FUNDAMENTALS OF PRESSURE RELIEF VALVES IN NATURAL GAS INSTALLATION - OPERATION - MAINTENANCE

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What Are They and Why Are They Needed

What: A stand-alone device that opens and recloses at a pre-selected pressure, containing an orifice sized to flow a required capacity to prevent / avoid overpressure.

Why: All natural gas equipment (pipelines, pressure vessels, air-cooled heat exchangers, compressor cylinders, odorant tanks, instrument control lines, valves, underground storage, industrial-residential-commercial system supply) has a maximum allowable operating pressure (MAOP) rating. Pressure ratings (MAOP) of each piece of equipment may be different. Pressure relief valves with proper application will prevent overpressure above MAOP. Set point is dictated by the lowest MAOP equipment in the system.

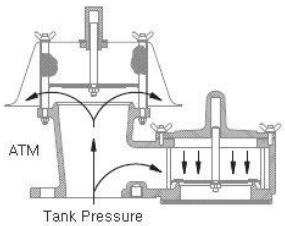
What Assurance Do I Have That the Chosen PRV Will Work and Prevent Overpressure?

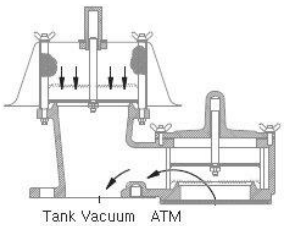
Most, if not all, valve manufacturers have or had brilliant design engineers who developed product lines offering safe, reliable and accurate performance. Testing to ensure good PRV performance is done either by the manufacturer, by an independent third party, or both. Knowing that a PRV might not open at set point should concern all of us – if not send shivers down your spine. Look for and use only those valves that are tested by manufacturers and a third party and have a continual testing program.

Pressure relief valves certified to the ASME Code require stringent flow testing by the National Board of Boiler and Pressure Vessel Inspectors (NB) to guarantee valve capacities. Furthermore, following good engineering practice, ASME-certified PRV's are designed to fail open. There are many utilities using regulators as relief valves that can fail closed without NB capacity testing, which is poor engineering.

Operation - Types of PRV's

1. Weight Loaded: Lead weights determine set point. Inexpensive, leaks at 80% of set point, needs 100% overpressure for full lift.

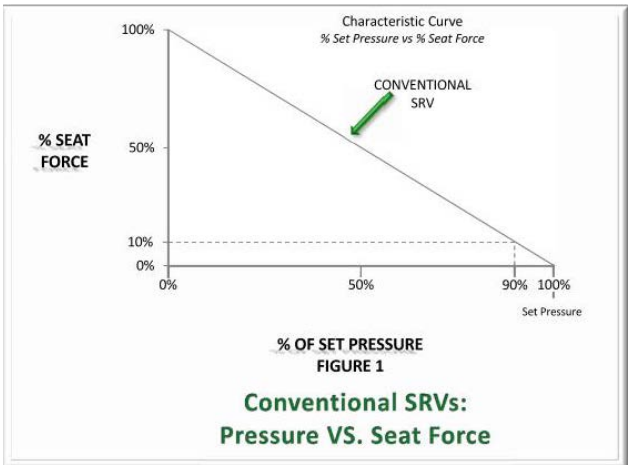


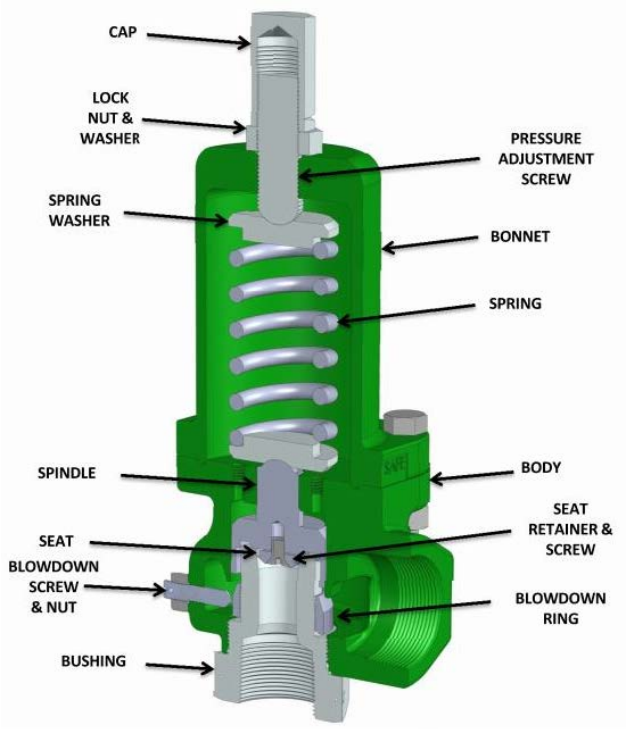


2. Rupture/Buckling Pin: Shearing or buckling of metal pin elasticity determines set point. Proven technology - non-reclosing - typically not used in the natural gas industry.

3. Bursting Disc: Using thin metal sheet, the thickness determines rupture pressure. Non-reclosing, typically not used in natural gas systems.

4. Spring Style: The potential (compressed) energy of a spring determines set point. Leakage at 85% of set point, requires 10% over-pressure for full lift with 40% fixed blowdown.





5. Regulator Used as Relief: Spring pilot holds process pressure in larger area of rubber boot main valve to determine set point. Restricted capacity, fail-closed design. Monitor regulators don't vent to atmosphere.

6. Pilot Operated: Closed pilot holds process pressure on top of larger area of main valve piston; at set point pilot opens to vent pressure off piston, allowing it to lift. Leaks at 90-92% of set point, 7-12% blowdown, 10% over pressure.

