



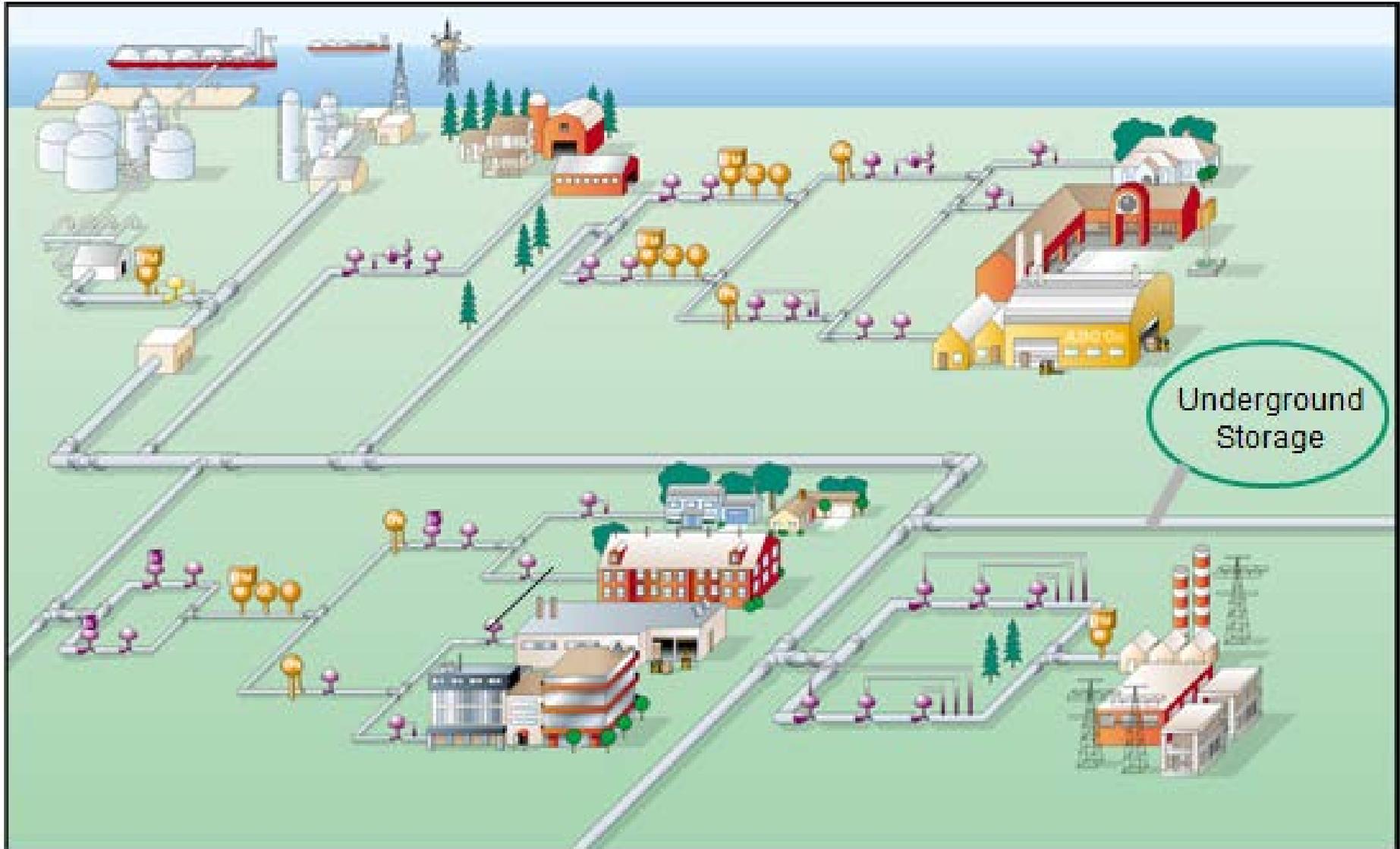
PHMSA & UTC
Training & Qualification
Gas Regulations and Code Compliance Seminar

REGULATORS 101 AGENDA

- Spring Operated Regs: principles of operation
- Pilot Op Regs: principle of operation
- System pressure trouble: causes & solutions
- Safety & Overpressure Protection
 - Monitors
 - Slam shuts
 - Relief valves: sizing
- Over pressure protection

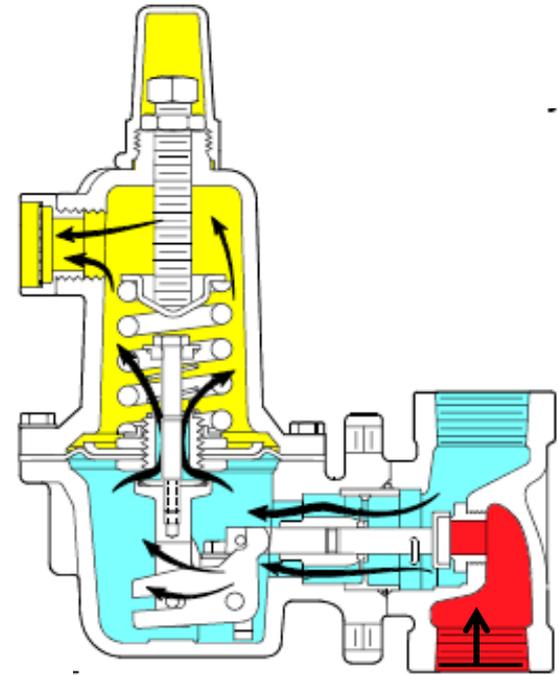
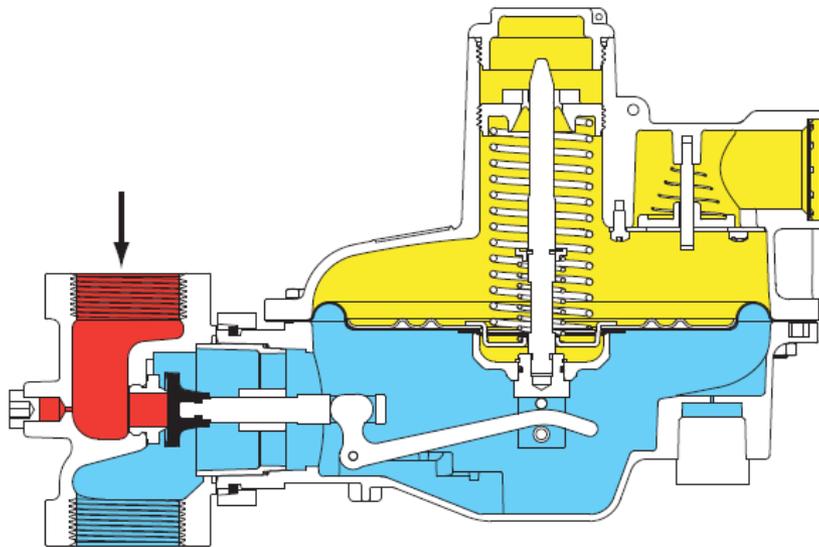
Gas Systems

