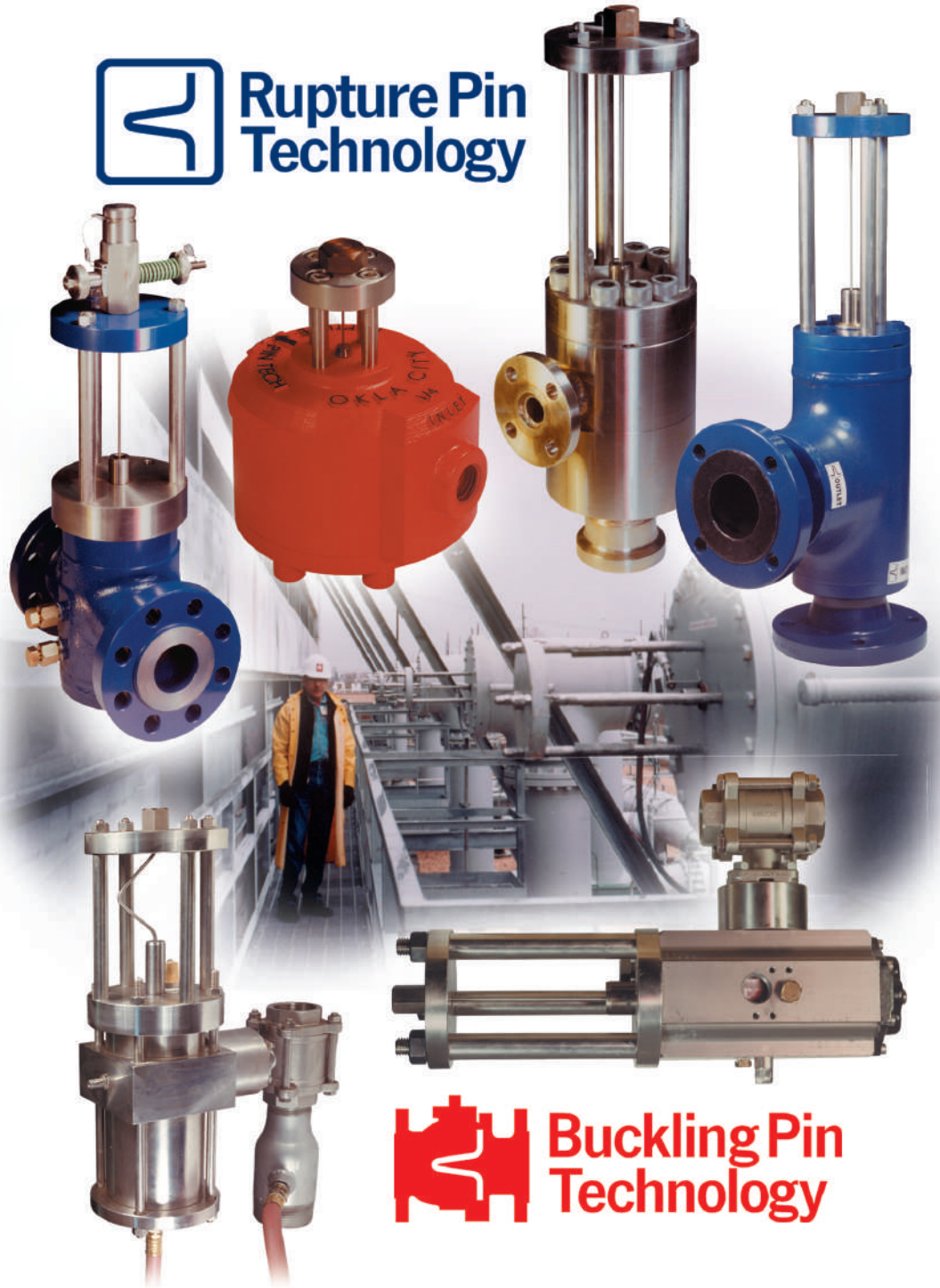
Quote Info _____ 14

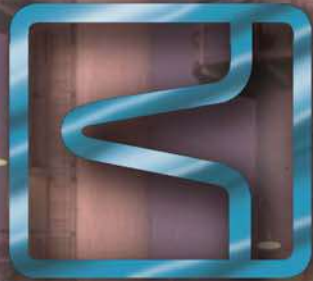
**Rupture Pin
Applications** _____ 15

**Buckling Pin
Applications** _____ 16

**Representative
Information** _____ 36

New Products ____ 37+





The History Of Rupture Pin

Rupture Pin Technology was developed in 1986 to solve a problem for Exxon and Shell in Holland where pilot operated valves were failing to operate 5% of the time.

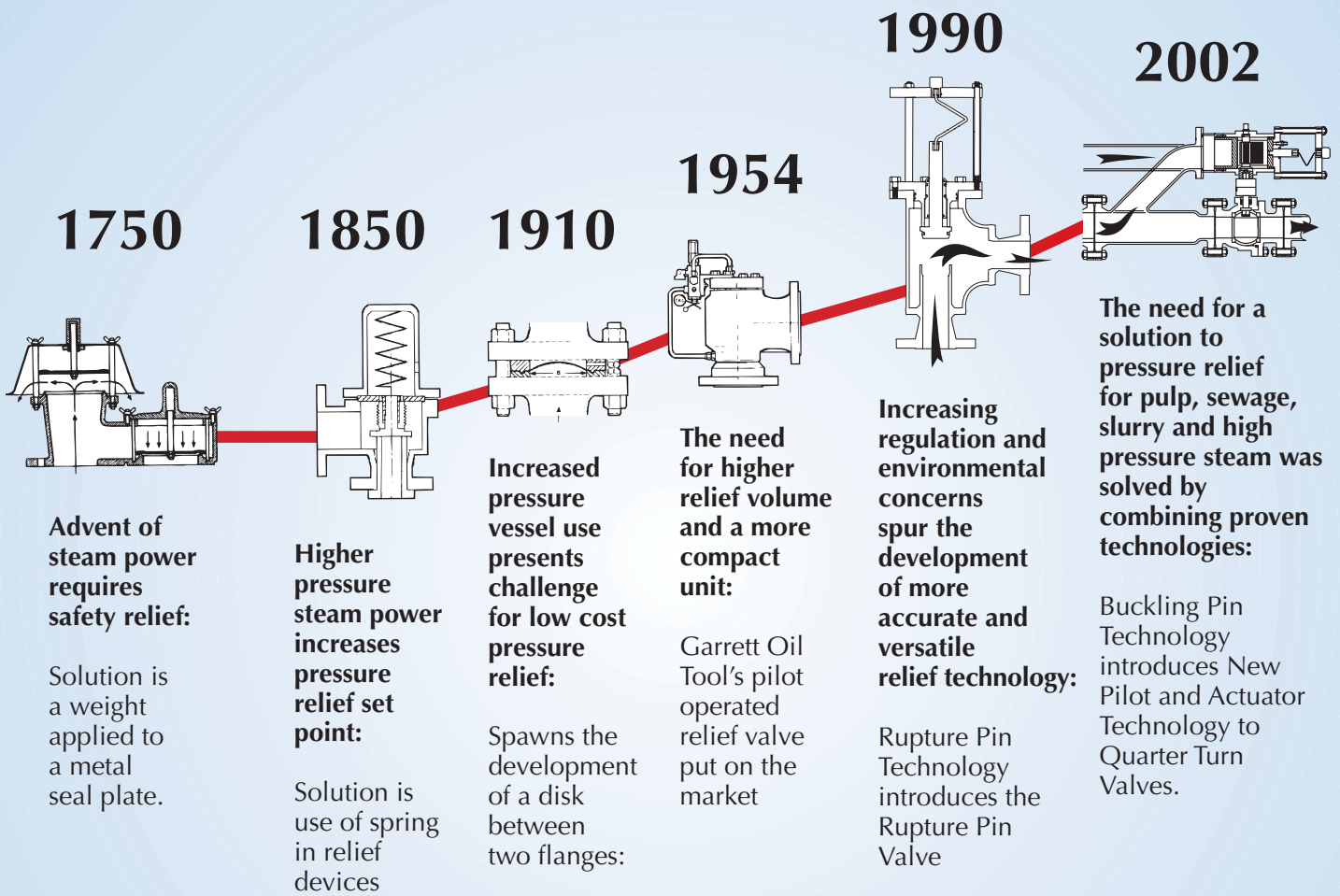
The tolerance on set point (83 bars) was $\pm 1\frac{1}{2}\%$ so all conventional methods did not apply.



Research by Taylor Tools successfully developed a unique Buckling pin to either open or close a bubble-tight valve element in milliseconds.

Volume sales started after ASME approval of Buckling Pin Section VIII UG 127c, Code Case #2091, May 2, 1990. Code stamped (ASME & NB) valves are available.

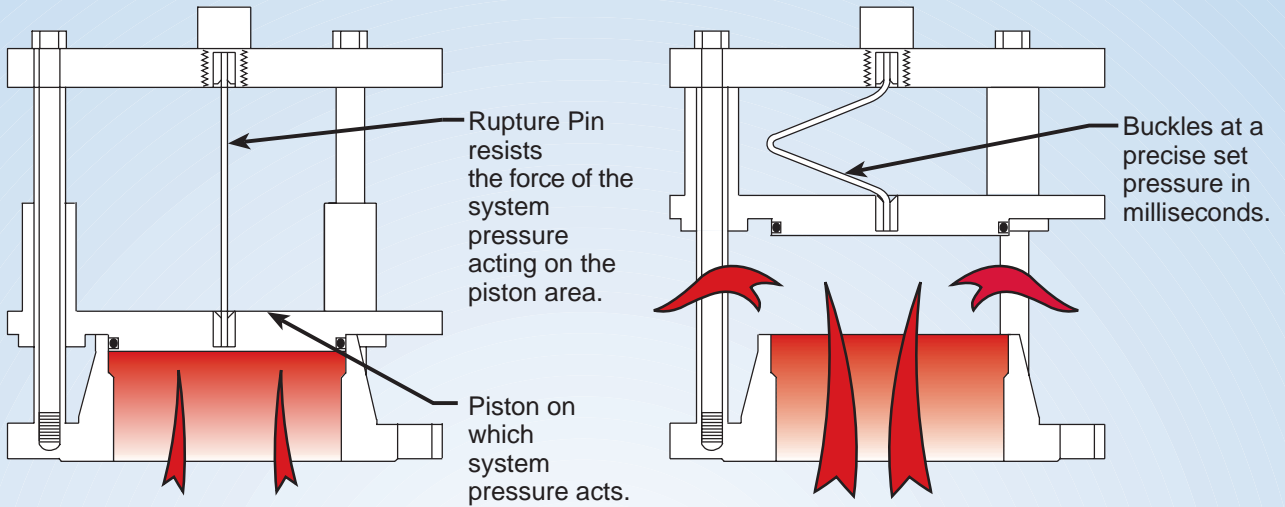
Time Line Of Relief Devices



Rupture Pin Relief Concepts

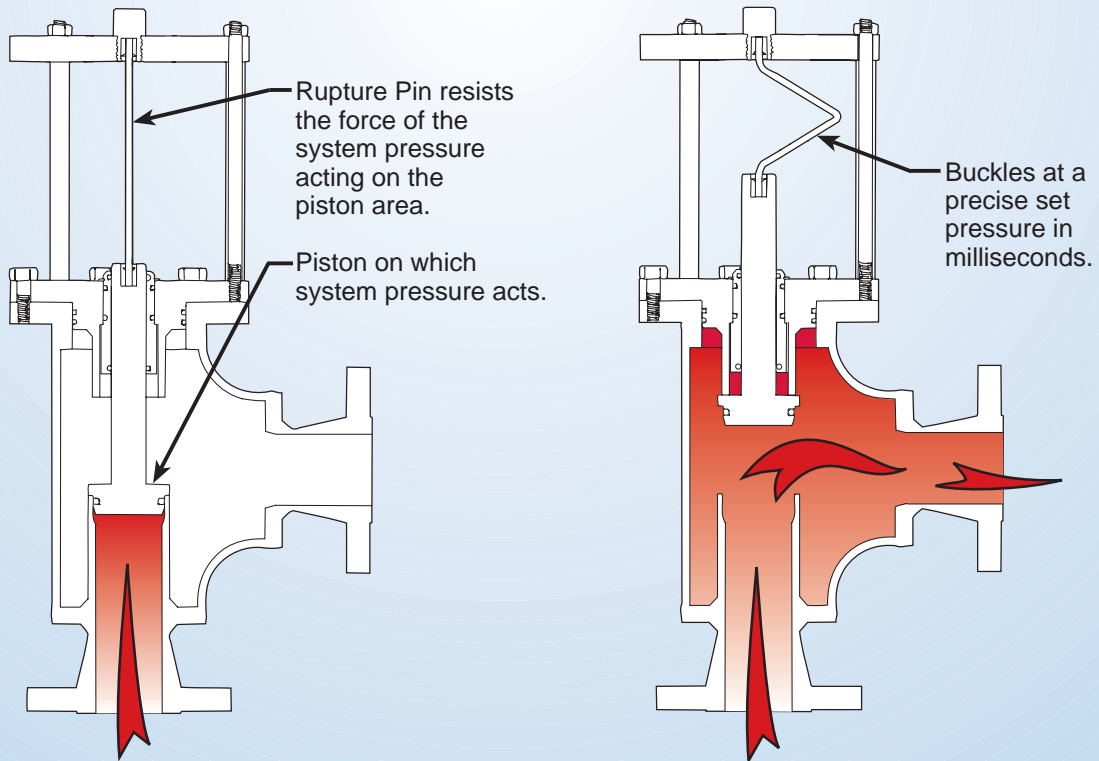
Rupture Pin Relief Valve Fuse (RVF)

Opens with excess pressure - Vents to atmosphere



Rupture Pin Relief Valve (RV)

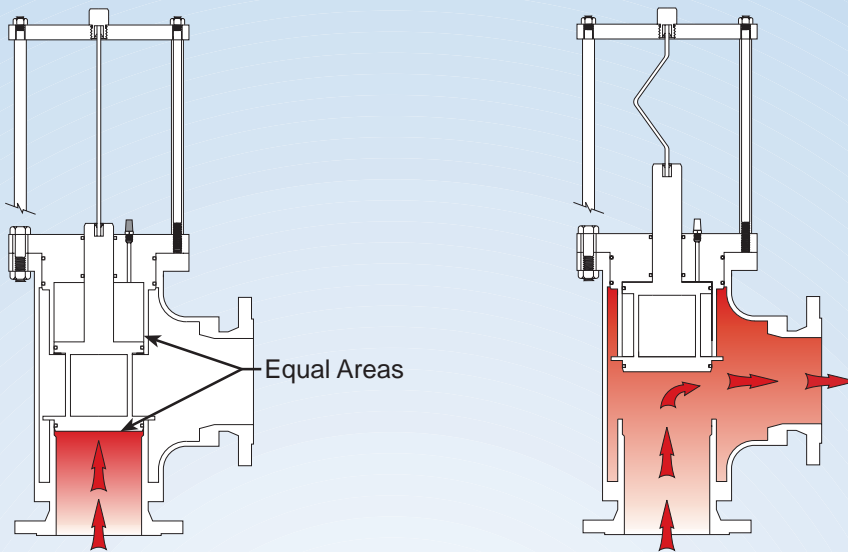
Opens with excess pressure



**Closed-Pressure
Below Set Point**

**Full Open-Pressure
At Set Point**

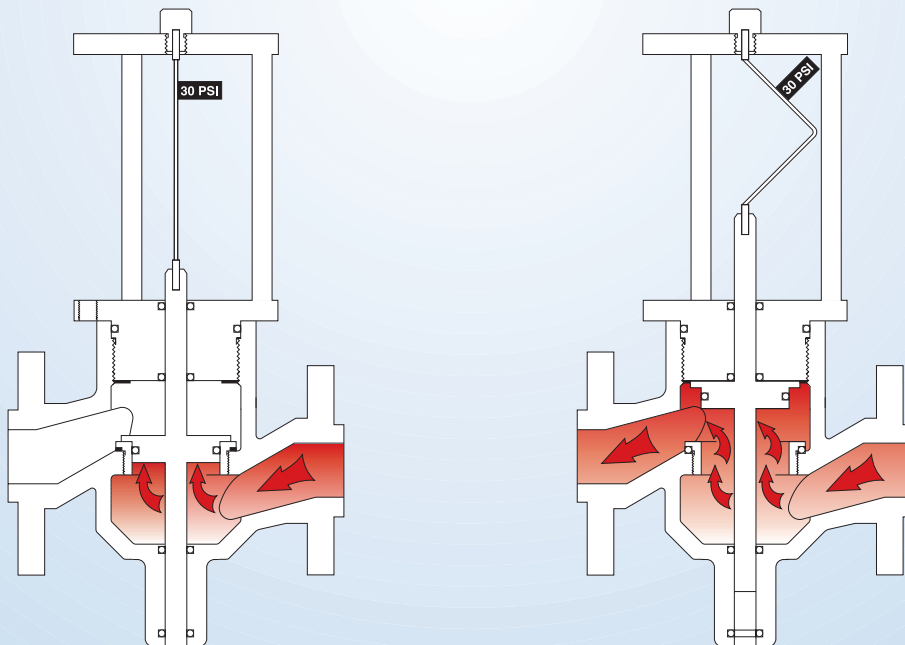
Rupture Pin Relief Concepts



Balancing Out Downstream Pressure

This is important where downstream pressure is relatively large, or varies. An example is the back pressure from a containment vessel to collect the relief valve discharge. Balancing is done by adding

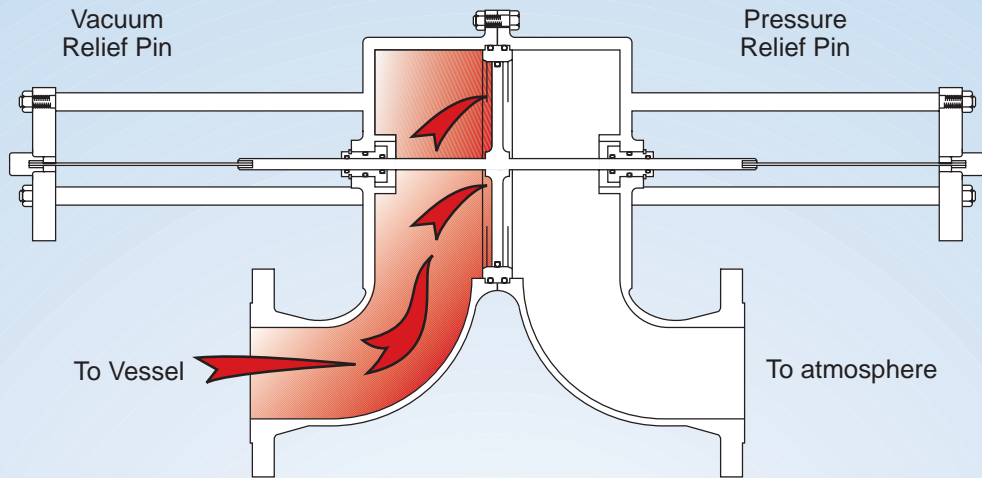
an additional piston referenced to atmosphere. The area of the balancing piston is equal to the area of the main piston. Downstream pressure "sees" equal areas on the stem and thus has no effect.