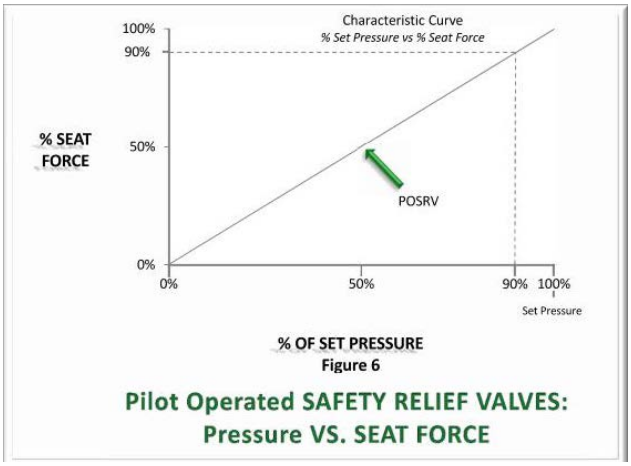
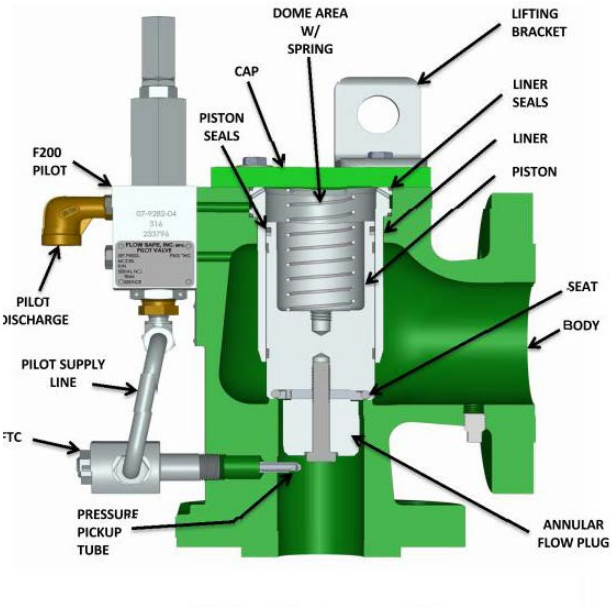


Figure 6

Pilot Operated SAFETY RELIEF VALVES: Pressure VS. SEAT FORCE



7. High-Performance Spring Style: Potential (compressed) energy of a spring determines set point. 95% bubble tight on plastic seat, 98% bubble tight on O-ring seat, full lift at set point (0 overpressure), adjustable blowdown from 3% to 20%.

8. High-Performance Pilot Operated: Closed pilot holds process pressure on top of larger area of main valve piston; at set point pilot opens to vent pressure off piston, allowing it to lift, opens in proportion to upset. Snap acting pilot 99% seat tight - modulation pilot 97% seat tight, no overpressure for full lift, field test connection and back-flow preventer.

Installation

Even the best PRV correctly sized with materials of construction suitable for natural gas will have problems in service if not properly installed. Valve damage, costly repair and system down time can result, not to mention the worst case scenario – reduction of capacity, leading to loss of overpressure protection. Most installation concerns are outside the PRV manufacturer's scope. They include:

1. Inlet Line Loss - Riser Length: From the vessel or pipeline to the PRV - no more than 3% loss. Riser length must be examined to avoid harmonics.

2. Discharge Line Backpressure: Unbalanced PRV will encounter set point change and rapid cycle or chatter with excessive backpressure.

3. Vertical and Plumb: Self-drain. Abnormal wear of moving parts.

4. Drain in Outlet Piping: Discharge PRV piping must have a drain preventing rain from collecting in/on the seat.

5. Full Port Ball Valves: For minimal pressure line loss below the PRV.

6. Vibration - Pulsation: Can affect set point and wear out internals.

7. Field Test Connection: Verify set point and pressure relief valve function without valve removal.

8. Remote Sense: Option to bypass high inlet line loss riser piping for pressure detection by pilot; helps keep sense line and PRV clean in dirty service.

9. Supports - Dual Outlet - Thrust: Always consider thrust effects on PRV installations. Support the valve or consider dual outlet PRV which equalize thrust.

Maintenance

Like any mechanical equipment in natural gas, pressure relief valves require maintenance. Usually maintenance is needed for three reasons:

1. Leakage
2. Set point non-conformance
3. Scheduled inspection, internally set by the end user

Seat leakage and incorrect set point require investigation/root cause to avoid future same issues. Unless the problem is apparent (contamination - operating outside specification, etc.) the best way to trouble shoot is contacting the PRV manufacturer or local authorized representative with as much information of the problem as possible. Always obtain the S/N from the valve name plate.

If you intend to repair or maintain the PRV yourself, be sure to download the IOM manual for the valve series to be worked on, reviewing all information prior to the attempt. Buying a repair kit or soft goods kit at the time of valve purchase assures correct parts if and / or when you need them.

Proactive - scheduled inspection is determined by the valve user. High quality PRV's today could function properly for several years with zero inspection or maintenance. However, most natural gas utilities mandate yearly set point verification and complete teardown inspection every 5-7 years. Repair as needed. Always verify that the seal wire is intact. Seal wires wrap around the set point adjustment screw and connect tightly to the inlet bushing, valve body or blowdown screw. The purpose of the seal wire is a telltale of the last person to adjust or touch the valve. If the seal wire is cut there is no way to show if the valve is set correctly and most likely it has been compromised.

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About the Author:

Gary S. Beckett is Global Sales and Business Development Manager for Flow Safe, Inc. - High Performance Safely Relief Valves. A BS graduate from Norwich University, Gary has 33 years of experience with valve design, application, field support and technical sales.