Operators & Direct Sales companies



Spring operated regs: Principles of Operation-Force Balance

- Purpose of a reg: to satisfy downstream flow demand
- Energy disturber: as load turns on regs disturb the potential energy that had been resting upstream during no demand & changes it to kinetic energy (velocity/flow) to satisfy downstream load demand
- DP: the greater the differential pressure across the reg the greater the flow
- The industry asks these devices to act as: regulator, relief valve and as a block valve

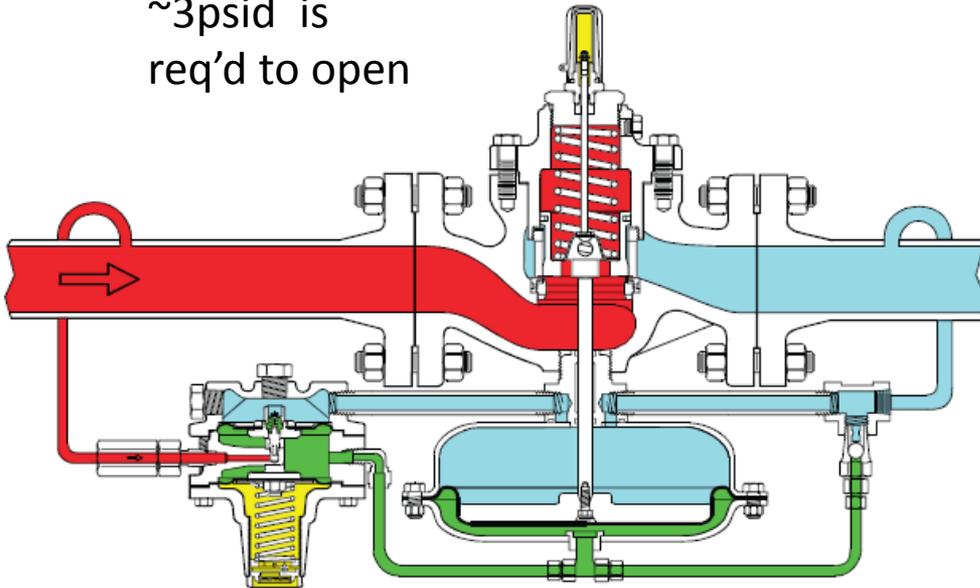


Piloted op regs: Principles of Operation

- Pilot (amplifier): controls the main valve
- Pilots attain their power from upstream pressure. The pilots amplified pressure is used to move the main valve. The gain (sensitivity) of the pilot makes the movement of the main valve more more accurate.

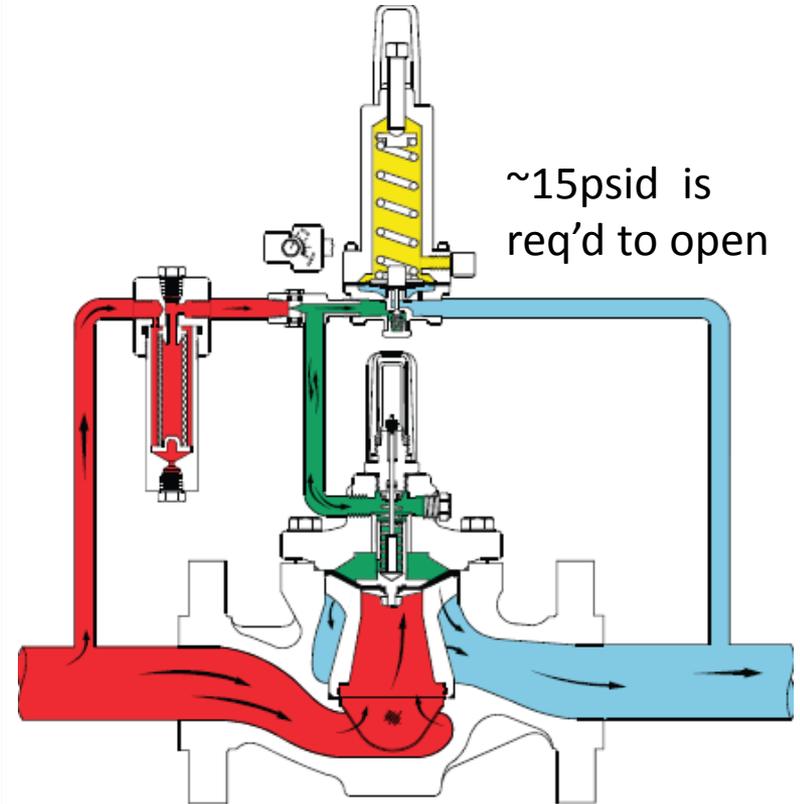
Pressure loading Reg: On increasing demand loading pressure is added to main diaphragm by the pilot. Appx 3psid is req'd to open.