Balancing Out The Stem Area

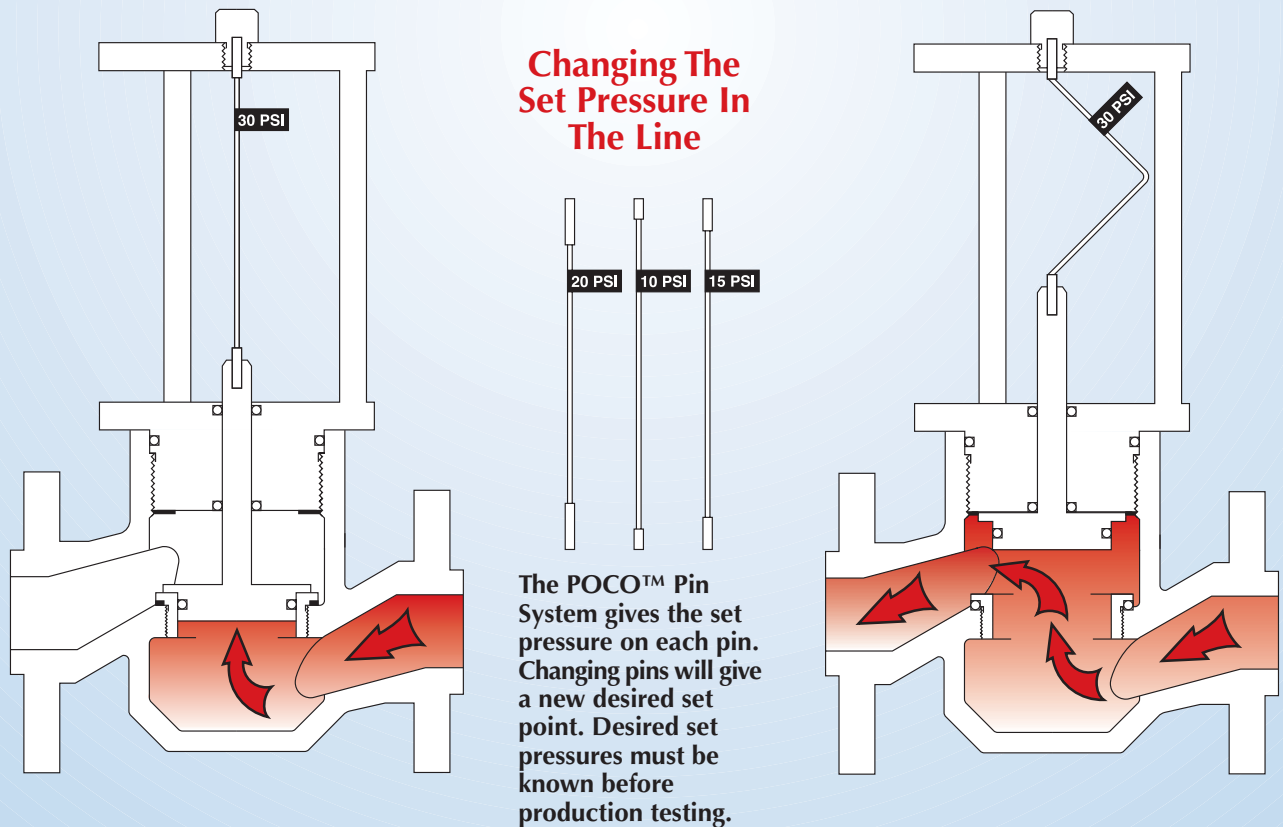
This is done when it is desired to relieve differential pressure as across a positive displacement meter, filter or flame arrestor. The valve "sees" only differential pressure.

Rupture Pin Relief Concepts



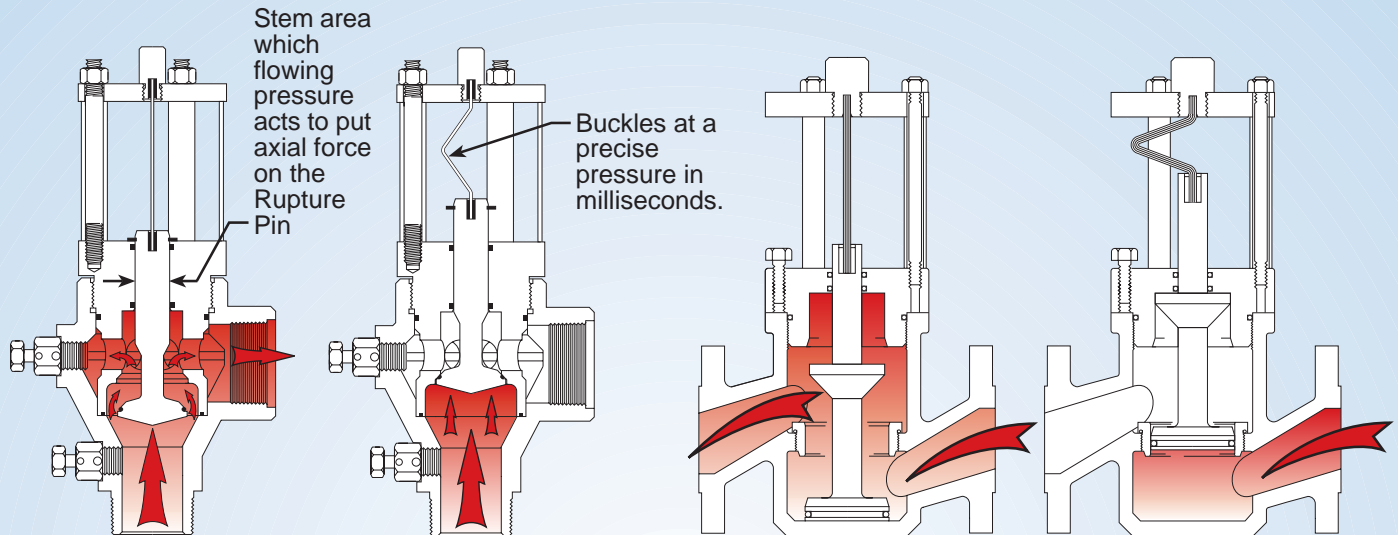
Low Pressure And/Or Vacuum Relief

Emergency high pressure and vacuum protection is possible with one valve. The settings are determined by the pin modulus of elasticity, the pin diameter and pin length.



Rupture Pin Emergency Shutdown Valve (ESV) Concepts

Closes with excess pressure



Model A - Angle Type

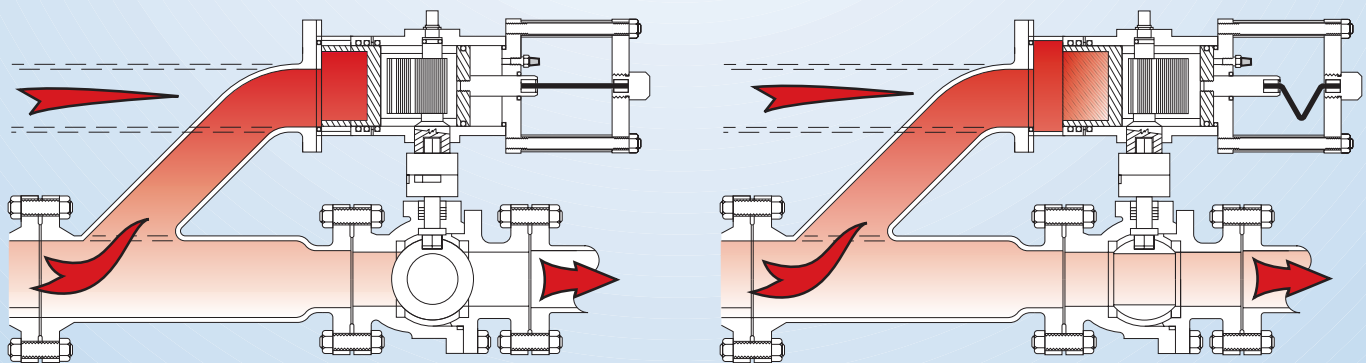
Flowing pressure acts on the stem area puts an axial force on the pin. At set pressure the pin buckles and the valve closes. In the case of a downstream line break, fluid impact on the piston face will put an axial force on the pin to close the valve if the flow has sufficient mass.

Model B - Inline Type

Flowing pressure acts on the stem area puts an axial force on the pin. At set pressure the pin buckles and the valve closes.

Buckling Pin Relief Valve (RV) Concepts

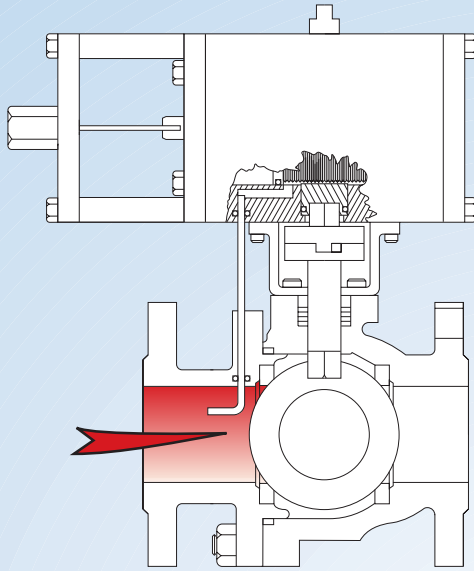
Opens With Excess Pressure



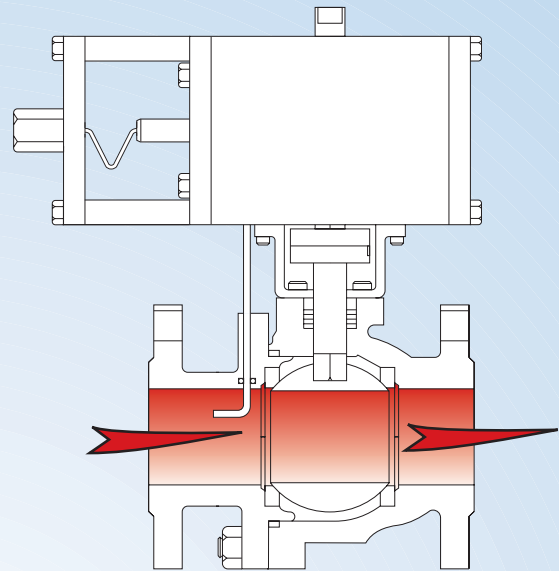
This design is reliable for difficult fluids as pulp, sewage, high pressure steam etc. Note that the actuator utilizes a plunger and that a delayed action (20° to 90°) clutch isolates the valve friction from the actuator to insure actuator accuracy. By rotating the ball 90°, the assembly becomes an ESV.

Buckling Pin Relief Valve (RV) Concepts

Opens With Excess Pressure



**Closed-Pressure
Below Set Point**

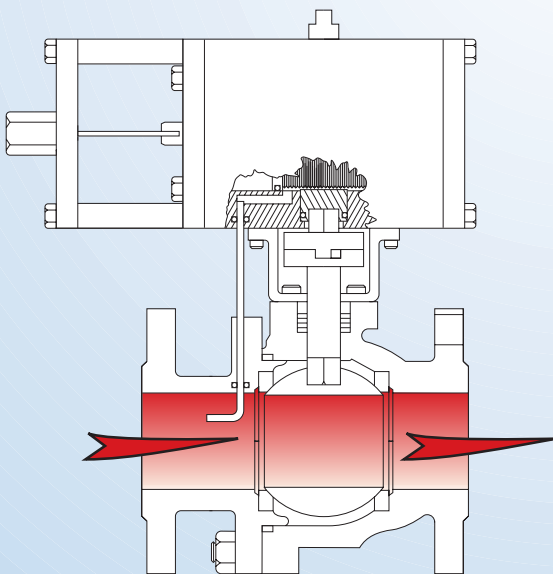


**Full Open-Pressure
At Set Point**

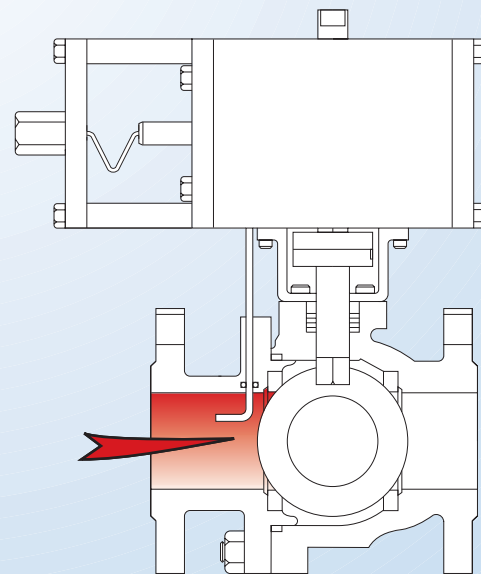
Conventional actuators are used only for clean, non-corrosive fluids. For dirty fluids a larger sensing line and a plunger actuator is used.

Buckling Pin Emergency Shutdown Valve (ESV) Concepts

Closes With Excess Pressure



**Open-Pressure
Below Set Point**



**Closed-Pressure
At Set Point**

Conventional actuators are used only for clean, non-corrosive fluids. For dirty fluids a larger sensing line and a plunger actuator is used.

Why Rupture/Buckling Pin Devices Should Be Used Instead Of Rupture Discs

(See Comparison Table-Page 10)

Rupture Discs

Rupture discs typically represent the lowest first cost method of relieving pressure, but often the highest operational cost.

An advantage to using rupture discs is that you usually have full flow at 0% over pressure. (When the disc breaks)

Accuracy is often poor because you cannot directly verify the set point.

At pressures below 40 psi the set point error resulting from the use of manufacturing ranges can often be so great that the burst pressure is a guess at best. The main inherent weakness of rupture discs is the fact that the discs stress at the burst point is much greater than the yield stress. The stress-strain curve of a forward acting/tension loaded rupture disc is shown. (page 11) Once the disc is pressured beyond its yield point the disc is irreversibly damaged. Unless, the pressure continues to increase to the burst pressure, the disc will fail far below set point usually at the next pressure increase over yield point. Yes, when the disc breaks early, it "fails safe", but consider the needless pollution, loss of product, downtime, disc replacement cost and labor to replace the disc.

Another limitation is the fact that many times operators neglect the fact the discs "see" only differential pressure. Any downstream pressure will increase the set point by an equal amount. Thus if the discharge from a rupture disc goes to a containment vessel where the pressure varies, you really don't know the true disc set pressure.

Discs are extremely temperature sensitive. We assume the temperature the disc sees is the system temperature, but if the disc is at the end of a dead ended piece of pipe, this isn't true. Since the temperature at the disc isn't measured you really don't know the true set point.

Another difficulty is that discs are delicate and so require careful handling storage and exact adherence to the installation and bolt torque procedures. If the handling and installation procedures are not followed exactly discs usually burst early, causing a loss of product and unwanted downtime.

Rupture discs cause major ecological pollution, because changing a disc requires physically opening of the line or removing the relief valve above it. Once the process is open to the atmosphere you have process fluids going to the atmosphere and falling to the ground.

If the process fluids are toxic you have to suit up at least two (2) maintenance specialists to change out the disc.

Discs are also susceptible to failing early due to fatigue, particularly if the fluid pressure pulses.

Rupture discs can also release plastic and metal fragments into the downstream system when they open. This can prevent relief valves from closing and plug flame arrestors or other downstream equipment.

In many cases vessels are over designed to allow for rupture disc inaccuracies.

Rupture Pin Devices

A. Devices that open for pressure relief.

Rupture Pin relief devices usually consist of a piston or plunger on seat; restrained from movement to the open position by a slender round pin. The pin buckles at set point from an axial force caused by system pressure acting on the piston or plunger area. The pin is retained at its extremities by close fitting recesses. The buckling point of the pin is determined by the unrestrained pin length, the pin diameter and the modulus of elasticity of the pin material. The only temperature sensitive element in the formula is the modulus of elasticity term. It is important to use a metal alloy for the pin whose modulus of elasticity does not vary over the ambient temperature range where the pin is located. For instance one special nickel alloy has a modulus variation of .3% over a temperature range from -100°F to +400°F.

There is no valve size limit, large or small. Valves have been manufactured as small as 1/8" and as large as 48". There are no pressure or vacuum limits. Valves can have a set pressure as low as 2" of water to as high as 35,000 psi and vacuums as low as 1 psi. Rupture Pin Valves can be designed to sense system pressure only, or only differential pressure. To handle corrosive fluids, special metals can be used. For extremely corrosive conditions the bodies can be glass lined or made of an appropriate plastic.

B. Devices that close to isolate pressure (Emergency Shutdown Devices)

The Rupture Pin devices in this application are in a normal unrestricted flow condition. The piston is held open by an external pin. The axial force on the pin is generated by the systems flowing pressure acting on the piston stem area. At set pressure the pin buckles, and the piston moves and seats to stop flow and isolate pressure from the downstream piping or vessels. Typically high pressures require a small stem area and low pressures use large stem areas, pistons or diaphragms. As with the Rupture Pin relief device there are no size or pressure limits. Materials of construction can handle most corrosive conditions. Simple designs are available to handle high pressure and low pressure shut off conditions in one valve.

Buckling Pin Devices

A. Devices That Open For Pressure Relief

Opening Buckling Pin Devices, differs from opening Rupture Pin Valves because instead of a piston that comes off seat at set pressure, you instead open a quarter turn valve driven by an actuator. System pressure is used to open the quarter turn valve at set pressure. The actuator is triggered by a slender pin that buckles at set pressure. The axial force on the pin is generated by system pressure acting on the actuator piston or plunger area. Another vital element is a delayed action clutch whose function is to isolate any valve friction from the quarter turn valve from the actuator. This is necessary so that valve friction does not affect the pin set point. Because of the clutch delay, the actuator is usually a 180° actuator the initial 30° to 90° of the actuator rotation allows the pin to buckle and greatly decrease its resistance and give rotating inertia to the pinion to speed valve turning in the remaining 90° of rotation. There are no reaction forces to consider.

B. Devices That Close To Shut Off Pressure Downstream (Emergency Shutdown Valves)

Closing Buckling Pin Devices differs from closing Rupture Pin Devices because instead of a piston that seats to stop flow at set pressure you instead close a quarter turn valve driven by an actuator. System pressure is used to close the quarter turn valve at set pressure. The actuator is triggered by a slender pin that buckles at set pressure. The axial force on the pin is generated by system pressure acting on the actuator piston or plunger area. Another vital element is a delayed action clutch whose function is to isolate any valve friction from the quarter turn valve from the actuator. This is necessary so that valve friction does not affect the pin set point. Because of the clutch delay the actuator is usually a 180° actuator. The initial 30° to 90° of the actuator rotation allow the pin to buckle and greatly decrease its resistance and give rotating inertia to the pinion to speed valve turning in the remaining 90° of rotation. There are no reaction forces to consider.

C. Devices To Meet Special Applications

Multi-Action Buckling Pin Devices that rotate 45° to 180° are available for other applications. Normal thru flow quarter turn valves require a 90° movement to function. However 3 way and 4 way ball valves can be used with the Buckling Pin Technology system to perform other functions. An example is that you may not only need to shut off upstream pressure to a process system but you may also want to drain the downstream pressure simultaneously.

The Versatility Of Quarter Turn Valves

- Balanced valves are available that are stable at all positions.
- They have full-bore opening and even butterfly valves have large cv's.
- They are built to open and close under pressure.
- Ball valves in particular can tolerate dirty fluids such as pulp, sewage and slurries.
- Triple offset metal seated, quarter turn valves can open or close tight in high-pressure steam applications.
- They are available in many sizes, materials pressure and vacuum ratings.
- They have good, versatile seal designs.
- They are compact and designs are available to mount between flanges.
- Costs are low compared to other valve types.
- Three and four way ball valves can be used effectively in unique applications.
- Valve reaction forces are not a concern.

Required Actuator Characteristics

- Stainless steel body.
- Steel or stainless pinion and gear rack.
- Grease can be injected in thru a zerk fitting in the top of the pinion to lubricate the gear system.
- Use a stainless actuator plunger to sense system pressure.
- Size the actuator plunger to the required valve torque vs. the system pressure available.
- To reseal the valve under pressure the portable pressure source should be at least twice the system pressure.

Advantages

Solutions to Rupture Disc Problems

Tension Loaded Rupture Disc's Major Problems	Rupture / Buckling Pin Solutions
Discs fatigue and usually fail early. Yearly Replacement is recommended.	Buckling Pins cannot fatigue; They buckle at set point - no yearly replacement required.
With the many chain tolerances, working close to set point is impossible.	Maximum operating pressure to 95% of set point. Zero leakage to set point.
Downstream fragmentation. Metal and plastic chards clog and damage downstream equipment.	No downstream trash possible.
Vacuum support may be required.	No vacuum support required.
Many chain tolerances (manufacturing, temperature and set point). Pressures below 40 psi have severe accuracy penalties.	Tolerance, below 5 psi, +/9%. 5 psi and above +/5%.
Senses differential pressure only. A major problem with containment systems.	Can sense upstream pressure only or differential pressure only.
Discs can be installed improperly.	It is difficult to imagine a pin installed improperly.
Discs are in contact with corrosive system fluids.	Pins are external to the process fluid and are made of corrosion resistant metals.
Costly storage and handling required.	Pins are rugged and can be stored at the valve.
Costly time is required to change the discs.	Pin changing is done with one man in minutes, even with large valves.
It is difficult or impossible to tell when a disc is cracked or burst. Open line visual inspection is usually required since broken disc indicators are not reliable.	A buckled pin is visually apparent. A proximity switch to sense a rising stem is reliable.
To change settings you must break the line, causing pollution.	Settings can be changed in minutes without breaking the line using the "Poco" system. (Optional)
Since the temperature of the disc is not monitored, you do not know the set point.	The pin is not ambient temperature sensitive.
Burst stress is much greater than yield stress.	Buckling stress is much lower than yield stress.
In many cases vessels are over designed to allow for rupture disc inaccuracies.	Rupture Pins are accurate, no vessel over design is required.