~3psid is
req'd to open



Pressure Unloading Reg: On increasing Demand loading pressure is added to Main diaphragm by the pilot.

~15psid is
req'd to open



Operator Stations

Annual UTC stroke & lock up tests



Gate stations: ~700 to 250#
District stations: ~250-55#



PCE
PCE Pacific, Inc.



Direct Sales: NFPA codes and DOT regulations

- NFPA guidance



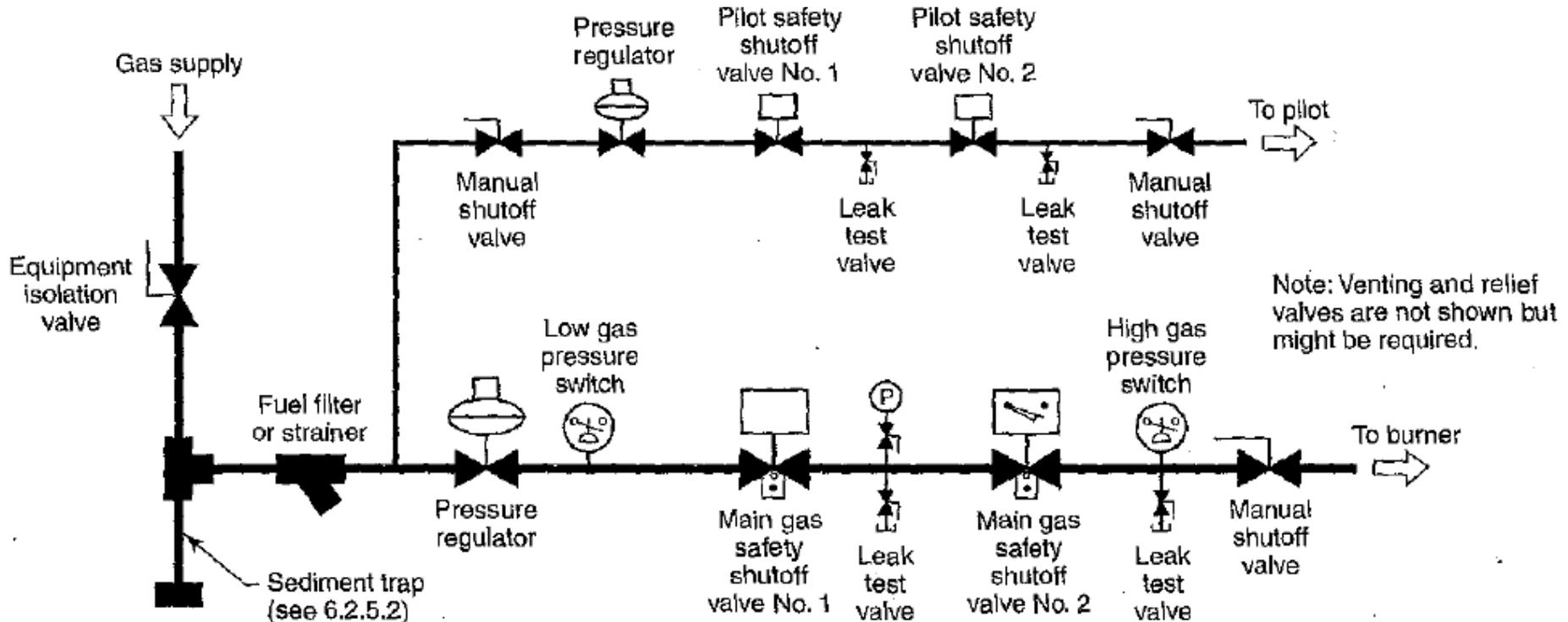
NFPA 86



National Fire Protection Association

The authority on fire, electrical, and building safety

Requirements address the safe design; installation; operation; and inspection, testing, and maintenance of Class A, B, C, and D **ovens, dryers, and furnaces**, thermal oxidizers, and any other heated enclosure used for processing of materials and related equipment.



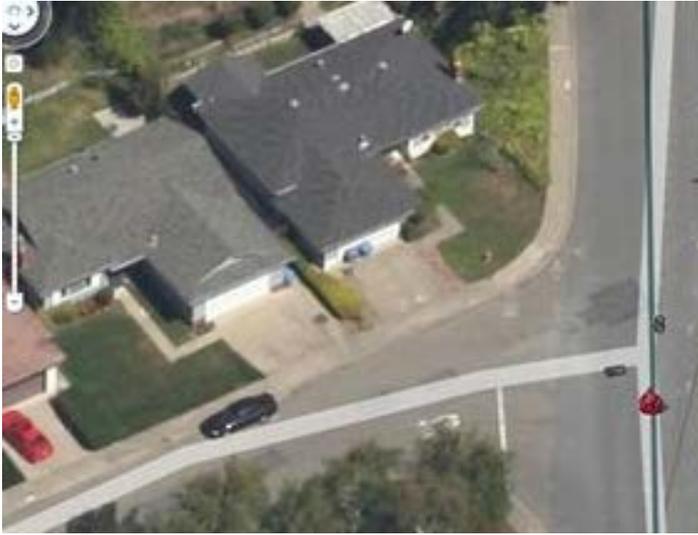
Key	Safety shutoff valve requirements		
Safety shutoff valve	Under 150,000 Btu/hr (44 kW)	150,000 to 400,000 Btu/hr (44 kW to 117 kW)	Over 400,000 Btu/hr (117 kW)
Safety shutoff valve with visual identification			
Safety shutoff valve with visual identification and proof of closure			