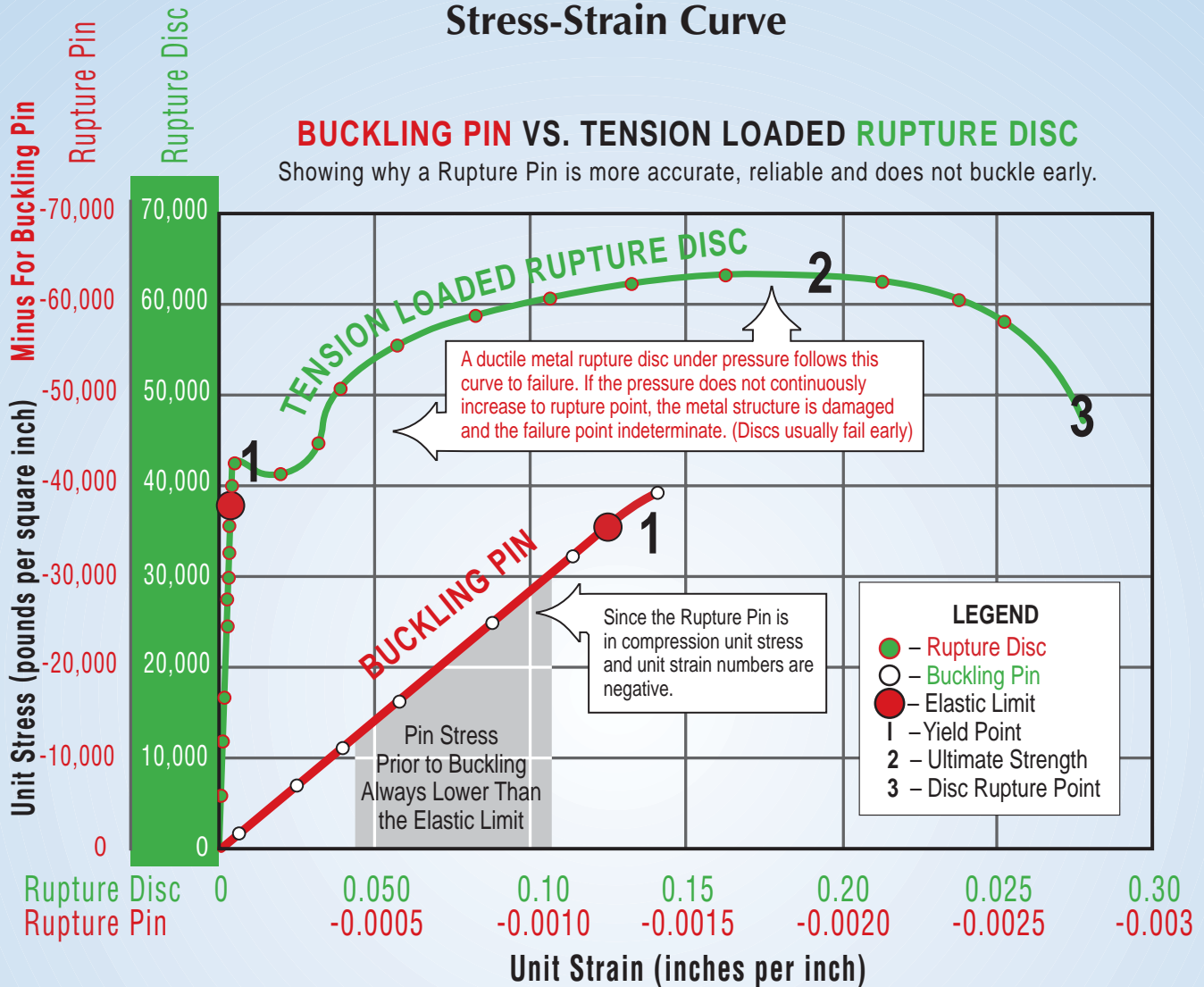


Advantages

Stress-Strain Curve

BUCKLING PIN VS. TENSION LOADED RUPTURE DISC

Showing why a Rupture Pin is more accurate, reliable and does not buckle early.



The main weakness of rupture discs is the fact that the discs stress at the burst point is much greater than the yield stress. The stress-strain curve of a forward acting/tension loaded rupture disc is shown. Once the disc is pressured beyond its yield point the disc is irreversibly damaged. Unless the pressure continues to increase to the burst pressure, the disc will fail far below set point usually at the next

pressure increase over yield point. Yes, when the disc breaks early, it "fails safe", but consider the needless pollution, loss of product, downtime, disc replacement cost and labor to replace the disc.

With the Buckling Pin the pin stress is always below the elastic limit because its mechanism of failure is Euler's Law. The pin can not fatigue.

Rupture Pin Valves

Yearly or Periodic Maintenance

Maintenance consists of assurance that the piston freely opens. Open the valve without a pin in place. If the pressure required to unseat the valve is more than 10% of the set point, remove the valve bonnet from the valve and clean all internal parts and replace all "O" rings.

Unless the pin is bent (check for bends by rolling-down a flat inclined surface), the pins have an infinite life.

Warning: do not remove the top plate or posts since exact alignment was made at the factory.

Certification Test

The pin diameter is measured to five decimal places and the length to four. Once pin dimensions are finalized, at least three pins are buckled at set pressure and deviations are noted. The ASME standard call for set point variation of $\pm 5\%$ but rarely is the deviation over $\pm 3\%$ from set point; $\pm 1\%$ is common. After successful valve testing, two to three pins are tested in a Tinius Olsen machine to determine a stress strain curve for the archives. If pins from a future different material batch are tested, the set point must not vary from the archive set point average by more than $\pm 1\%$. Special machines are used to cut the

pins to length perpendicular to the pin axis and polish the cut end. On pins over 1/8" diameter, a logo indent mark is placed on the end face to insure it is a genuine certified pin. To order pins you must know the valve serial number. This number is stamped on the valve label and on the valve bonnet. If ordered before noon, pins can be shipped the same day.

Certification tests are done on all valves. Sample certification results are shown. All pins are labeled with all pertinent information required to match the pin to the valve.

The Pin

For accuracy the pin must have a precise diameter, length and material modulus of elasticity. The Euler's Law formula for buckling as it applies to Rupture/buckling pins follows. The graph on the following page shows how pin resistance changes before and after the set point of the pin is reached.

The pin can never fatigue. The only factor in the Euler formula that is temperature sensitive is the pin material modulus of elasticity. It is important that the modulus of elasticity be constant over the ambient temperature range the pin will experience in operation.

The stress strain curve for a forward tension rupture disc is shown to bring out the fact that with a rupture disc the ultimate burst strength is far greater than the elastic limit whereas the buckling stress of the pin is far lower than the elastic limit of the pin.

The pin dimensions must be precise. For these reasons it is important that only genuine Rupture/Buckling Pins be used. If genuine Rupture/Buckling Pins are not used, the valve warranty is void. Pin identification marks and labels must not be defaced.

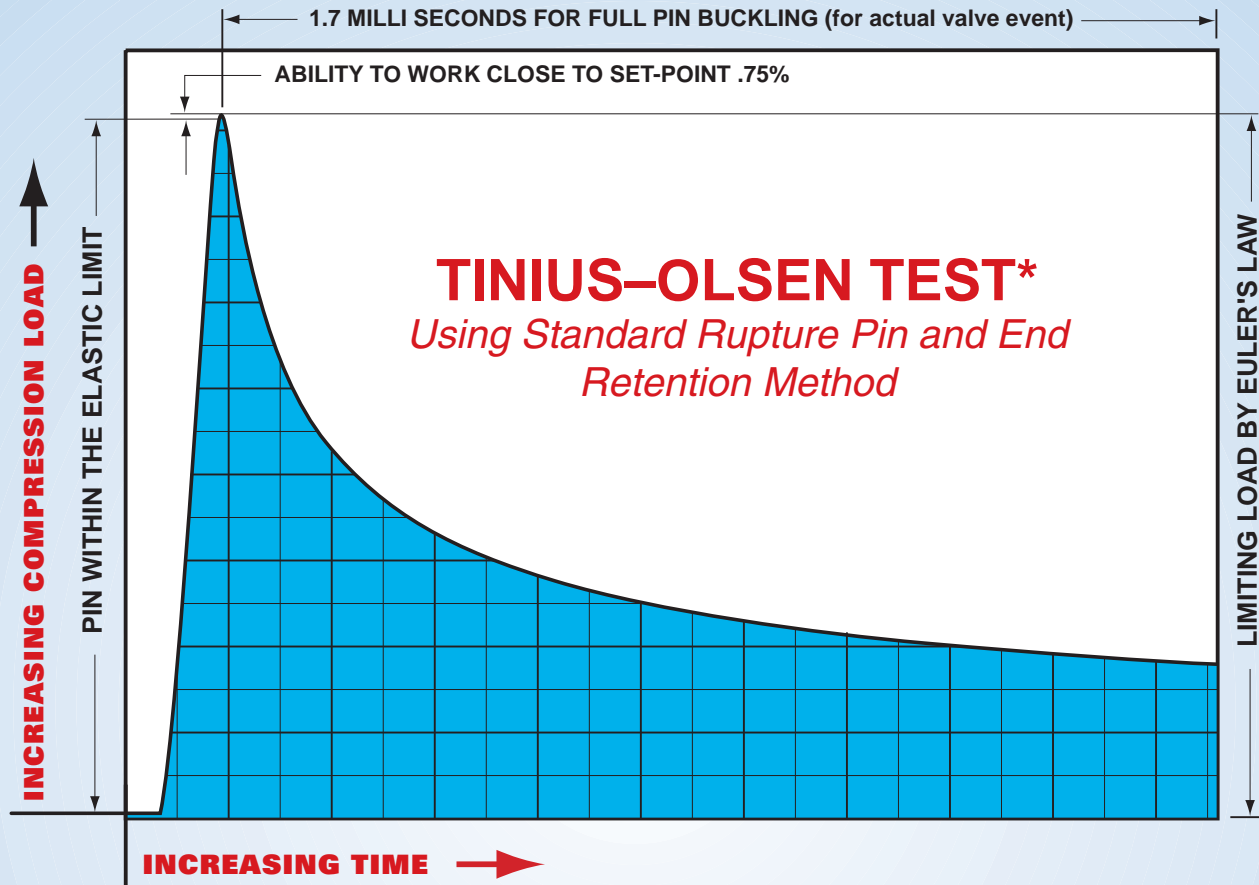
Options

1. Pin holders are optional on all valves so that pins can be readily available for resetting.
2. Proximity sensors are optional on all valves for a remote indication that the valve has opened.
3. Fire safe features are optional on all valves.
4. Remote operating option is available on all valves except high/ low emergency shutdown valves and fire safe valves.
5. Balancing out downstream pressure is optional.

Valve Orientation

Pins are sized with the valve oriented as it will be in actual use; so that piston weight will not affect set point. This is essential where piston weight is more than 1% of the axial force on the pin.

Characteristics Of The Pin



The Characteristics of the Buckling Pin make it uniquely suited for the application:

$$\text{AXIAL FORCE ON THE PIN CAUSING THE PIN TO BUCKLE} \sim \frac{\text{PIN DIAMETER}^4 \times \text{PIN MATERIAL MODULUS OF ELASTICITY}}{\text{PIN LENGTH}^2}$$

(piston/plunger area x system pressure)

1. The pin obeys Euler's Law and buckles precisely at set point:
2. The buckling point is exact, $\pm 1\%$ of set point is common.
3. The opening is rapid.
4. The modulus of elasticity is the only factor that is temperature sensitive. Materials used for the pin have a constant modulus over the ambient temperature range experienced during use.
5. The pin is external from corrosive system fluid. Corrosion is easy to eliminate by using a stainless or alloy pin material. Plating or coating is also possible.

Corrosion of the pin is not a factor in the application.

6. One of the most important characteristics of the pin is that the pin bows elastically to allow a slight axial movement. For instance, the elastic bow of the pin will allow about a .009" axial piston movement with a 2" valve. This is more than enough movement to remove built-up friction before set point is reached. This movement breaks loose any seal cold vulcanization or penetration of the elastomer into the minor surface roughness of the metal seat over time. The result of piston movement, the seal friction returns to that experience when the valve was tested prior to shipment. The set point is held.

* Test graph of a 1" valve set at 900 psi.

RUPTURE/BUCKLING PIN TECHNOLOGY

Customer Specifications and Application Sheet For A Quotation

Date _____
Customer _____
From _____

Fax No: _____
Phone No: _____
Project: _____

Application Description:

Angle Body _____ In-line Body _____ Quarter turn valve: _____ Ball, _____ Butterfly

Service Conditions:

1. Maximum operating pressure: _____ PSIG (or provide other units)
2. Desired set pressure: _____ PSIG (or provide other units)
3. Fluid type / state: _____
4. Temperature: Maximum: _____ Operating: _____ Degrees F (or provide other units)
5. Backpressure: Constant: _____ Variable: _____ PSIG (or provide other units)
6. Allowable overpressure: _____ % (10% standard)
7. Molecular weight: _____
8. Specific gravity: _____
9. Viscosity at flowing temperature: _____ CP
10. Compressibility: _____
11. Ratio of specific heats: _____
12. Relieving capacity required: _____ (provide unit of measure)

Connections:

13. Size NPT Inlet: _____ Outlet: _____
14. Class flange Inlet: _____ Outlet: _____
15. Other _____

Materials: Of Construction:

16. Body: _____
17. Seat: _____
18. Piston: _____
19. Gland bushing: _____
20. Seals: _____
21. Pin material 304 SS: _____ Inconel: _____ Inco: _____

Standard Options Of Materials:

Body: C/S, low temperature C/S or SS.
Seat: Stainless steel.
Piston: SS with 17-4 SS stem.
Bushing: Aluminum bronze or SS.
Seals: Viton, Buna or EDPM or other. (list)
Pins: Four come with valve.

Options:

22. Proximity switch: _____
23. Pin storage at valve: _____
24. 100% NDE: _____
25. Special Paint: _____
26. Spare pins (qty): _____
27. Fire Safe _____
28. Remote operating _____
29. Downstream pressure balancing _____
30. POCO Pin System for multiple set points _____

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Applications for Rupture Pin Valves

Using piston and plunger valves for pressure relief and emergency shutdown

Standard Rupture Pin Relief Valves

Model "B" Rupture Pin RELIEF FUSE – Valve vents to atmosphere. 1" to 24" _____	17a
Model "A" Rupture Pin RELIEF FUSE – Valve vents to atmosphere. 1/8" TO 1" _____	17b
Model "C" Angle Type Rupture Pin RELIEF VALVE – Fabricated design 1" TO 4" _____	18a
Model "C" Angle Type Rupture Pin RELIEF VALVE – Fabricated design 6" TO 96" _____	18b
Model "C" ASME/NB Certified Angle Type Rupture Pin RELIEF VALVE – 316 SS Cast Body 1" to 4" _____	19a
Model "D" Inline Type Rupture Pin RELIEF VALVE – Fabricated design 1" to 8" _____	19b
Model "D" ASME/NB Certified Inline Type RELIEF VALVE Steel or 316 SS Cast Body 1" to 4" _____	20a
Model "O" Stem Balanced DIFFERENTIAL PRESSURE RELIEF VALVE 1" to 4" _____	20b

Typical Downstream Balanced Relief Valves – Option used when downstream pressure is present so that set point is not affected.

Model "C" Angle Type DOWNSTREAM BALANCED RELIEF VALVE using the stem to balance downstream pressure – 1/2" to 4" NPT Inlet and outlet. Also available for Model "D" Inline Relief Valve _____	21a
Model "C" Angle Type DOWNSTREAM BALANCED RELIEF VALVE using a balance secondary piston – 3" to 48" with flange inlet and outlet. Also available for Model "D" Inline Relief Valves _____	21b
Model "F" Tank Emergency RELIEF VALVE BALANCED for containment vessel discharge _____	22a

Special Designs For Rupture Pin Valves

TOXIC FLUIDS – pressure relief _____	22b
MEDIUM PRESSURE RELIEF using a PISTON – 1,500 to 6,000 PSI _____	23a
MEDIUM PRESSURE RELIEF using a PLUNGER – 1,500 to 6,000 PSI _____	23b
HIGH PRESSURE RELIEF using PRESSURE BALANCING SLITS to pass the seal – 5,000 to 30,000 PSI _____	24a
HIGH TEMPERATURE STEAM PRESSURE RELIEF to 900°F _____	24b
Corrosion protected GLASS LINED PRESSURE RELIEF VALVE _____	25a
Corrosion protected all PLASTIC RELIEF VALVE _____	25b
CLEAN SERVICE RELIEF VALVES, designed for easy disassembly and cleaning _____	26a
STEAM JACKET CONDUIT thru bore RELIEF VALVE _____	26b
PILOT VALVE DOME RELIEF in case of pilot discharge failure _____	27a
PRESSURE AND VACUUM RELIEF with one valve _____	27b
FILTER CHANGE when main filter clogs _____	28a
TWO-POSITION, FIVE-WAY VALVE SHIFT at precise set point _____	28b

Special Options Available On Most Valves

FIRE RELEASE OF PIN RESTRAINT _____	29a
PROXIMITY SENSING OF OPENING _____	29a
PIN STORAGE AT THE VALVE _____	29a
POCO PIN SYSTEM TO CHANGE SET PRESSURE _____	29b
REMOTE OPERATION of rupture pin valves _____	30a
BALANCED PISTON for elimination of downstream pressure affect on set point _____	21a, 21b, 22a

Rupture Pin Emergency Shutdown Valves

Model "A" Angle Type EMERGENCY SHUTDOWN VALVE WITH LINE BREAK PROTECTION _____	30b
Model "B" Inline Type EMERGENCY SHUTDOWN VALVE FOR HIGH PRESSURE ISOLATION _____	31a
Model "D" Inline Type EMERGENCY SHUTDOWN VALVE WITH BOTH HIGH AND LOW PRESSURE PROTECTION _____	31b
Model "E" Offset Inline EMERGENCY SHUTDOWN VALVE FOR HIGH PRESSURE ISOLATION _____	32a
Method of HIGH PRESSURE VESSEL ISOLATION in the case of heat exchange tube failure _____	32b

Applications for Buckling Pin Valves

Using 1/4 turn valves for pressure relief, emergency shutdown or pressure diversion



Standard Buckling Pin Relief Valves

- Buckling Pin Model "A" RELIEF VALVE using conventional actuators for clean service, below 250 PSI system pressure _____ 33a
- Buckling Pin Model "B" RELIEF VALVE with PLUNGER ACTUATOR for difficult fluids _____ 33b
- Buckling Pin Model "A" RELIEF VALVE as used for pressure isolation beneath a relief valve _____ 34a



Buckling Pin Emergency Shutdown Valves

- Buckling Pin Model "A" EMERGENCY SHUTDOWN VALVE using conventional actuator for clean services below 250 PSI system pressure _____ 34b
- Buckling Pin Model "B" EMERGENCY SHUTDOWN VALVE with PLUNGER ACTUATOR for difficult fluids _____ 35a

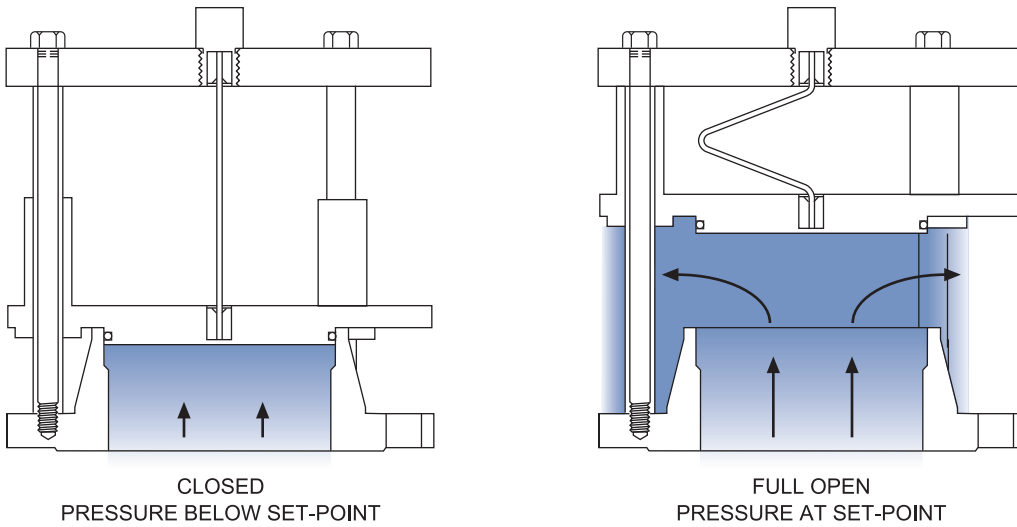


Buckling Pin Diverting Valves

- Buckling Pin EMERGENCY DIVERTING VALVE using a MULTI-PORT ball valve _____ 35b

Model "B" Rupture Pin Fuse (Pressure Relief To Atmosphere)

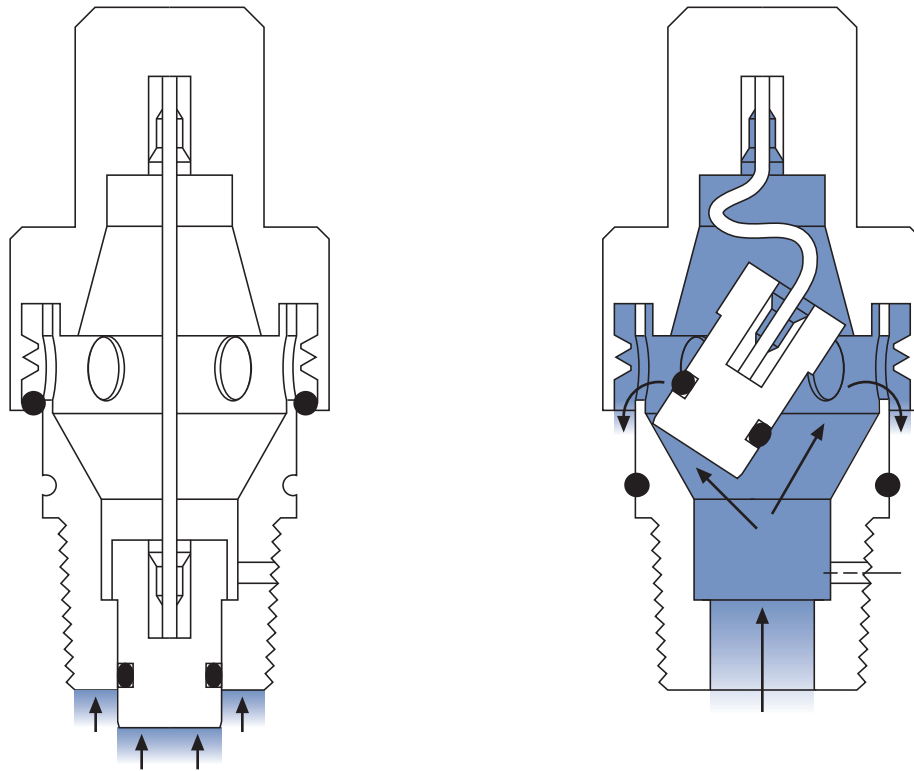
17a



Advantages: Simple, accurate and reliable pressure relief of non-toxic fluids

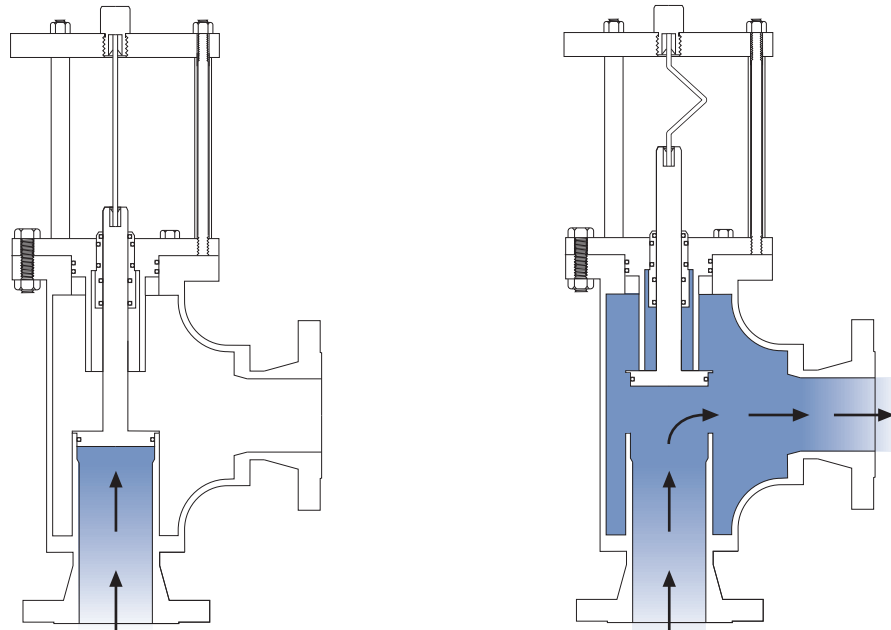
Model "A" Rupture Pin Fuse (Pressure Relief To Atmosphere)

17b



Advantages: Simple, accurate and reliable pressure relief of non-toxic fluids. Small, up to 1" mnpt, show externally it has opened because the protective "o" ring blows down. The cap threads engage body threads on the hex corners.

Model "C" Relief Valve

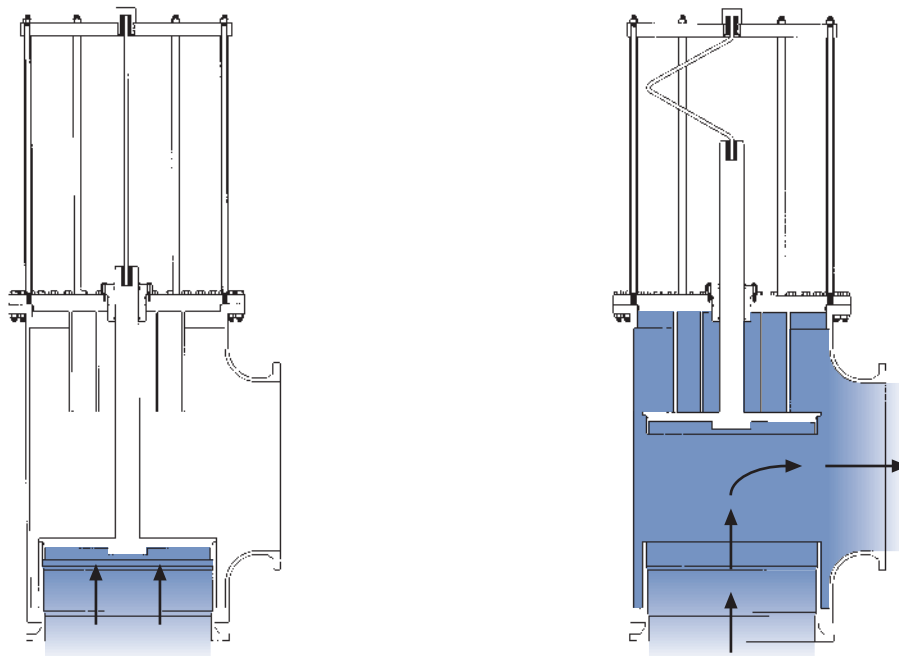


18a

Angle type flange end relief valve.

Advantages: Fabricated from fittings so there is little limit on size or special features. Excellent accuracy, simplicity(one moving part) and reliability.

Model "C" Angle Type Relief Valve Showing A Standard Design For Valves 6" to 48" Piston Diameter

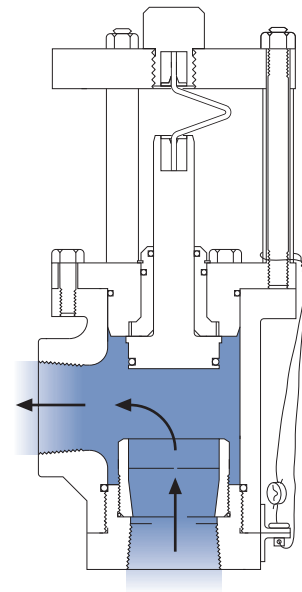
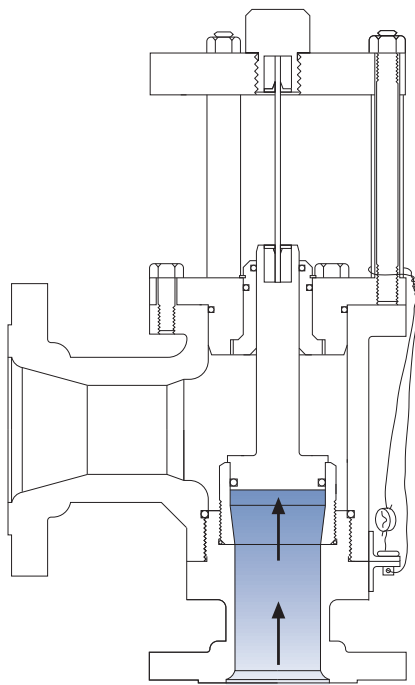


18b

Angle type flange end relief valve.

Advantages: Fabricated from fittings so there is little limit on size or special features. Excellent accuracy, simplicity(one moving part) and reliability.

Model "C" Relief Valve ASME Type

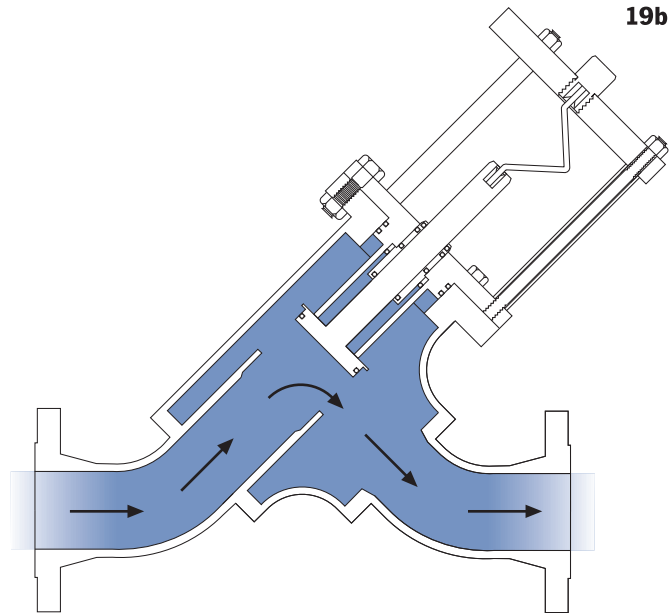
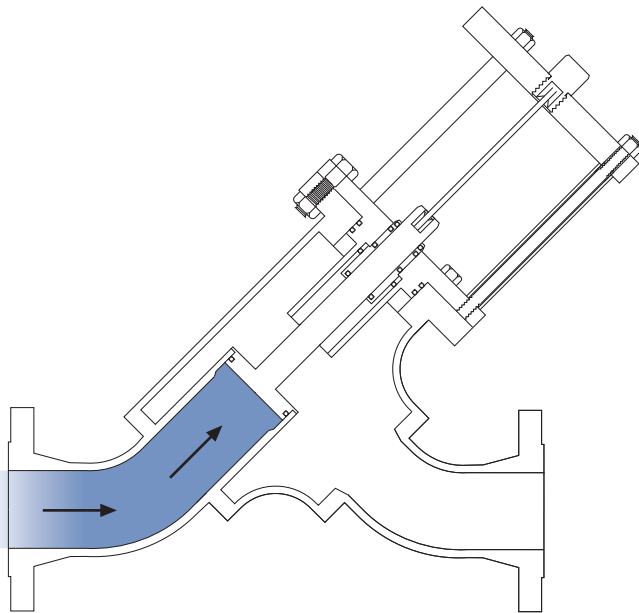


19a

Rupture Pin relief valve, flange or pipe thread ends.

Advantages: Excellent accuracy, simplicity(one moving part) and reliability. National Board rated capacity, ASME Section VIII.

Model "D" Relief Valve



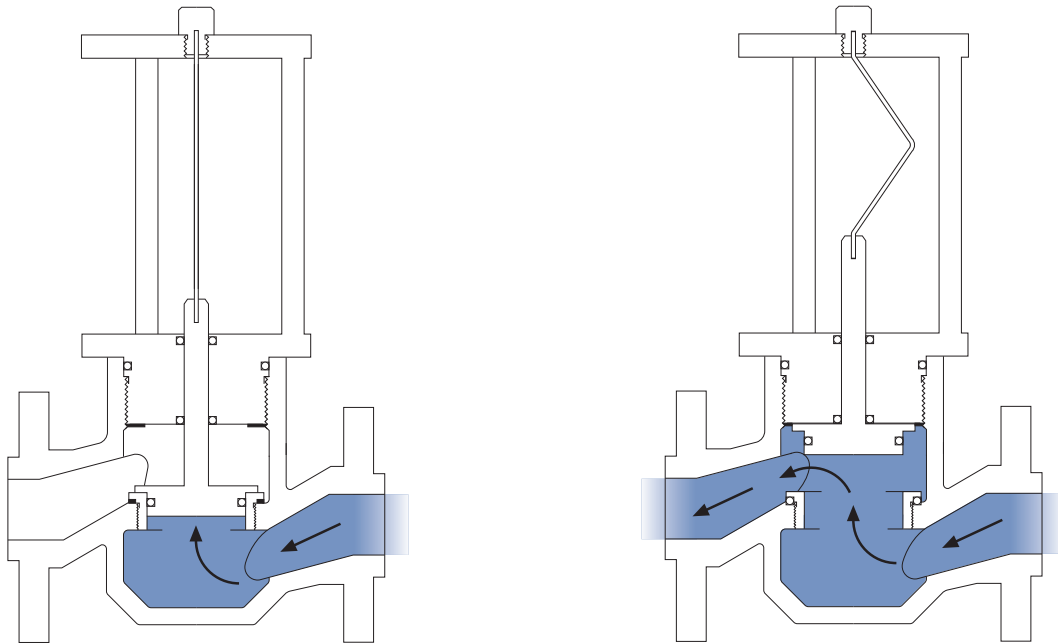
19b

Inline type flange end relief valve.

Advantages: Fabricated from fittings so there is little limit on size or special features. Excellent accuracy, simplicity(one moving part) and reliability.

Model "D" Relief Valve ASME Type

20a

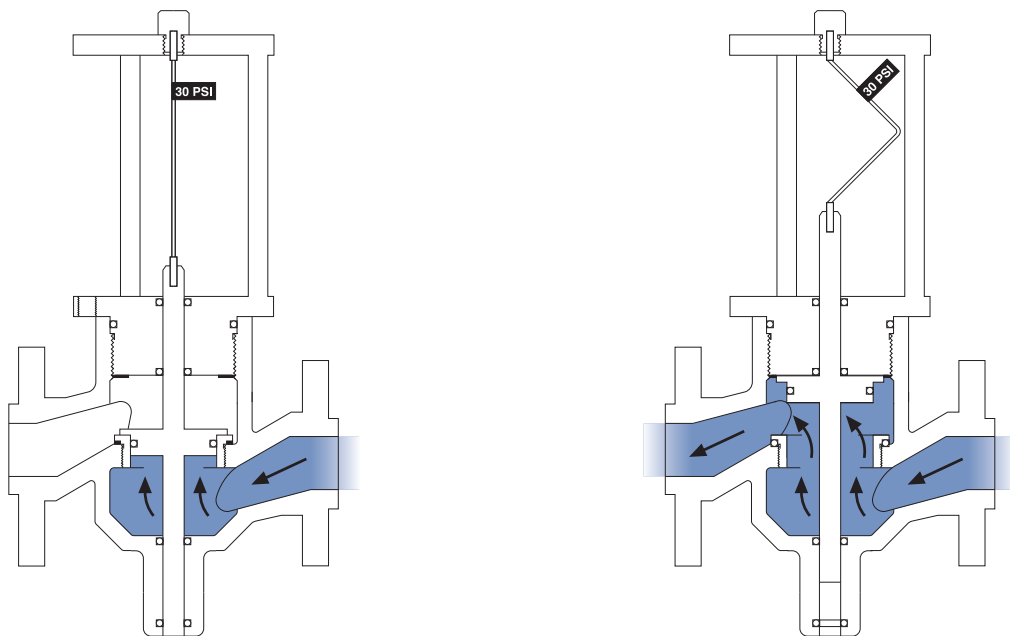


Rupture Pin relief valve, flange or pipe thread ends.

Advantages: Excellent accuracy, simplicity(one moving part) and reliability. National Board rated capacity, ASME Section VIII.

Model "O" Differential Pressure Relief Valve Showing Poco Pin System

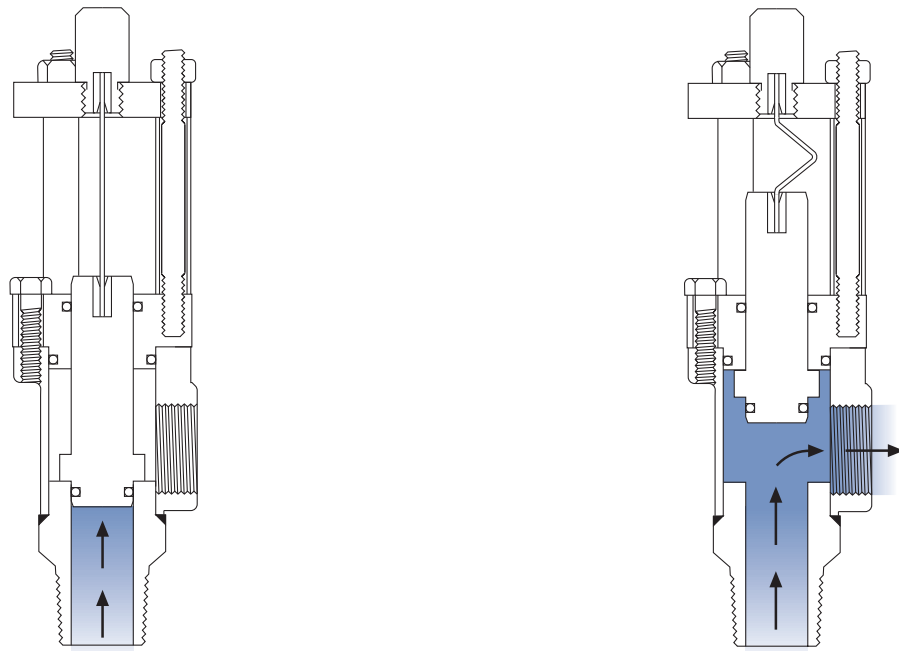
20b



Rupture Pin Differential Pressure Relief Valve. With piston stem areas equal, the valve "sees" only differential pressure as across a filter or positive displacement meter.

Advantages: Easy to put in service without requiring a bypass valve. Only one moving part. Visual or remote indication of opening.