System Pressure Trouble: delivery pressure-high-low-unstable

Could lead to code or tariff issue

- Instability: tariff compliance, asset issues
 - Cause: oversized regs, load smaller than planned, quick acting load, Inadequate downstream piping volume
 - Solution: check total connected load & resize reg, add pipe volume, change equipment operation procedures
- Low pressure: tariff compliance, asset issues
 - Cause: under sized reg, load larger than planned
 - Solution: check total connected load & resize reg, check upstream pressure
- High pressure: UTC safety compliance issue, asset issues
 - Cause: reg can't lock up due to pipe debris, Sulphur, quick closing load, Inadequate piping volume, JT freezing
 - Solution: clean/rebuild reg, add strainer, add pipe volume, change equipment procedure, add heat



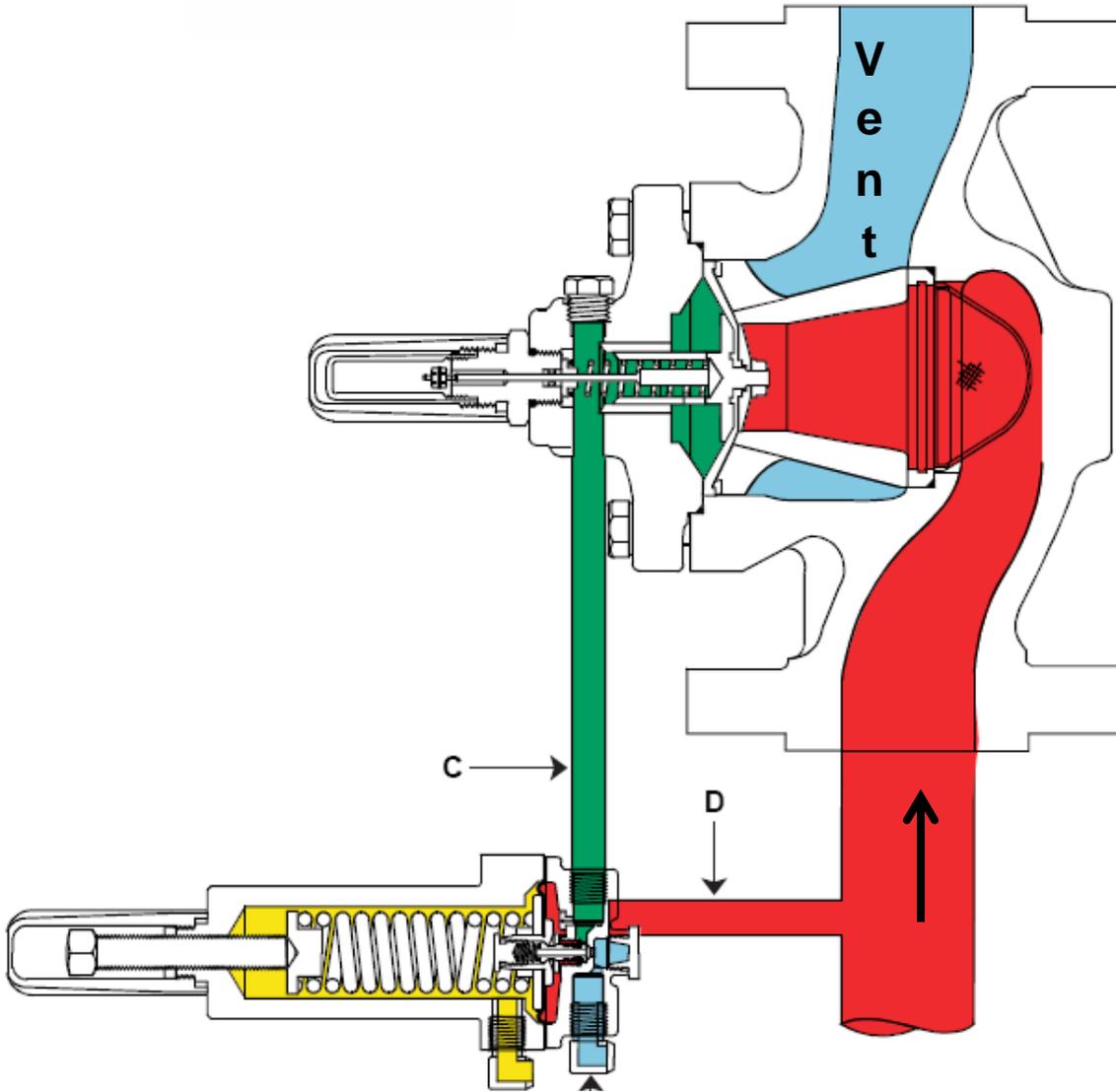


Overpressure protection

Holding pressure to a maximum safe value
-Protecting to one failure

- Relief valves: holding pressure to max safe value through venting
- Monitors: holding pressure to max safe value through containment
- Slam shuts: holding pressure to max safe value by shutting off gas flow

Overpressure protection: Relief valve sizing



Overpressure protection: Relief valve sizing

$$Q = \text{Reg } C_{g_{wo}} \times P_{1_{\max}} \times 1.29$$

§192.743 Pressure limiting and regulating stations: Capacity of relief devices.

(a) Pressure relief devices at pressure limiting stations and pressure regulating stations must have sufficient capacity to protect the facilities to which they are connected. Except as provided in §192.739(b), the capacity must be consistent with the pressure limits of §192.201

(a). This capacity must be determined at intervals not exceeding 15 months, but at least once each calendar year, by testing the devices in place or by review and calculations.

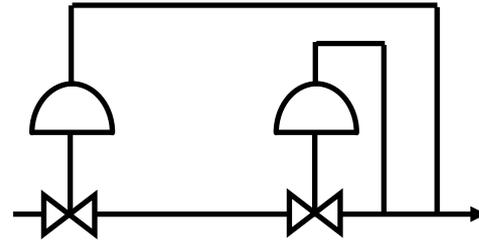
(b) If review and calculations are used to determine if a device has sufficient capacity, the calculated capacity must be compared with the rated or experimentally determined relieving capacity of the device for the conditions under which it operates. After the initial calculations, subsequent calculations need not be made if the annual review documents that parameters have not changed to cause the rated or experimentally determined relieving capacity to be insufficient.

(c) If a relief device is of insufficient capacity, a new or additional device must be installed to provide the capacity required by paragraph (a) of this section.

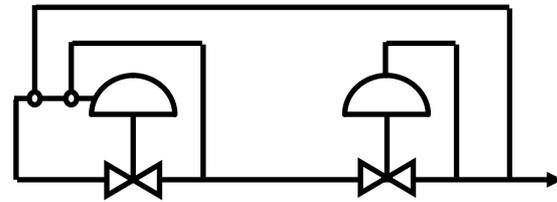
[Amdt. 192-93, 68 FR 53901, Sept. 15, 2003, as amended by Amdt. 192-96, 69 FR 27863, May 17, 2004]

Overpressure protection: monitors

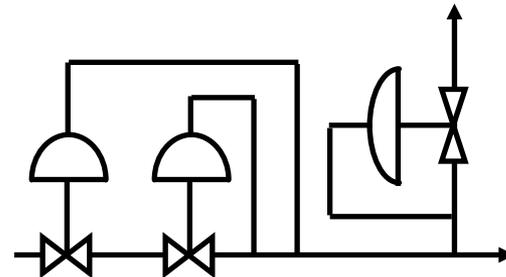
Wide Open Monitor



Worker Monitor

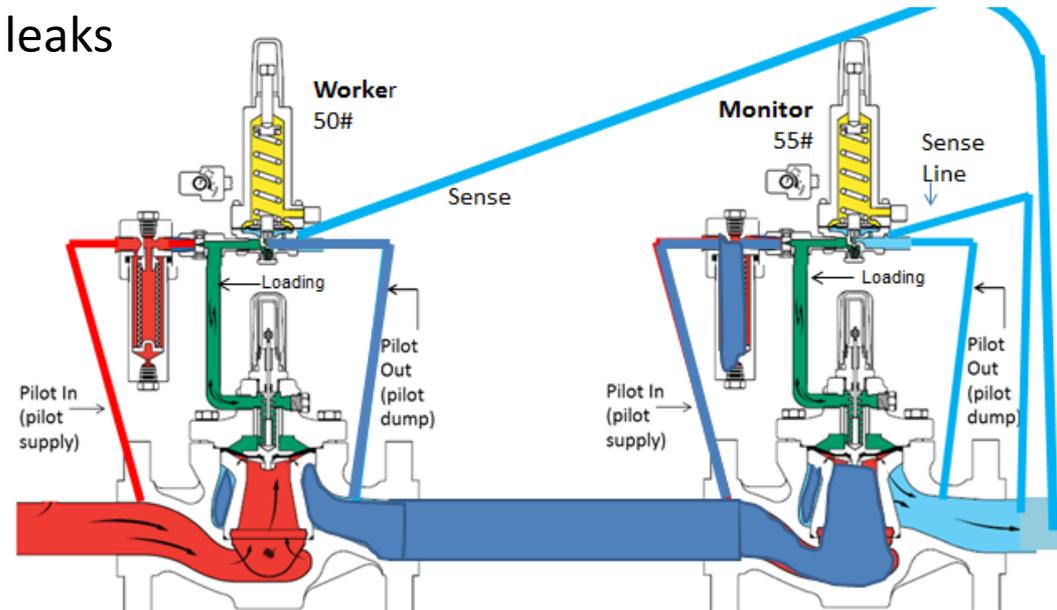


Wide Open Monitor & Relief



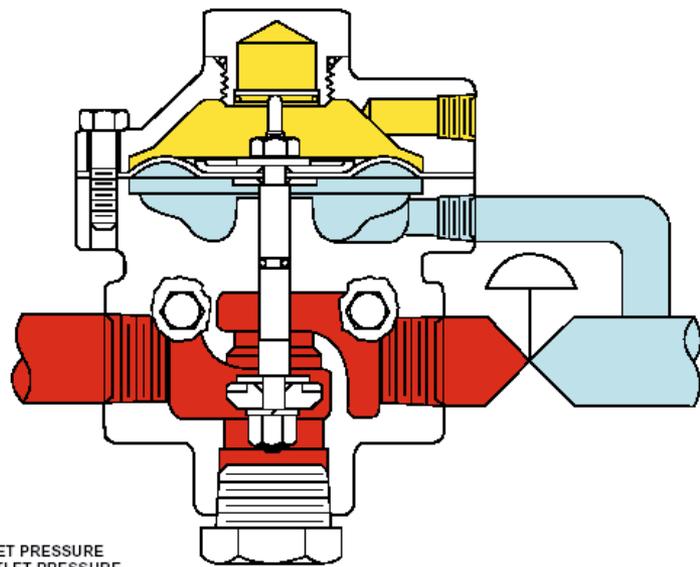
Monitor lock up test procedure

- **Shutdown:** Close inlet and outlet isolation valves, install christmas tree in pipe tap between reg and downstream block valve, open and close needle valve on tree and record pressure in which reg locks up at, if value is too high take apart the reg and clean or replace components
- **Start up:** Open outlet valve first (so only have 45lbs pressures) and check for leaks
- Open sense line valves
- Back out pilots so not feeding
- Open inlet valve
- **Calibration:** set monitor at 55lb
- Set worker at 45lb