Model "C" Relief Valve Downstream Balanced

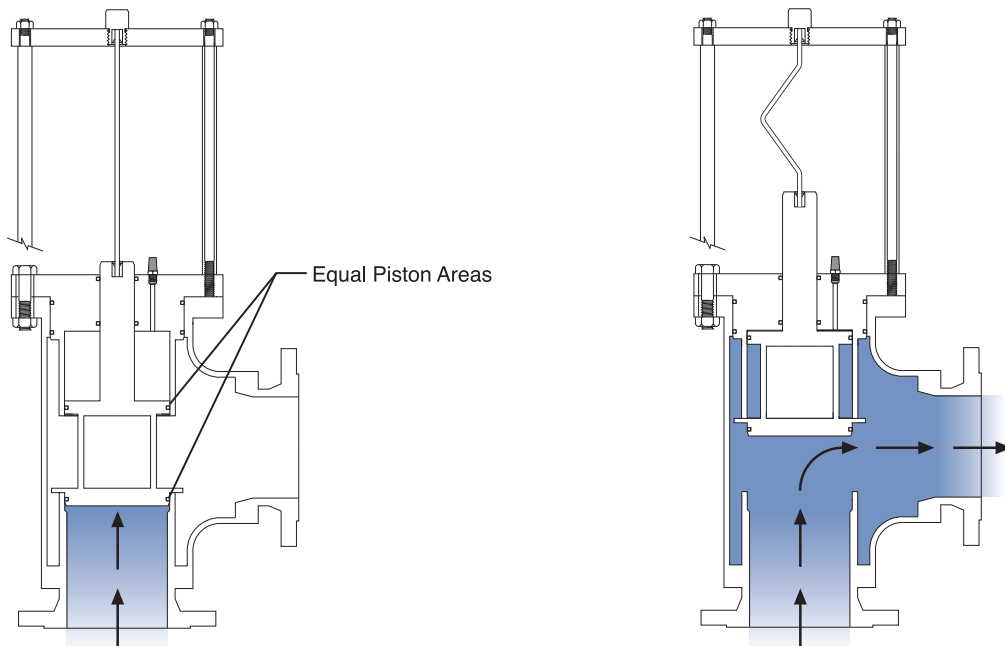


21a

Rupture Pin relief valve. Balancing out downstream pressure on small valves to 4" is easy because the stem area can be the same as the piston area.

Advantages: Downstream pressure does not affect set point.

Model "C" Relief Valve Downstream Balanced



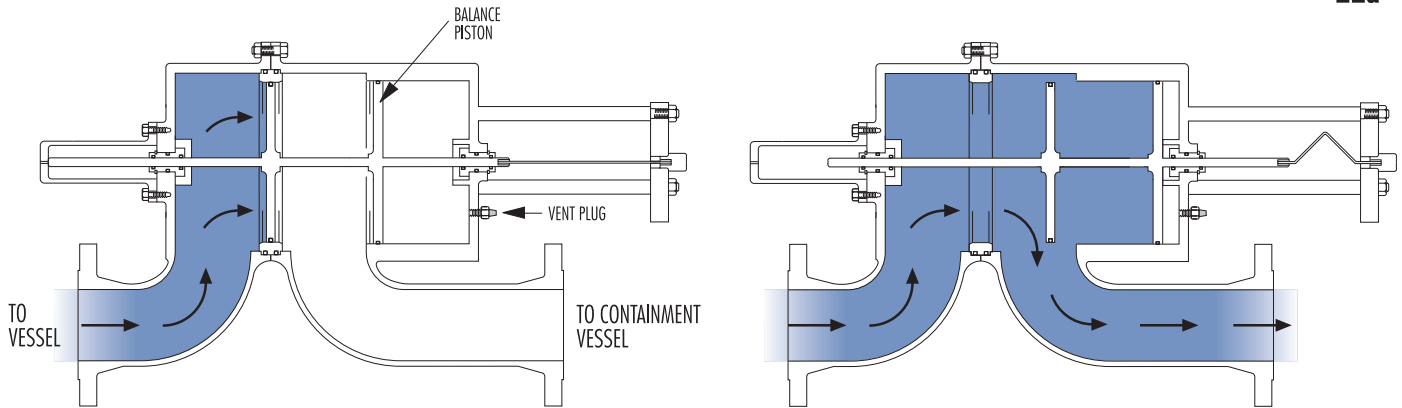
21b

Angle type flange end relief valve.

Advantages: Fabricated from fittings so there is no limit on size or special features. Excellent accuracy, simplicity(one moving part) and reliability. With equal piston areas bridging the outlet, downstream pressure is balanced out and does not affect set point.

Model "F" Pressure Relief Valve

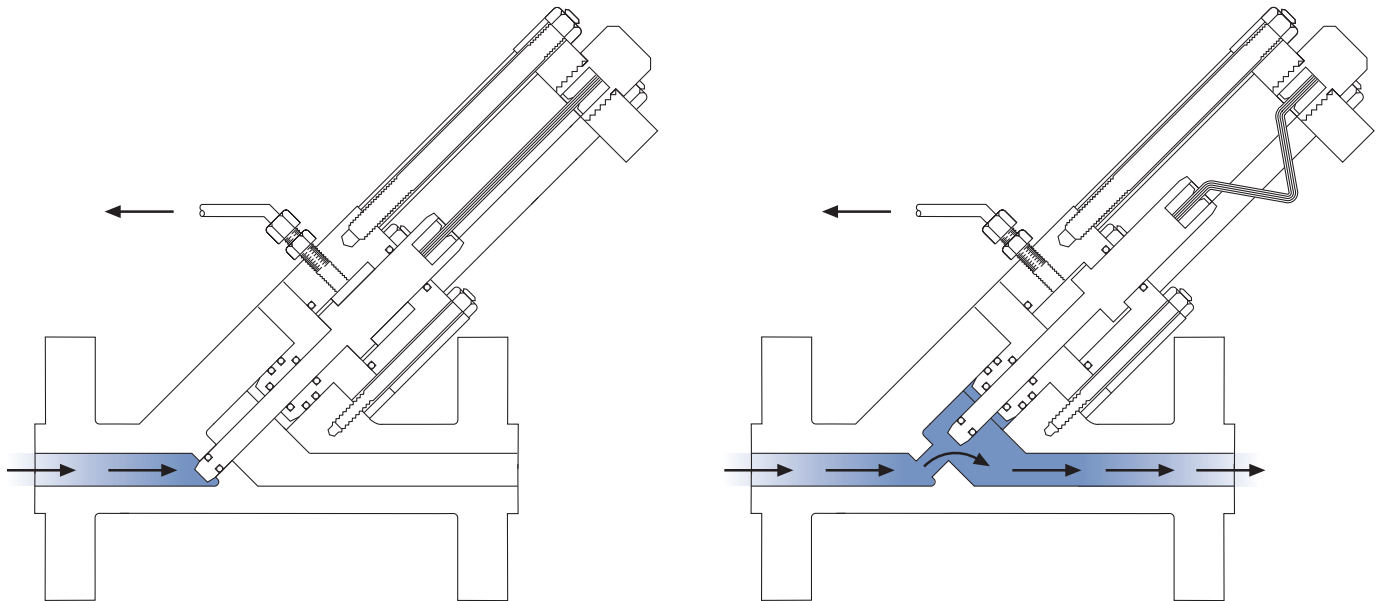
22a



This design illustrates the use of a pressure balancing piston so that containment pressure does not affect set point.
Advantages: Exact set point is maintained.

Model "D" Relief Valve With Isolating Venting Chamber
 For Use With Toxic Fluids

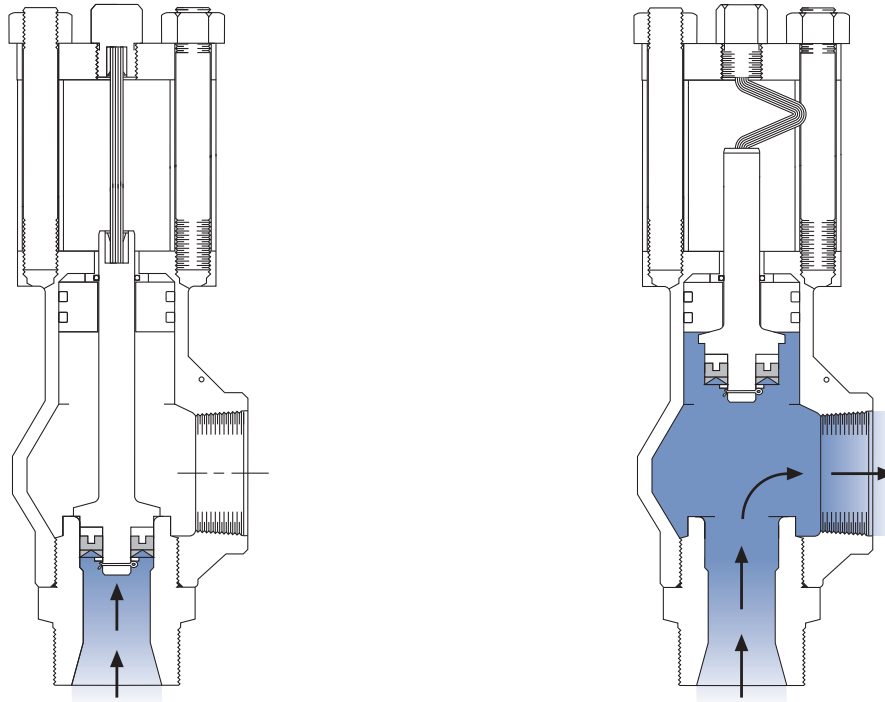
22b



Inline Rupture Pin Relief Valve designed for high pressure toxic fluids. Any stem leakage is contained and vented to a neutralizing solution, a flare or other safe disposal method.

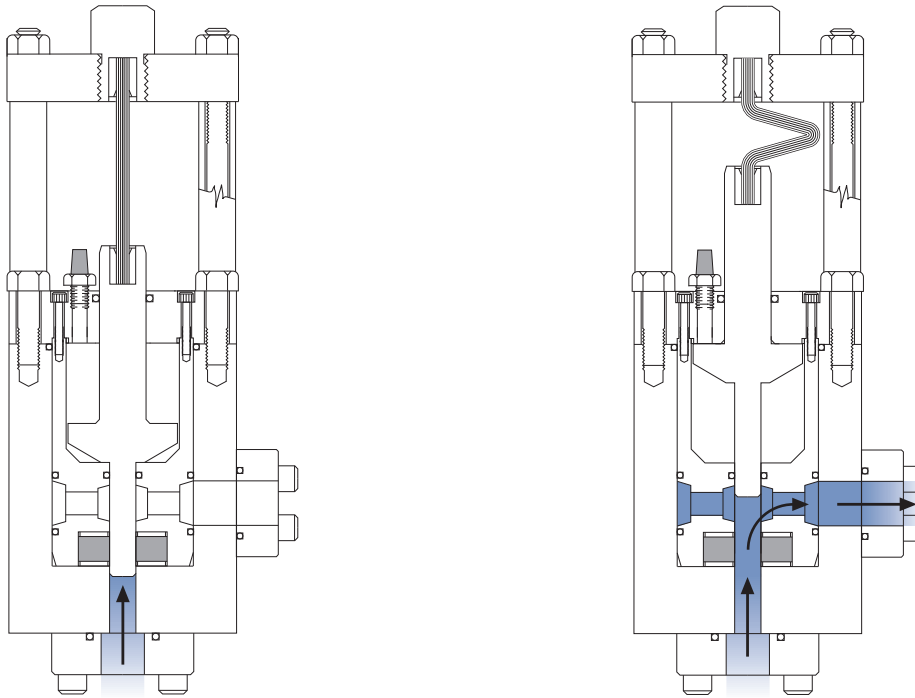
Advantages: Once pressure is relieved, the valve can be reset in minutes without suiting up workers.

Model "I" Relief Valve For Drilling Mud and Mine Slurries



Advantages: Rugged elastomer piston seal and impact arrestor. Pulsating fluid pressure does not affect set point.

Model "K" Plunger Type High Pressure Relief Valve

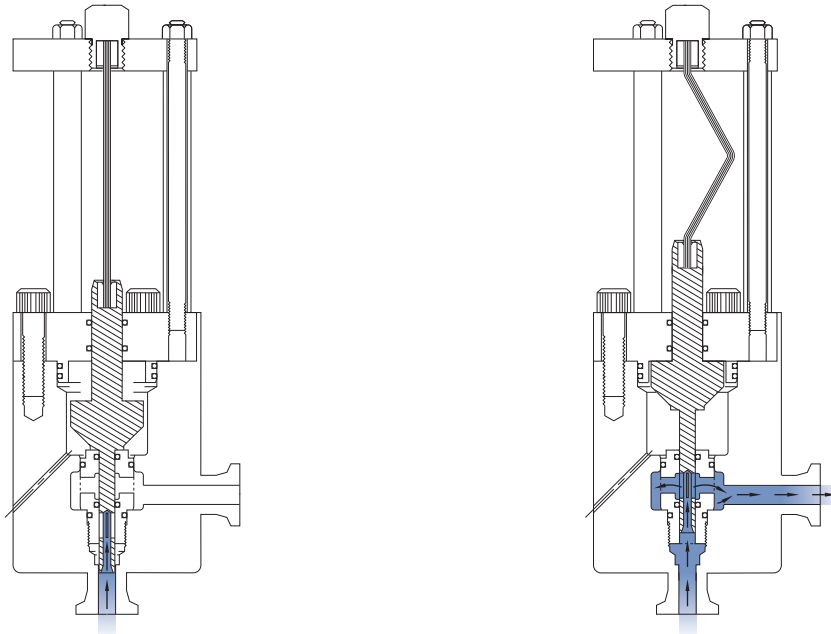


Rupture Pin plunger type high pressure relief valve is used to relieve high pressure slurries.

Advantages: Excellent accuracy, simplicity(one moving part) and reliability.

Model "H" High Pressure Relief Valve

24a

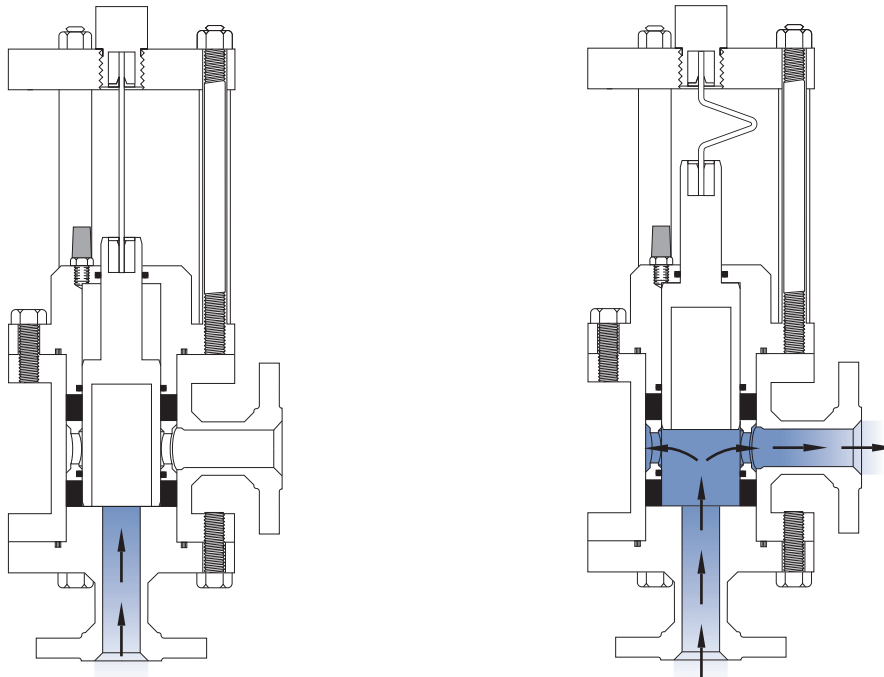


Rupture Pin relief valve for high pressure relief. The valve is bubble tight to set point and the main seal "sees" flowing differential for only a millisecond while the special formed slits move to a full open position.

Advantages: Accurate set point, long seal life(up to 50 resettings) and bubble tight seal at set point.

Model "Q" Relief Valve For Pressure Relief of High Temperature Steam

24b

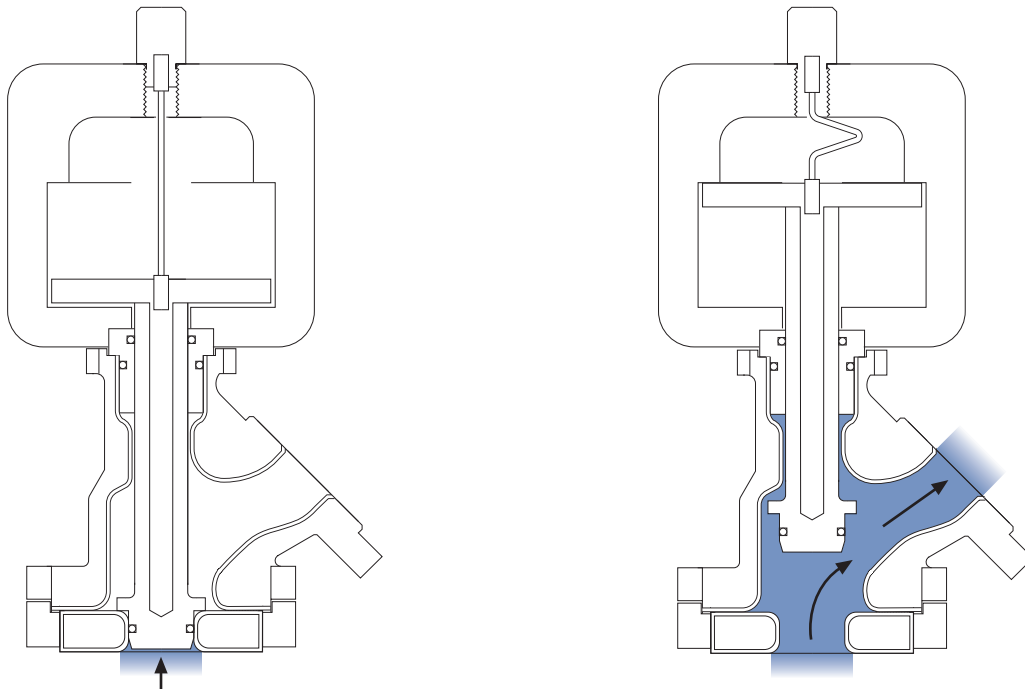


Rupture Pin high pressure steam relief valve with plunger type piston and graphoil seals. Relieves high pressure steam at an accurate set point.

Advantages: Excellent accuracy, simplicity(one moving part) and reliability.

Model "C" Glass Lined Relief Valve

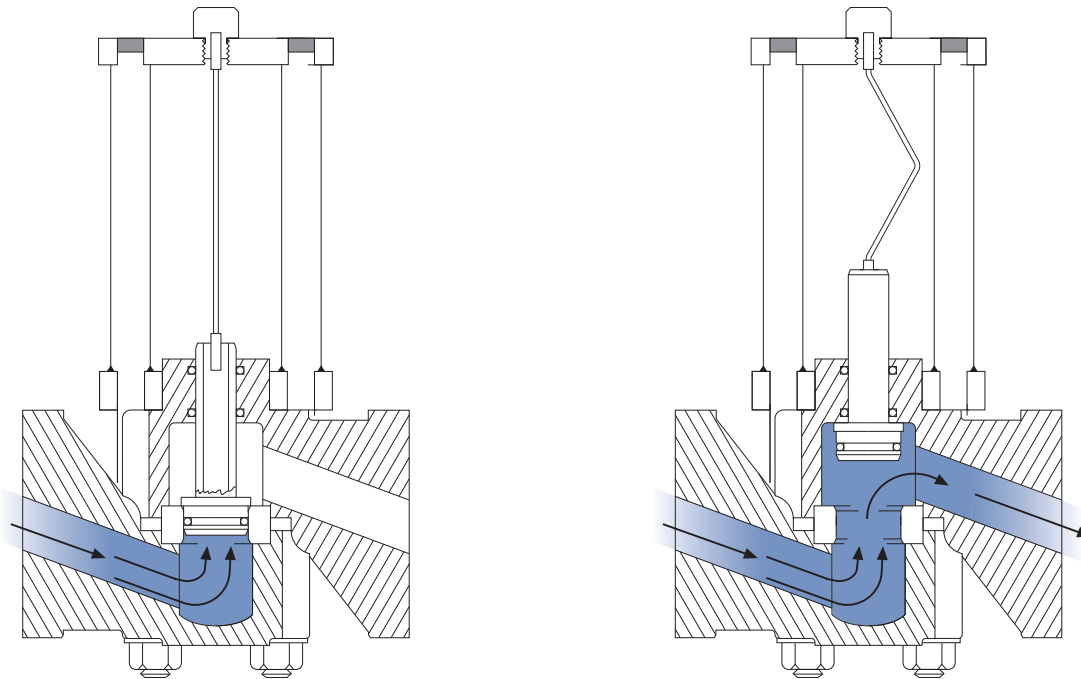
25a



Rupture Pin glass lined relief valve body and a piston of Teflon or Ryton with a stainless steel core
Advantages: Extreme corrosion resistance, Poco pin system for rapid set point change

Model "S" Plastic Relief Valve

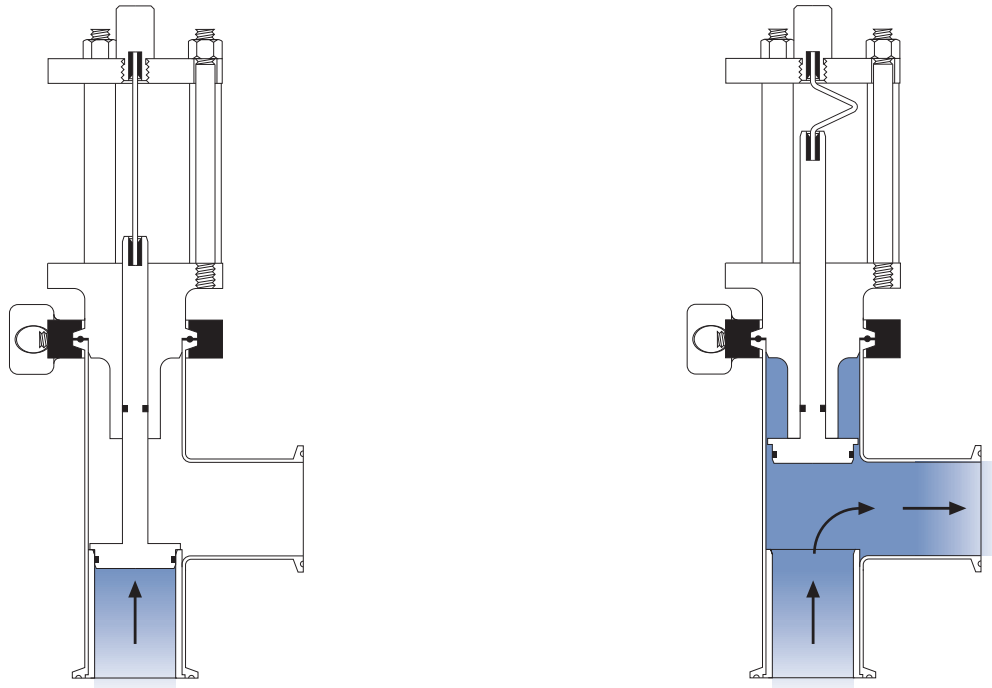
25b



Rupture Pin plastic wetted parts relief valve. The body can be PVC, polypropylene, Kynar or PVDF. The piston is usually Teflon or Ryton with a stainless steel core.