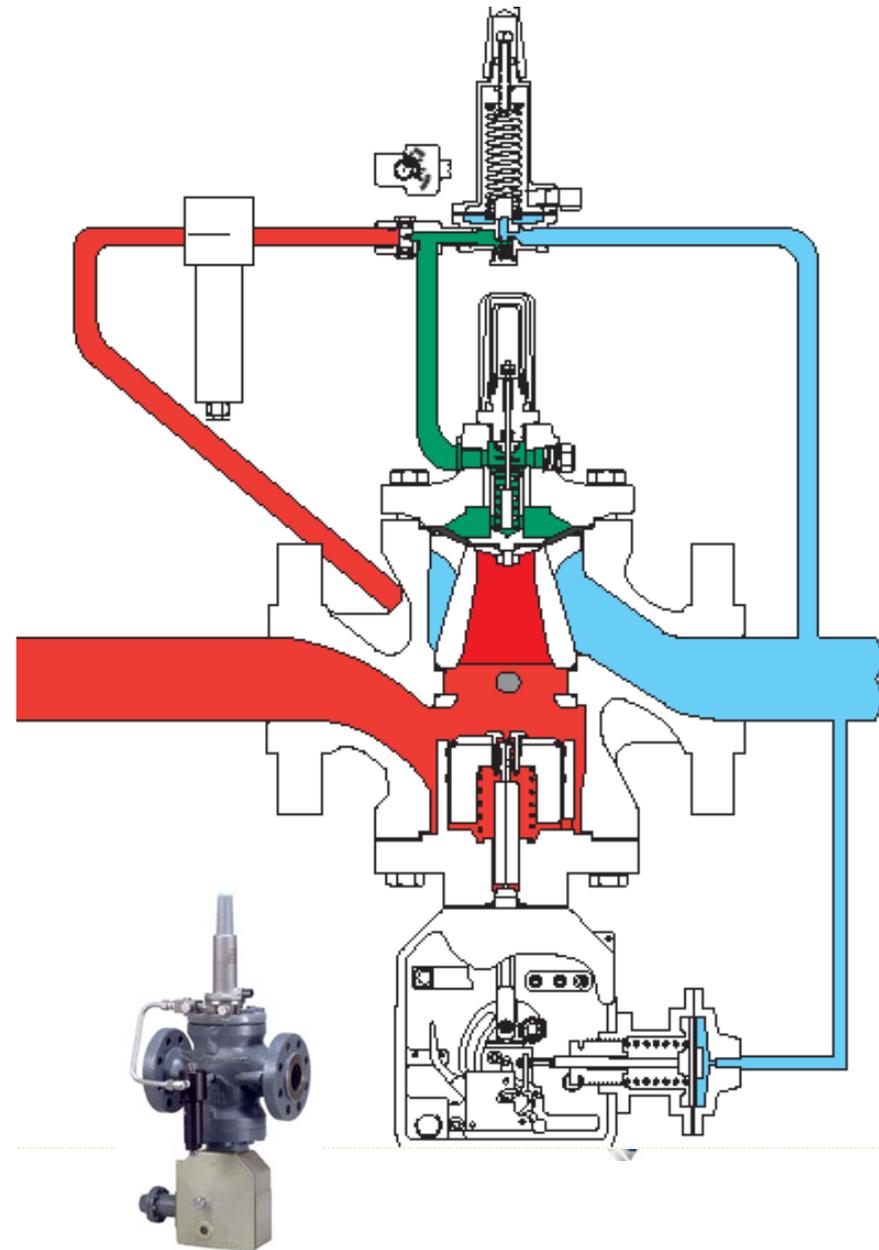


Overpressure protection: slam shuts

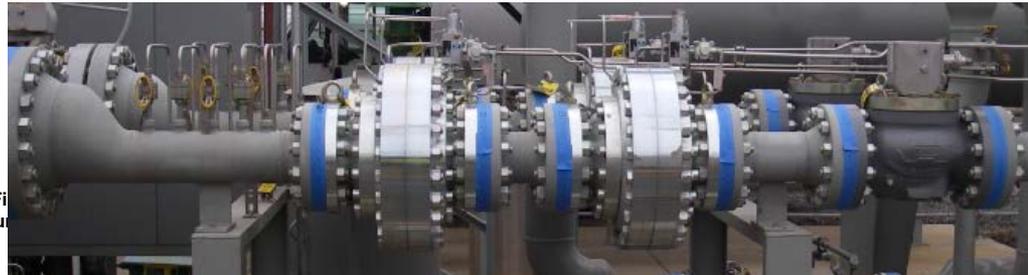
Shutting off the flow of gas



■ INLET PRESSURE
■ OUTLET PRESSURE
■ ATMOSPHERIC PRESSURE
AG488



Overpressure protection: slam shuts Industrial meter sets and user fuel trains



Types of Over-Pressure Protection

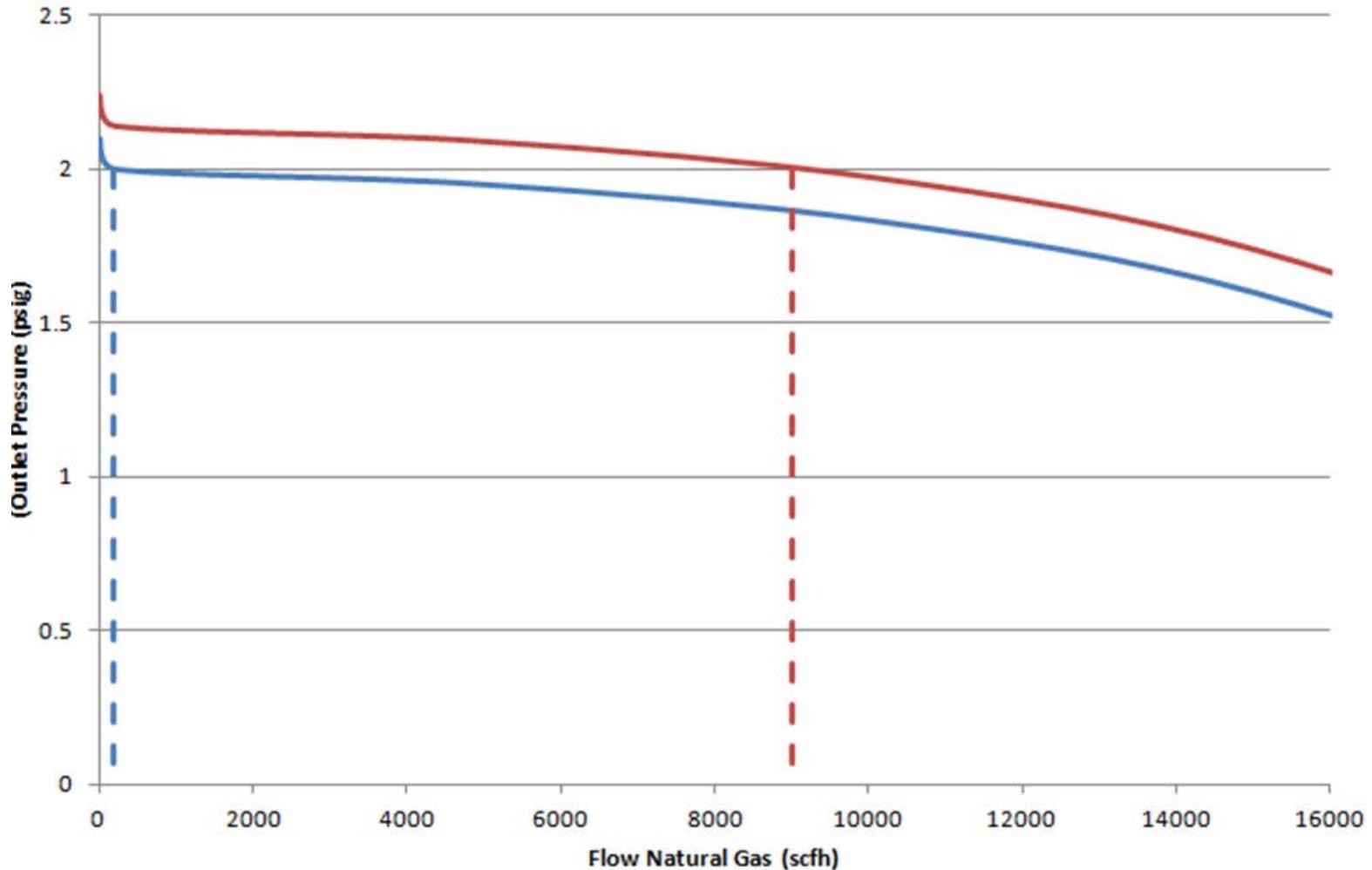
	Relief	Worker Monitor	Wide Monitor	Series Regulation	Shut Off	Relief Monitor
Keeps Customer "On Line"	Yes	Yes	Yes	Yes	No	Yes
Public Relations Problems Caused by Venting?	Yes	No	No	No	No	Minor
Required After Operation	No	No	No	No	Yes	No
Reduces Capacity of Regulator?	No	Yes	Yes	Yes	No	Yes
Constantly Working During Normal Operation?	No	Yes	No	Yes	No	Maybe

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When adjusting a reg set pt what should flow rate be?

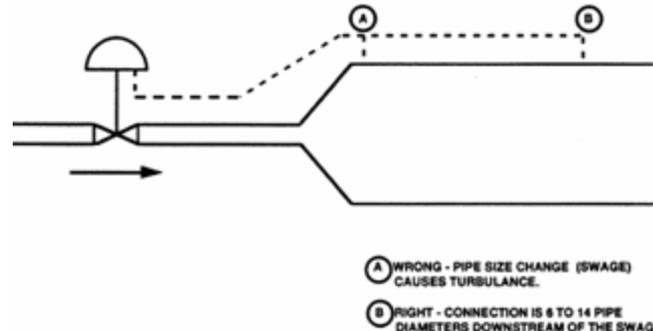
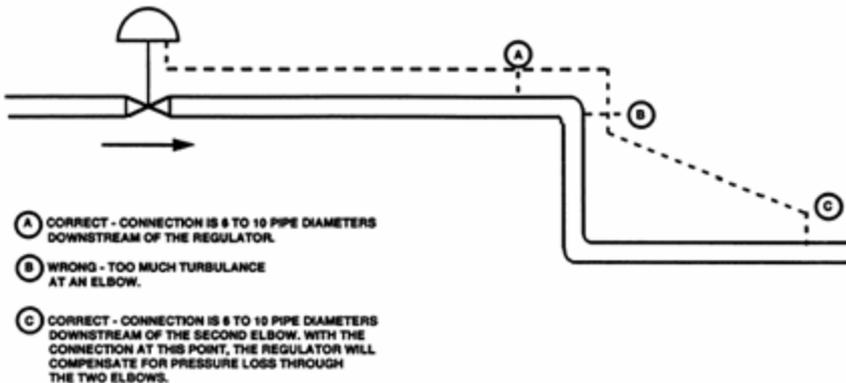
Droop: what delivery pressure must drop to during increasing demand