Advantages: Light weight, high corrosion resistance

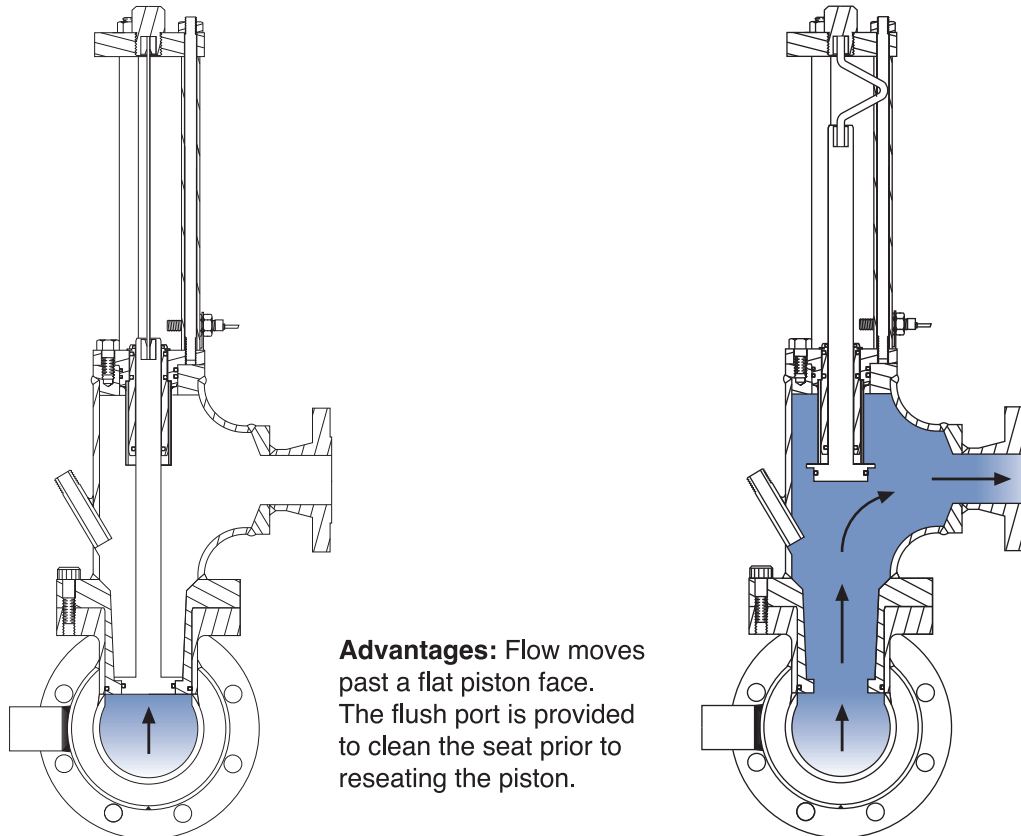
Model "C" Clean Service Relief Valve With Tri-Clamp Connections



26a

Advantages: Simple construction for rapid cleaning. Features +/-5% accuracy and bubble tight seals.

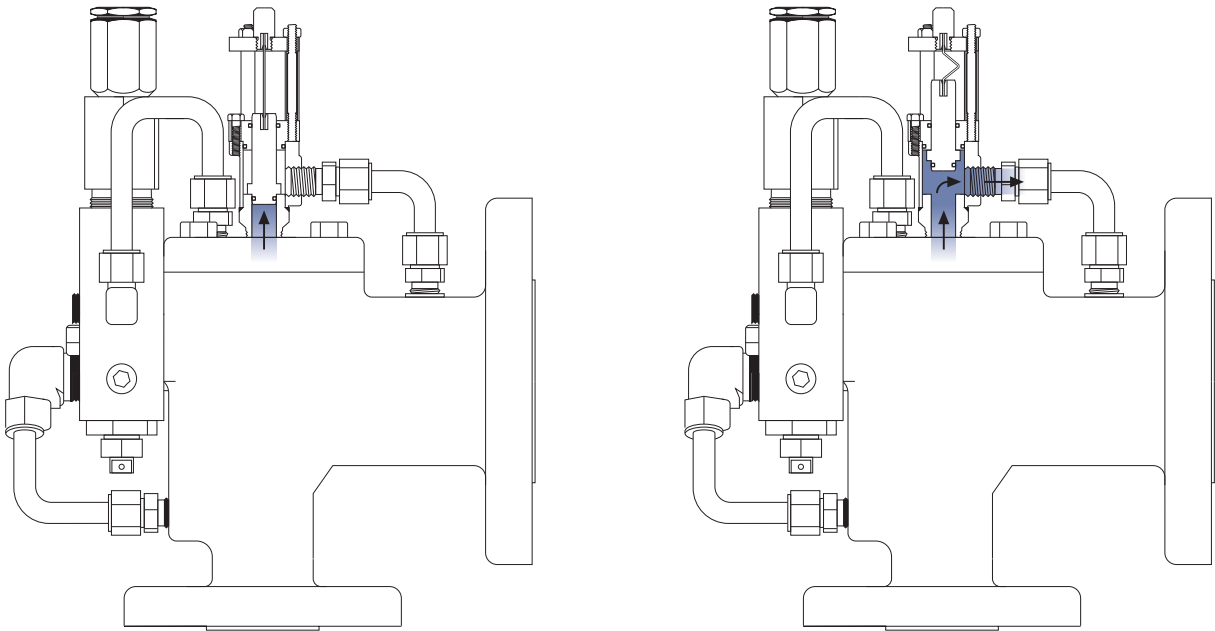
Model "M" Relief Valve On A Steam Jacketed Flow System



26b

Advantages: Flow moves past a flat piston face. The flush port is provided to clean the seat prior to reseating the piston.

Model "C" Downstream Balanced Relief Valve
Used As Back-Up Relief Pilot For A Pilot Operated Valve

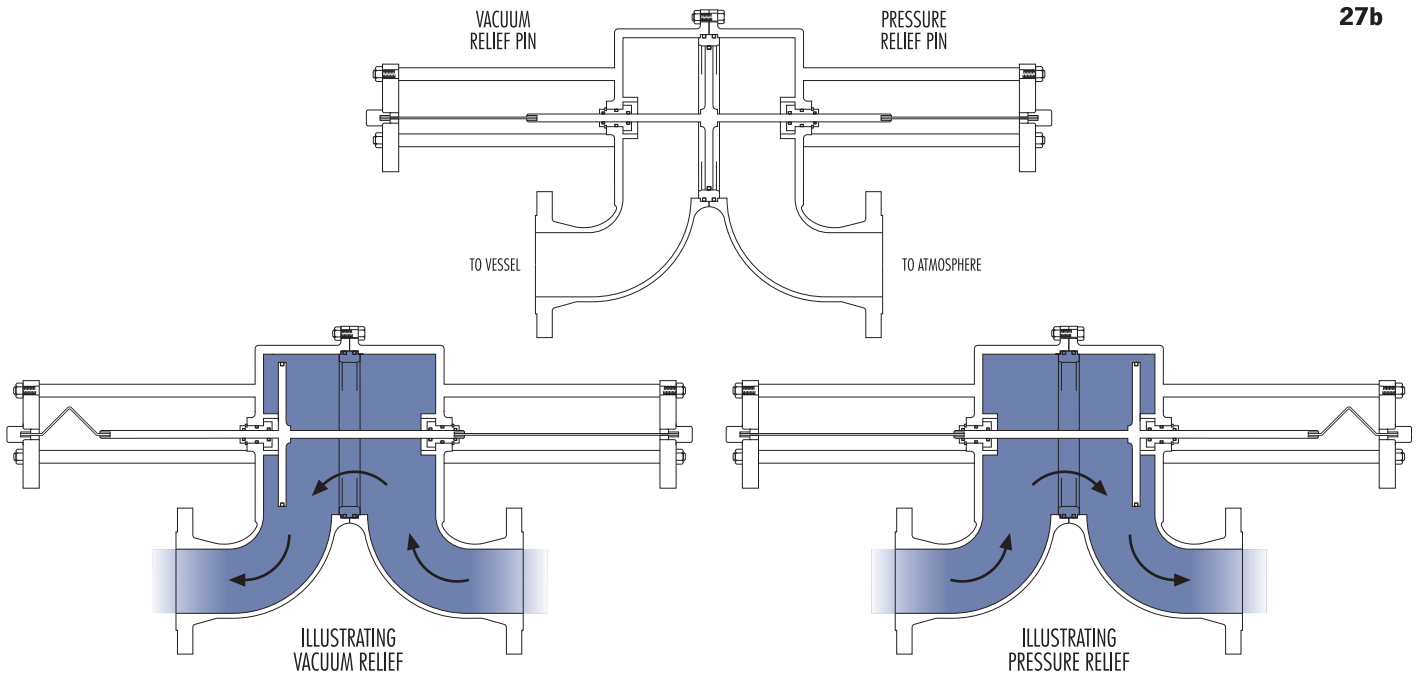


27a

Rupture Pin redundant relief system to dump dome pressure over-set point in case of malfunction of relief valve pilot.

Advantages: The Rupture Pin valve is downstream balanced so the dome pressure can be discharged downstream. The Rupture Pin relief valve gives needed safety. The Rupture Pin valve offers simplicity, accuracy and reliability.

Model "F" Pressure or Vacuum Relief Valve



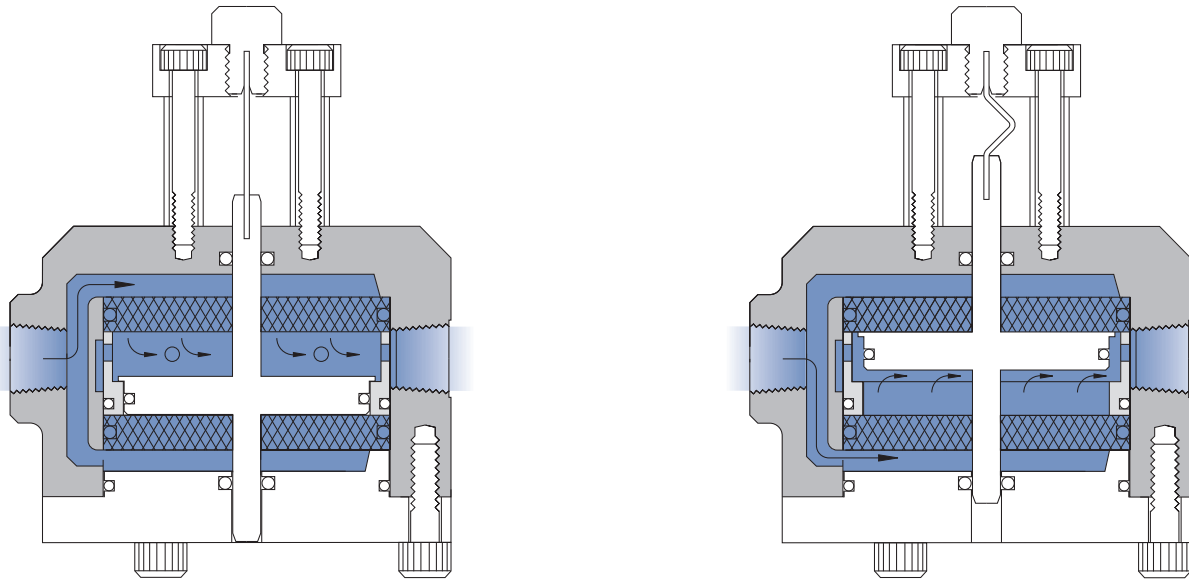
27b

Emergency relief of pressure or vacuum for dual protection.

Advantages: Has accuracy at low pressures, only one moving part, full opening at set point.

Model "U" Differential Pressure Filter Switch-over Valve

28a

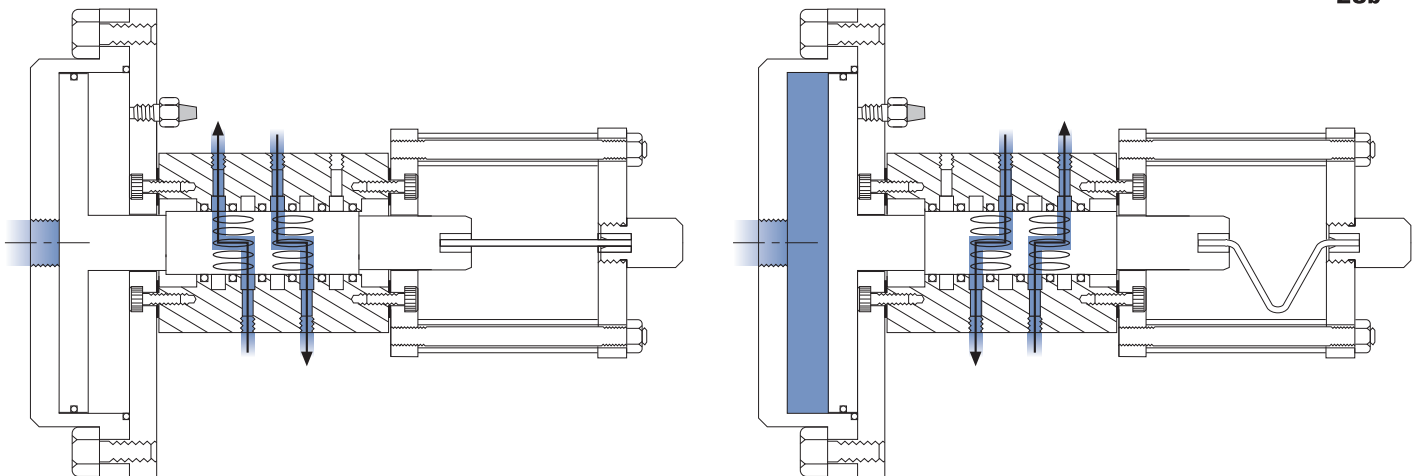


Rupture Pin compact dual filter element switchover device. One filter disc is normally in the flow path. When the primary filter element becomes clogged, then there is a pressure differential across the element and across the balanced piston. When the differential across the piston reached set point, the pin buckles the pin. The piston moves to uncover the reserve filter element.

Advantages: A visual inspection tells when the primary element is clogged. The uncovered reserve element allows continued safe operation. A proximity switch to detect a rising piston stem can be used as a remote warning.

Model "W" System Pressure Switches
Multi-Port Spool Valve At Set Point

28b

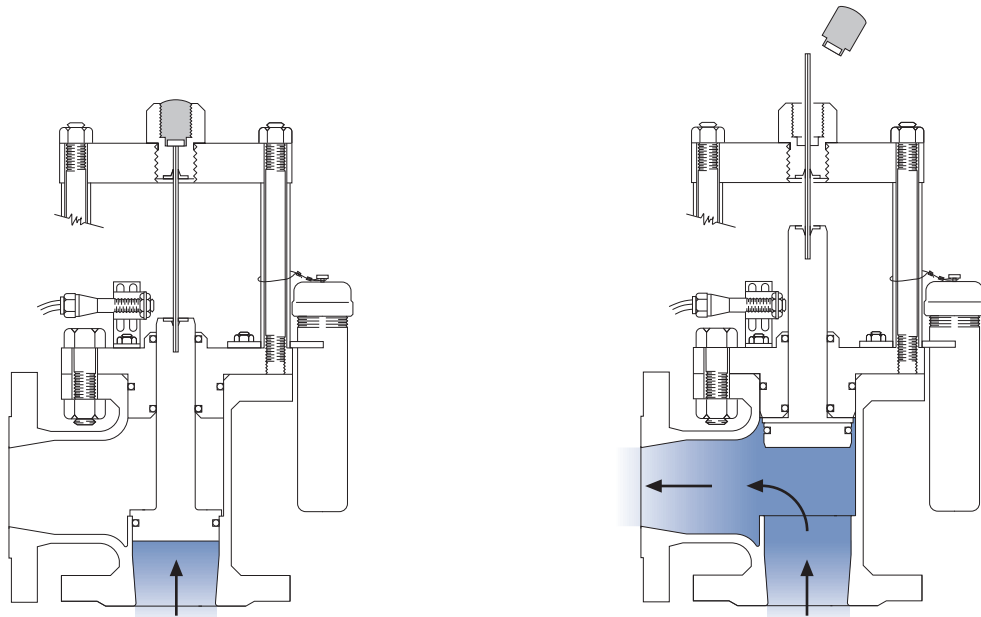


Rupture Pin multiple orifice spool valve actuated by system pressure on a piston giving an axial force that buckles a pin to shift the spool at set point.

Advantages: System pressure can shift a spool valve over a wide pressure range with excellent accuracy.

Model "C" Relief Valve Showing Three Options: Fire Release of Pin Restraint, Proximity Sensing Of Opening and Valve Pin Storage

29a

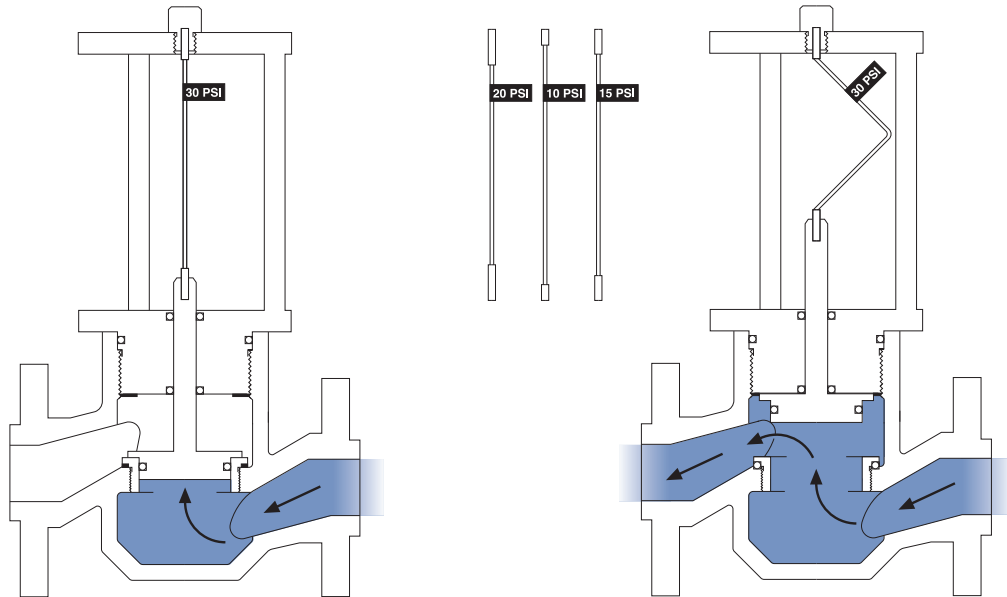


Rupture Pin Relief Valve Under Pressure that will open when fire softens the low temperature alloy plug threads. The pin then has no restriction and system pressure is relieved. The proximity device senses piston opening and pin storage at the valve for rapid valve resetting.

Advantages: Pressure and fire protection in one valve. Proximity device gives a remote warning of opening. Pin storage puts the pin inventory at the valve.

Model "D" Relief Valve Using Poco Pins For Rapid Set Pressure Change

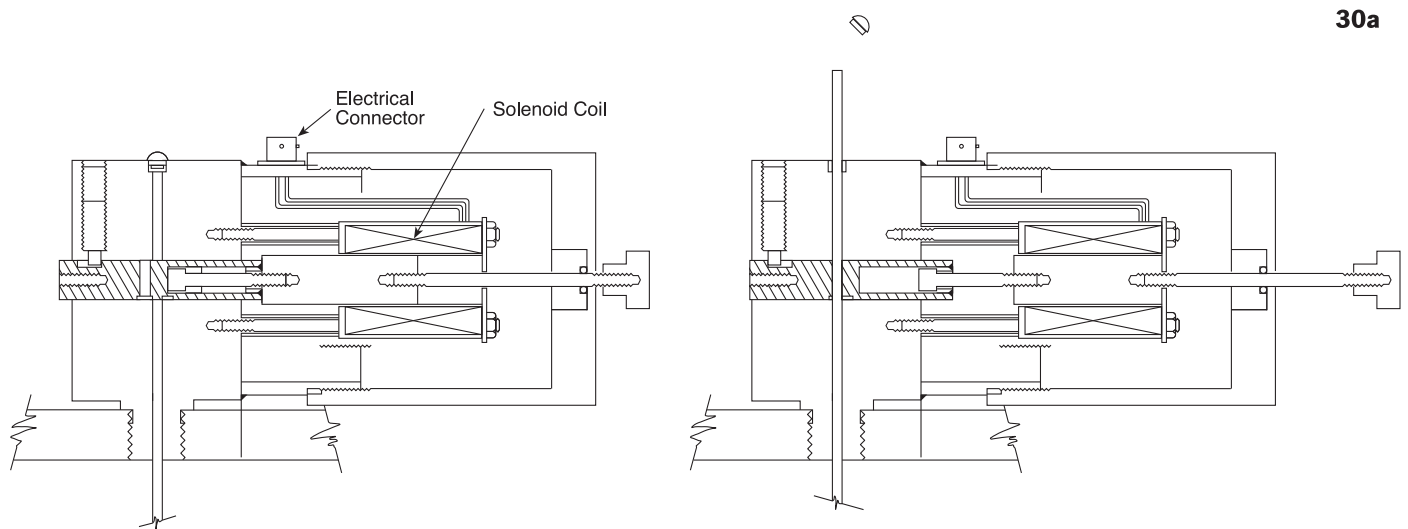
29b



Rupture Pin inline relief valve showing the poco pin method of changing set pressure. Multiple settings must be known at the time of building the valve.

Advantages: Change set pressure by changing pins - applies to most rupture pin and buckling pin valves.

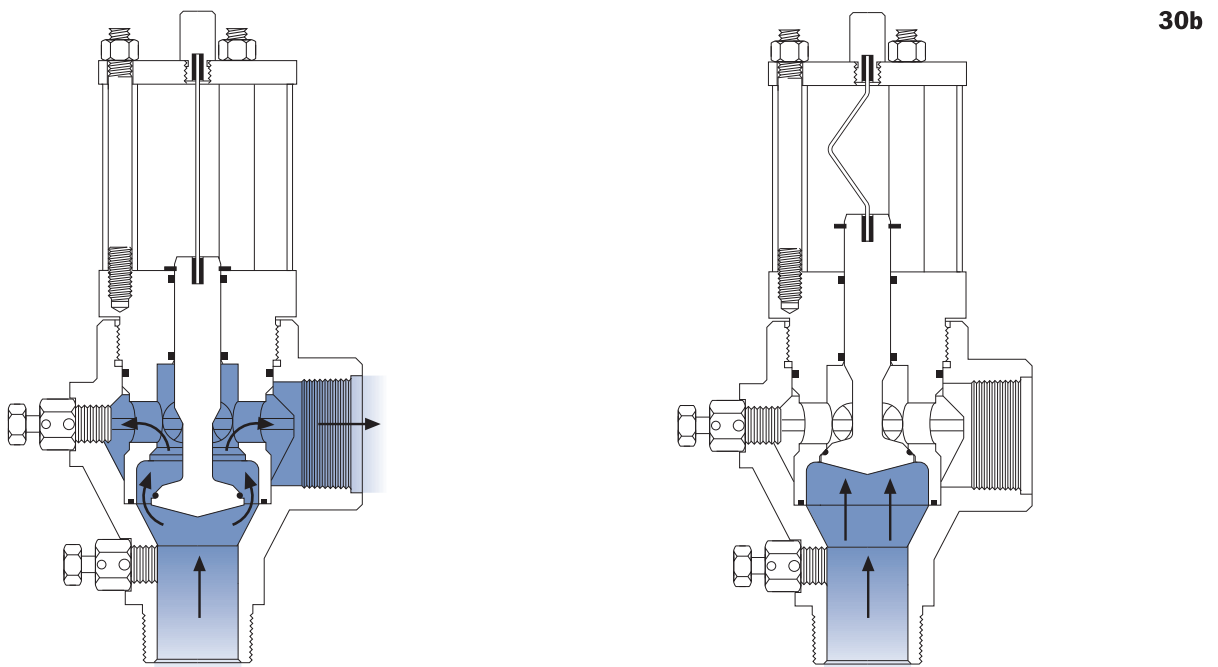
Remote Operation Of Buckling Pin Valves Under Pressure



This mechanism replaces the holding nut in any valve. Its purpose is to allow a valve under pressure to open or close by the force from an energized solenoid coil. The magnetic force shifts a spool that lines up a hole in the spool with the hole in the body holding the buckling pin. The pin is free to move. The piston, with no restraint, is free to move to an open or closed main valve position.

Advantages: A remote or at the valve signal can energize the solenoid to open or close the main valve, depending on valve type. In solenoid tripping, the pin remains useable after opening.

Model "A" Emergency Shutdown Valve

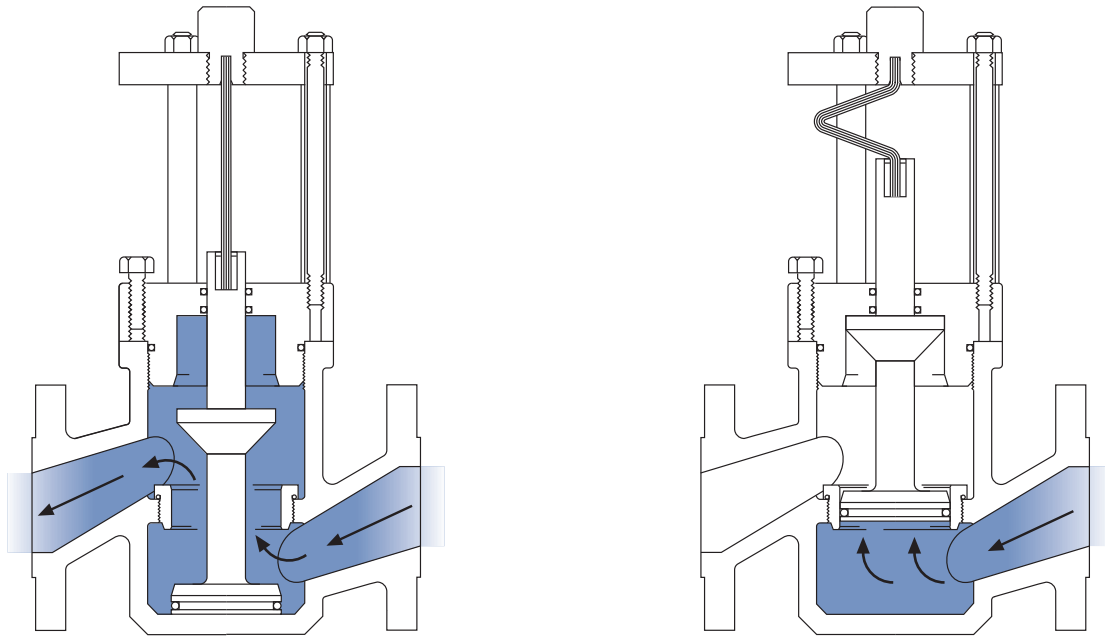


Flowing pressure on the unbalanced stem area puts an axial force on the pin. At set point, the pin buckles and the valve closes for a bubble tight seal. In case of a downstream line break, the mass velocity impinging on the lower piston surface will force the pin to buckle and the valve will seal closed.

Advantages: Only one moving part, has extreme accuracy and proven reliability.

Model "B" Emergency Shutdown Valve

31a

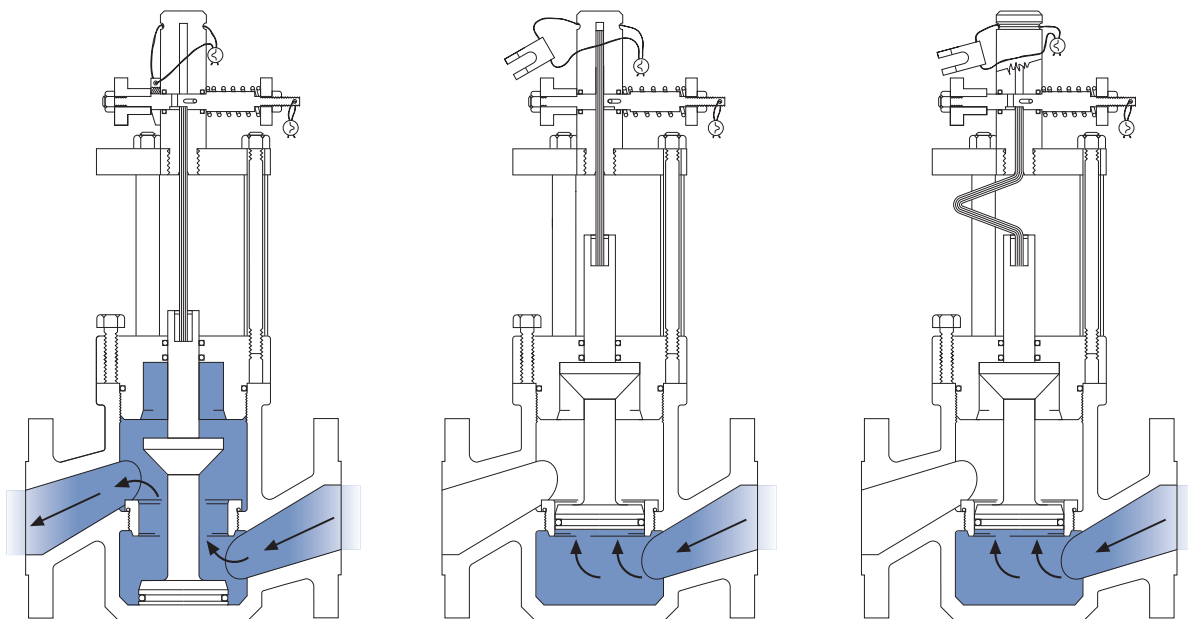


Rupture Pin inline emergency shutdown valve. Flowing pressure acting on the stem area puts an axial force on the pin. At set point, the pin buckles and the piston rapidly moves to a bubble tight closed position.

Advantages: Excellent accuracy, simplicity(one moving part) and reliability.

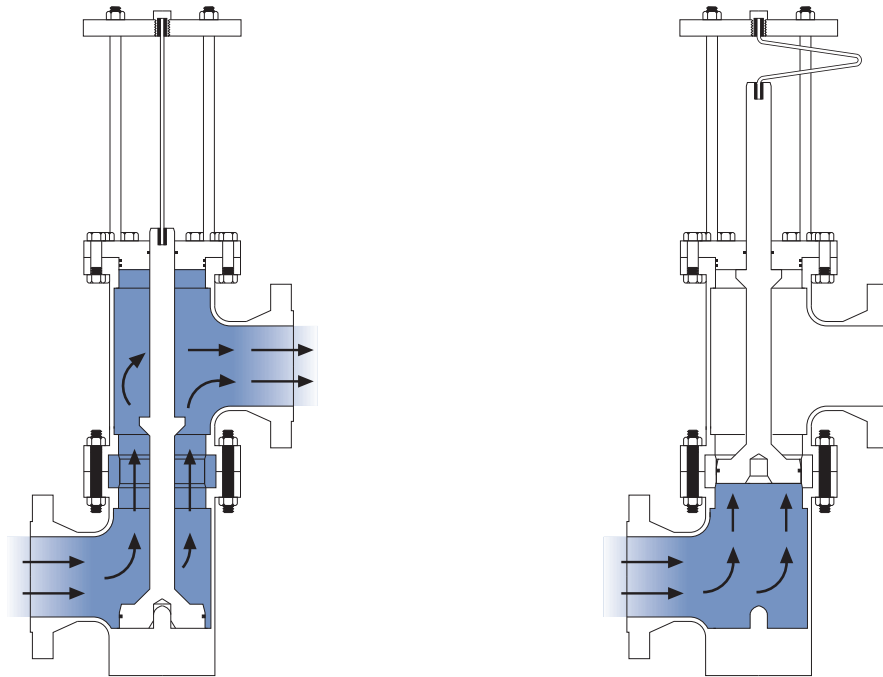
Model "D" Emergency Shutdown Valve
With Pin Friction Device To Sense Low Pressure Set Point

31b



High and low pressure shut off device. The wedge disables the low pressure sensing mechanism until the internal pressure of the valve is above the low pressure set point. The high pressure set point is always active. Once the wedge is removed, the low pressure set point is active. The axial pin force creates friction in the spool mechanism that is proportional to the system flowing pressure. At the low pressure set point, the spring force shifts the spool to line up escape holes for the pin and the valve closes.

Model "C" Offset Type Emergency Shutdown Valve
Showing A Standard Design For Valves 3" to 24" Piston Diameters

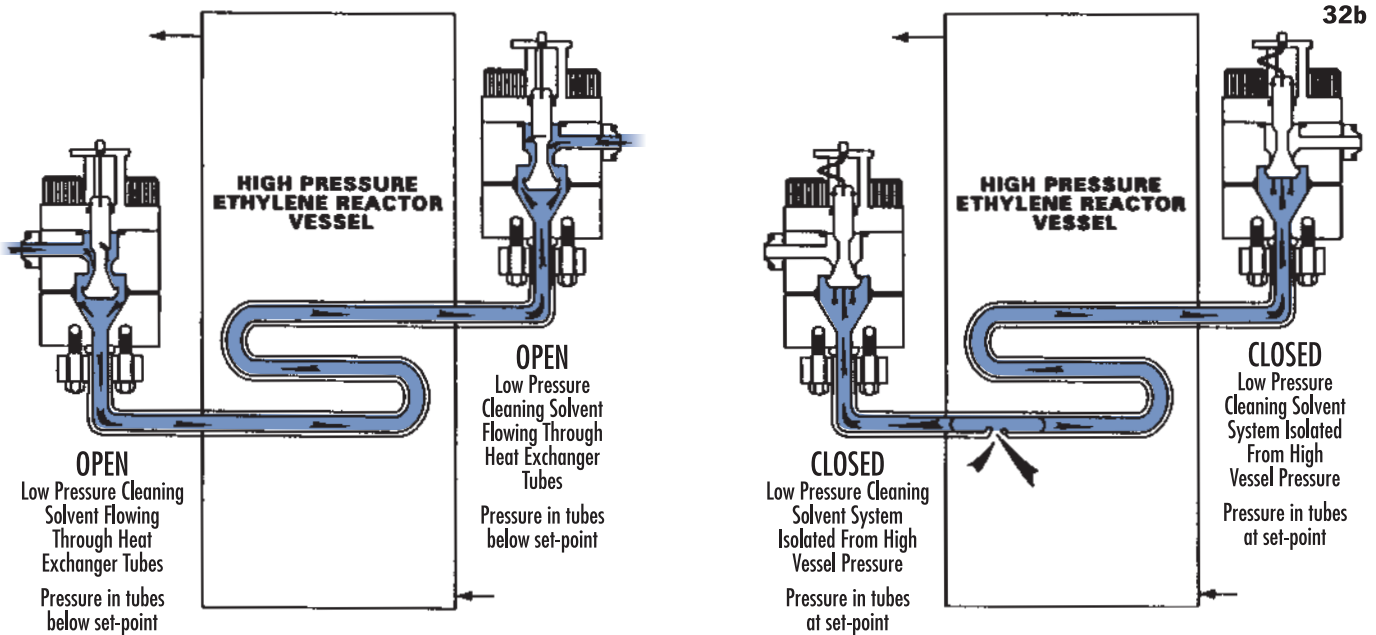


32a

Offset inlet and outlet type emergency shutdown valve.

Advantages: Fabricated from fittings so there is no limit on size or special features. Excellent accuracy, simplicity (one moving part) and reliability.

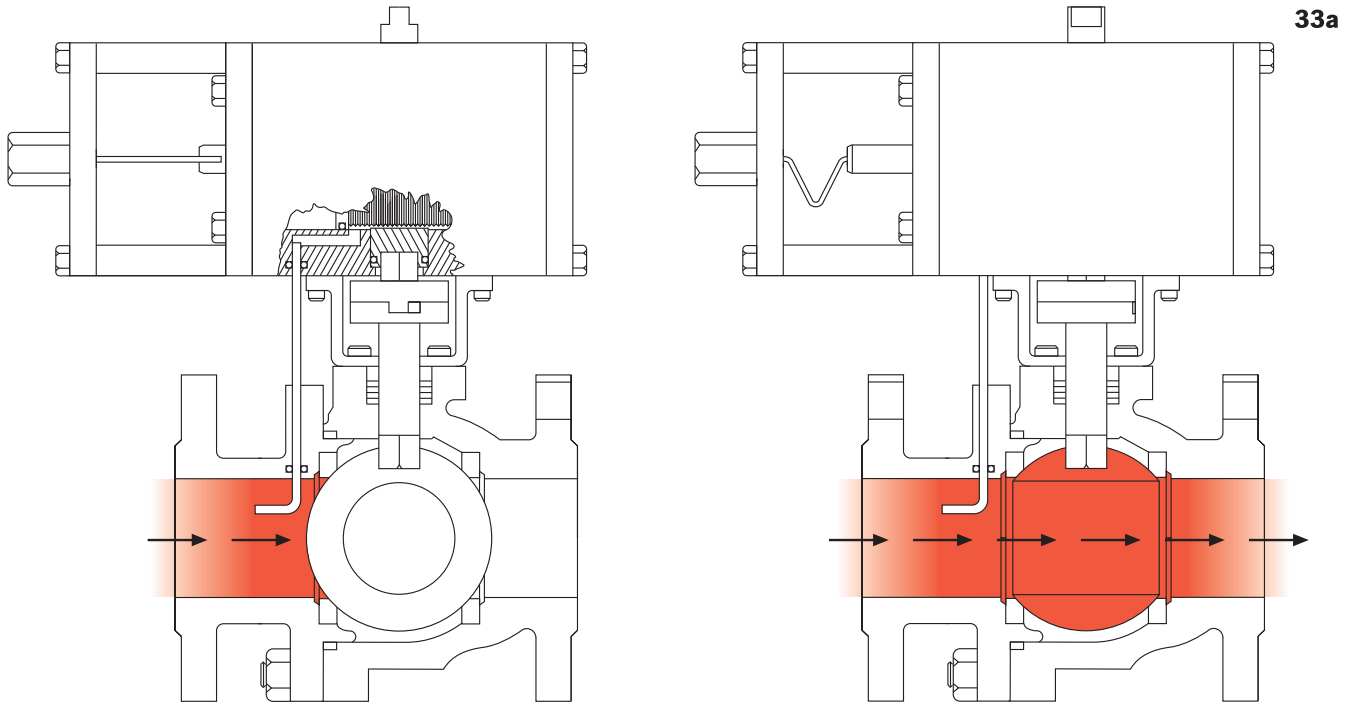
APPLICATIONS
(ESV) Emergency Shutdown Valve



32b

Protects low pressure systems from high pressure fluid.