Best practices: sense line location

-After every 20' of sense line length go one size larger

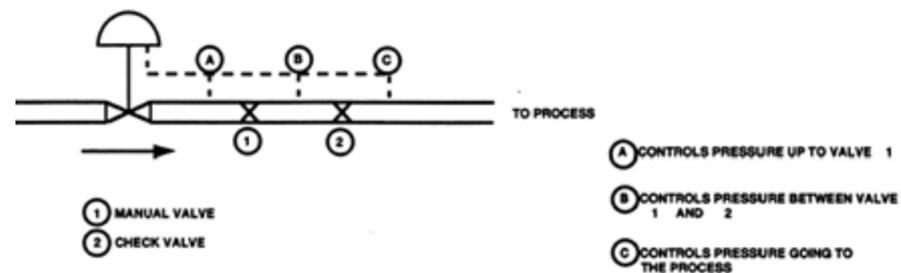
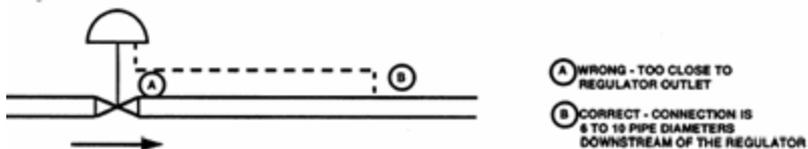
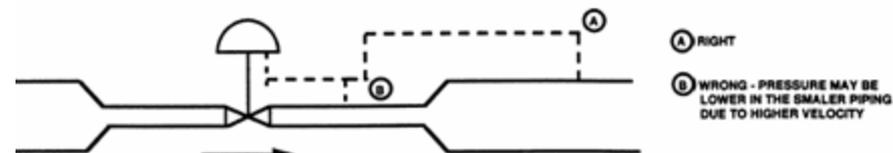
-6-10 pipe diameters downstream of the reg



Regulator Supplying to Large Header



Regulator in Swages



Best Practice Freezing trouble: Joules' Thompson gas effect

Temperature change of a gas or liquid across a restriction.

-for every 15dp temp drops 1F

Best practices

- Heat the gas main
- Heat the pilot supply
- Remove moisture from the gas stream
- Inject antifreeze in pilot supply
- Hydrates can freeze above 32F

~Common gas quality market spec = 7lbs water per million cubic feet gas~



PERSON.
management



REGULATOR TROUBLESHOOTING

System Components: piping (small volume, restricted, turbulent) & load (fast changing, low flows)

Regulator Components: valve & actuator size

p2 UNDER PRESSURE

- Valve undersized: check load requirements- valve capacity, inc. orifice size, inc. p1 (move reg closer to pres source)
- Check upstream pressure: Pilot filter or line strainer clogged-blow down, leaking trap or safety valve-rebuild
- Incorrect spring setting: vary setting and recalibrate
- Quick opening loads
- Diaphragm rupture

p2 OVER PRESSURE

- Bleed restriction clogged: clean
- Pilot leaking: check disc & plug-replace
- Main valve leaking: ck disc & plug-replace
- Quick closing load

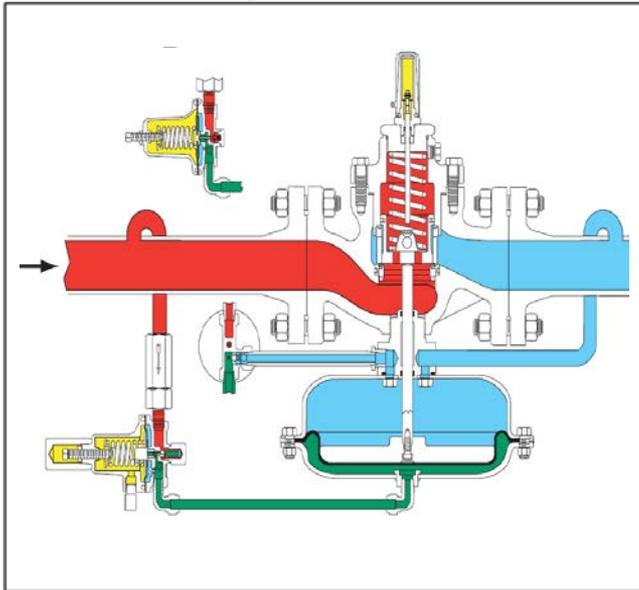
p2 UNSTABLE

- Valve oversized: check req'd capacity, check valve capacity, consider putting self op in sense line set at 30# above set point
- Be sure sense line valves are full port: reduced port valves intro speed & cycling into the system
- High pressure drops: too large dp can cause excessive forces in valve which cannot be overpowered by the actuator. Consider two cut.
- Small volume piping: any flow into or out of this volume will shock system pressure & reg can't respond quick enough, inc pipe size, inc pilot supply/valve won't have to open so much
- Restricted piping: too many headers, valves, meter run downstream that create small volume situation in large systems
- Turbulent piping: piping components (contractions or expansions) create erratic pressure profiles
- Sense line tap in turbulent area: check tap location

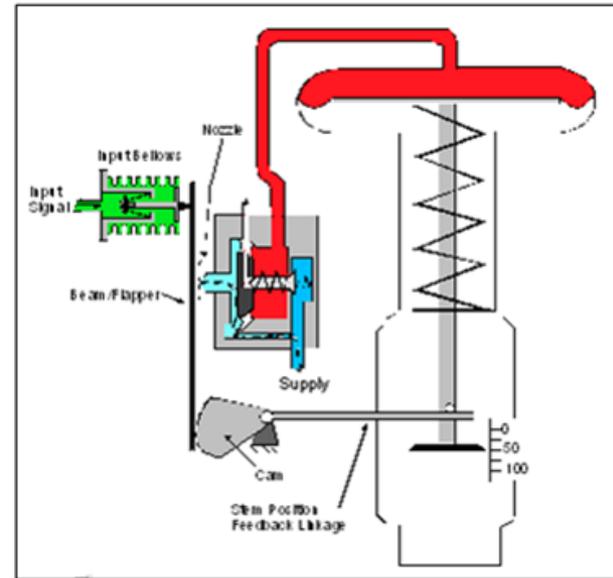
Final control element selection: control valve vs regulator

	Accuracy	Set point change	Position feedback	Clean medium	Air supply	Speed of response	budget
Regulator	1%	Field	No	Must be clean	Air not needed	Fastest	½ price of control valve
Control valve	.25%	Work Station	Yes	Any medium	Air Required	Fast	Expensive

Regulator



Control Valve



Questions?

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