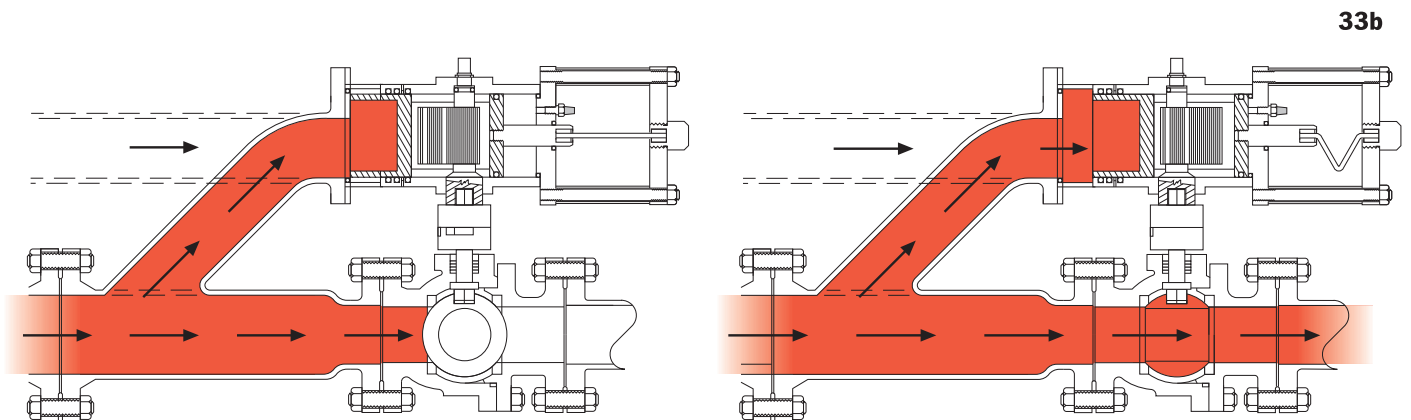
Model "A" Relief Valve Using A Ball Valve



Buckling Pin relief valve using a pitot tube pressure pick up. For contaminated fluids, a large pressure pick up tube is connected directly to the protected vessel or pipe line.

Advantages: Full bore flow. Can be reseated under pressure in minutes to install a new pin and return to a system protection condition.

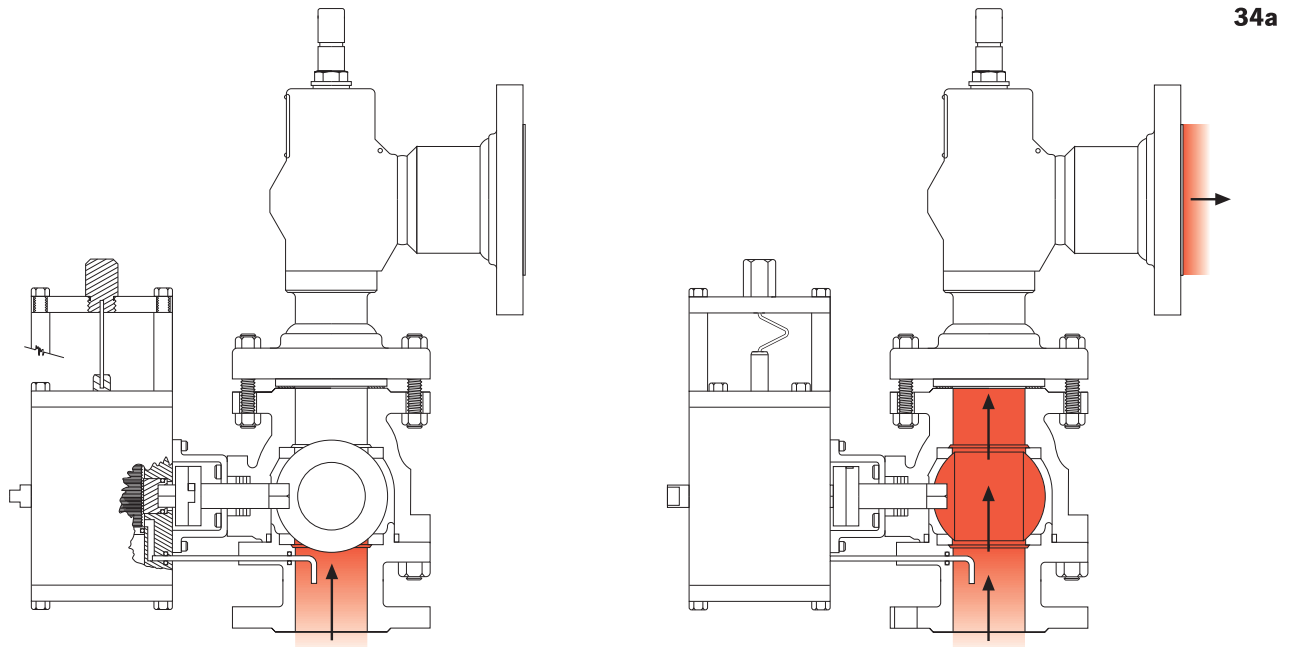
Model "B" Relief Valve Self-Contained Pressure Relief System For Pulp, Sewage and Slurries



A plunger actuator is used to allow free movement with solids contaminated system pressure. The pressure source can be an enlarged pipe section from the protected system or a large direct line from the system. The actuator does not "see" any valve friction because the clutch does not engage until the actuator takes up the clutch slack. At set point, the ball valve opens in milliseconds.

Advantages: The device operates with proven elements. Valve friction does not affect accuracy. A ball valve designed for the application is used. After opening, the valve can be closed in minutes for a pin change by removing the vent plug and applying pressure to close the valve. When the valve is on seat, change the pin. Remove the auxillary pressure source and replace the vent plug. The valve is now in a ready position to vent excess pressure at set pressure.

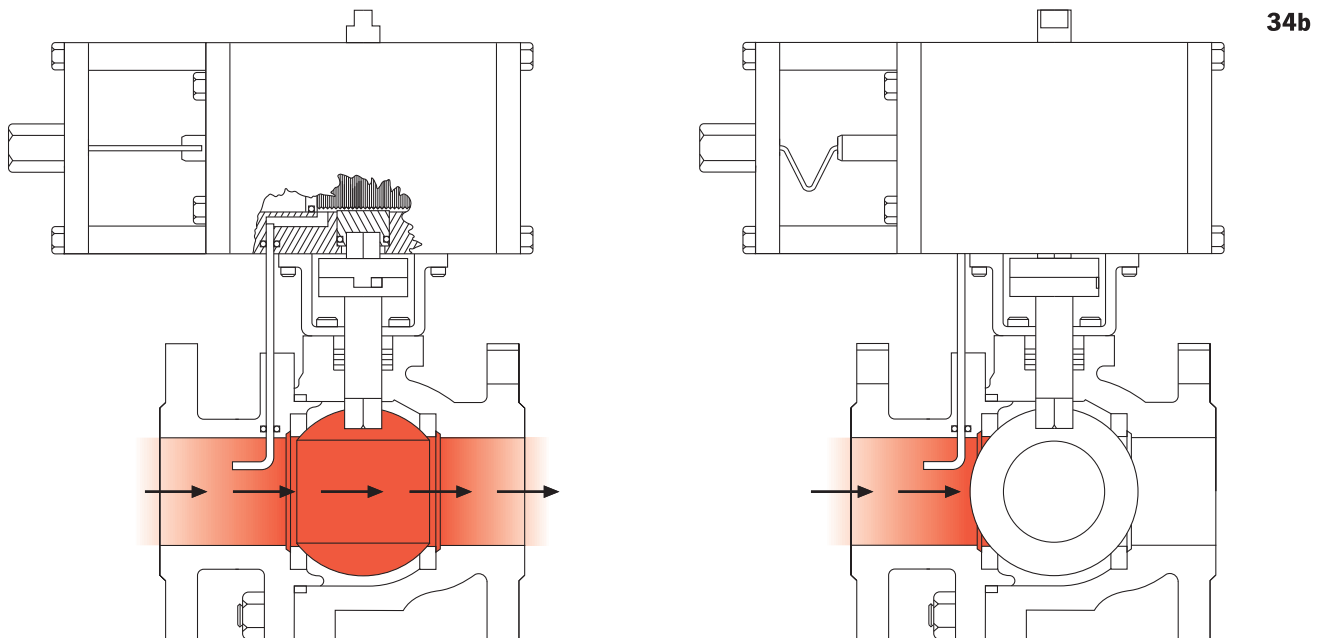
Model "A" Relief Valve With A Ball Valve For Relief Valve Isolation



A buckling pin relief valve shown beneath a conventional spring loaded relief valve to prevent valve leakage and corrosion on the valve seat.

Advantages: No intermediate pressure monitoring required. The buckling pin valve can be reseated under pressure in minutes.

Model "A" Emergency Shutdown Valve Using A Ball Valve

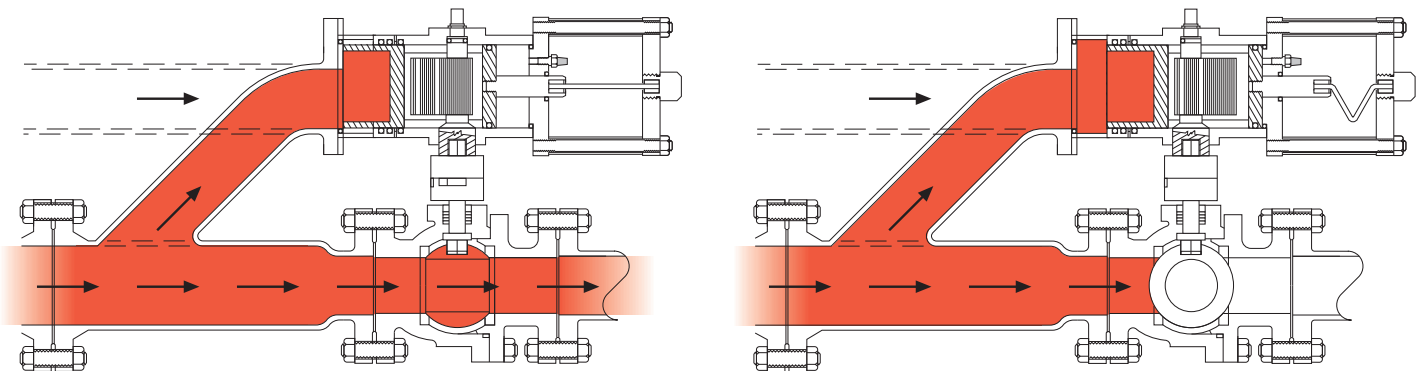


Buckling pin emergency shutdown using a pitot tube pressure pick up. For contaminated fluids, a large pressure pick up tube is connected directly to the upstream pressure source.

Advantages: Full bore flow. Can be unseated under pressure in minutes to install a new pin and return to a system protection condition.

Model "B" Emergency Shutdown Valve System for Pulp, Sewage or Slurries

35a

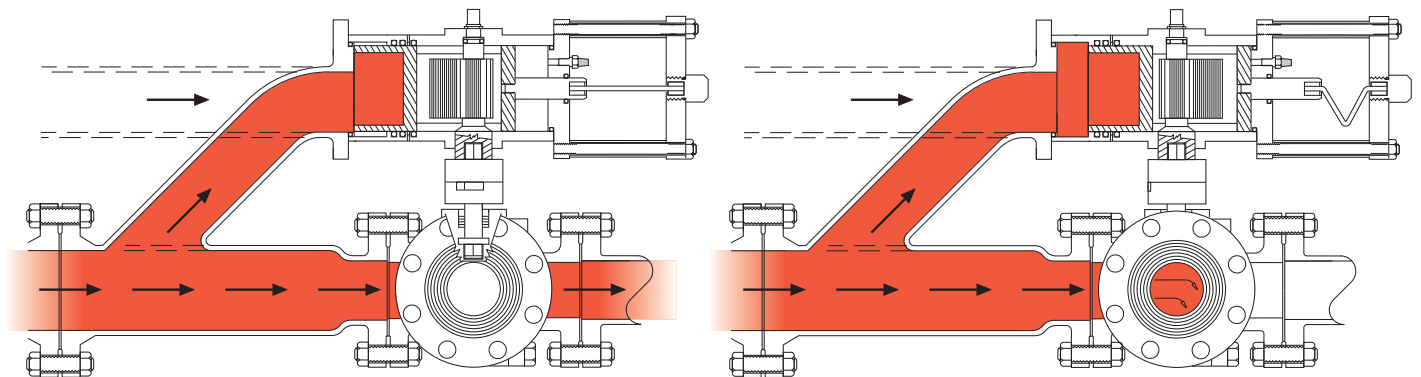


A plunger actuator is used to allow free movement with contaminated system pressure. The pressure source can be an enlarged pipe section from the protected system or a large direct line from the system. The actuator does not "see" any valve friction because the clutch does not engage until the actuator takes up the clutch slack. At set point, the ball valve closes in milliseconds.

Advantages: The device operates with proven elements. Valve friction does not affect accuracy. A ball valve designed for the application is used. After closing, the valve can be opened in minutes for a pin change by removing the vent plug and applying pressure to open the valve. When the valve is in its original position, change the pin. Remove auxiliary pressure source and replace vent plug. The valve is now in a ready position to protect the downstream system from excess pressure.

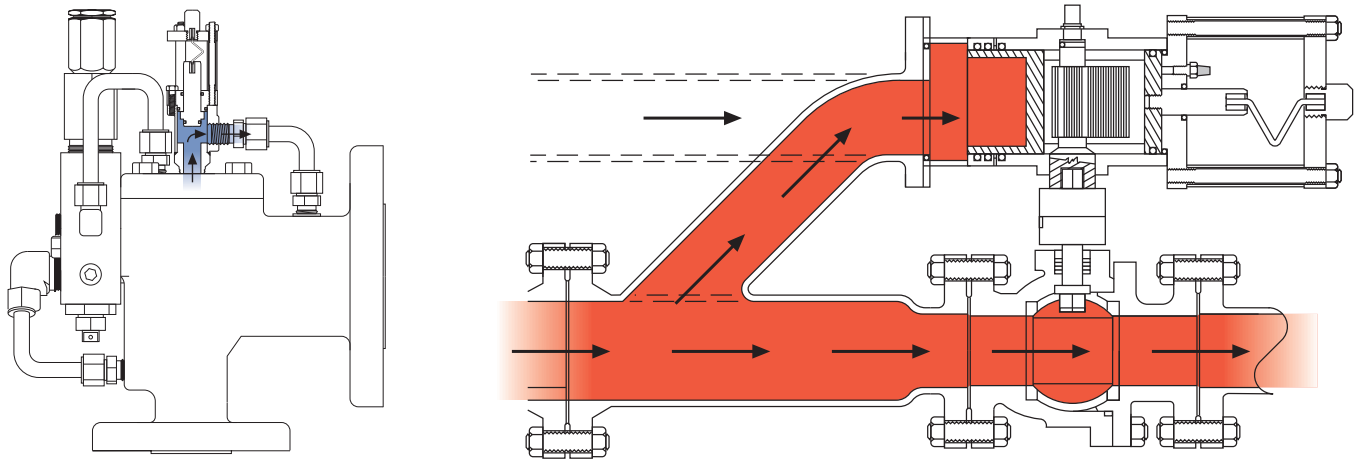
Model "C" Flow Diversion Valve System For Pulp, Sewage or Slurries

35b

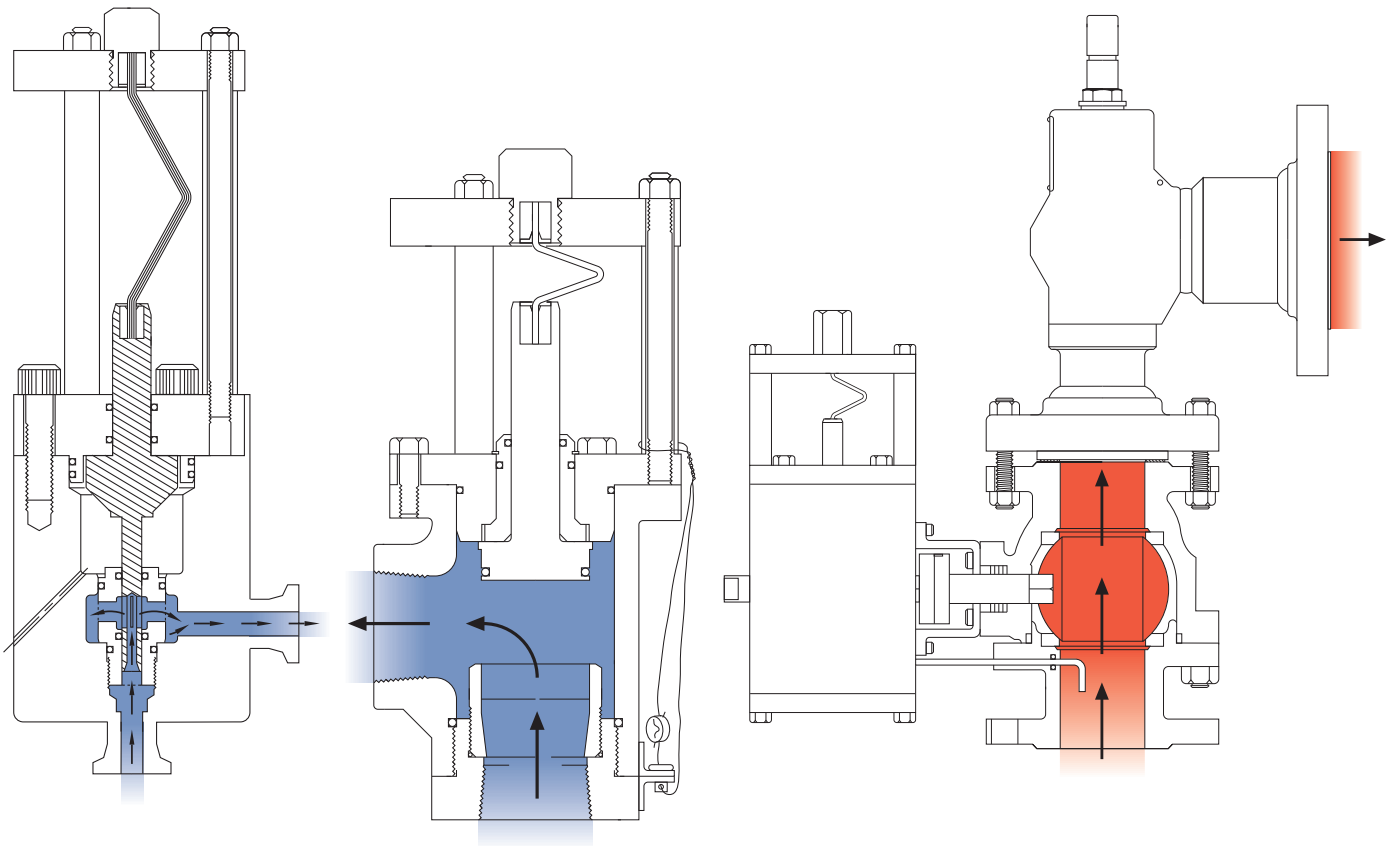


A plunger actuator is used to allow free movement with contaminated system pressure. The pressure source can be an enlarged pipe section from the protected system or a large direct line from the system. The actuator does not "see" any valve friction because the clutch does not engage until the actuator takes up the clutch slack. At set point, the ball valve diverts flow.

Advantages: The device operates with proven elements. Valve friction does not affect accuracy. A ball valve designed for the application is used. After diverting, the valve can be reoriented in minutes for a pin change by removing the vent plug and applying pressure to open the valve. When the valve is in its original position, change the pin. Remove auxiliary pressure source and replace vent plug. The valve is now in a ready position to divert flow when the upstream pressure reaches set point.



Rupture Pin / Buckling Pin Advantage



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