Master Controls

Master Controls
P.O. Box 217 •Granville, OH 43023 • www.mastercontrolsinc.com
P 800-521-5738 • F 740-587-2531

BelGAS Pressure Regulators
High and Low Pressure Gas Regulators • Back Pressure Relief Regulators • I/P and E/P Transducers

GE - Becker Precision Equipment
Ball Valve Regulators • Globe Valve Regulators
Pneumatic Double Acting and Spring Return Actuators
Pilots, Positioners and Electro-Pneumatic Positioners

Boehmer Ball Valves
Floating and trunnion mounted ball valves from 1" through 56" for natural gas transmission, distribution and production applications.

GE - FlexFlo Regulators
Model 900TE • Flexible Element Top-Entry Regulators
Model 80 • Flexible Element Regulators
Model 887 • Surge Relievers

GE - Mooney Controls
FlowGrid • Flexible Element Top-Entry Regulators
FlowMax • High Capacity, Low Differential Regulators
FlowTap • Farm Tap Style Regulators

GE- Mooney Specialty Regulators
Small volume, high pressure regulators that provide extremely accurate trouble-free performance

GE - Sensing
Moisture Analyzers, Measurement,
Regulation & Flow Control Products

YZ Systems
NJEX • Odorization Equipment
DTEX • Odorant Detection System
Dyna Pak • Sampling Systems

History of Mooney Controls

- Founded by Dick Mooney in 1984
- Pilot added ~ 1990
- Acquired by Dresser 1998
- FlowMax added ~ 2001
- FlowTap added ~ 2005
- Acquired by GE in 2011

FlowMax® Regulator with Series 20 Pilot and Type 30A Pilot Supply Filter

Series 20 Pilot

FLOWGRID REGULATORS

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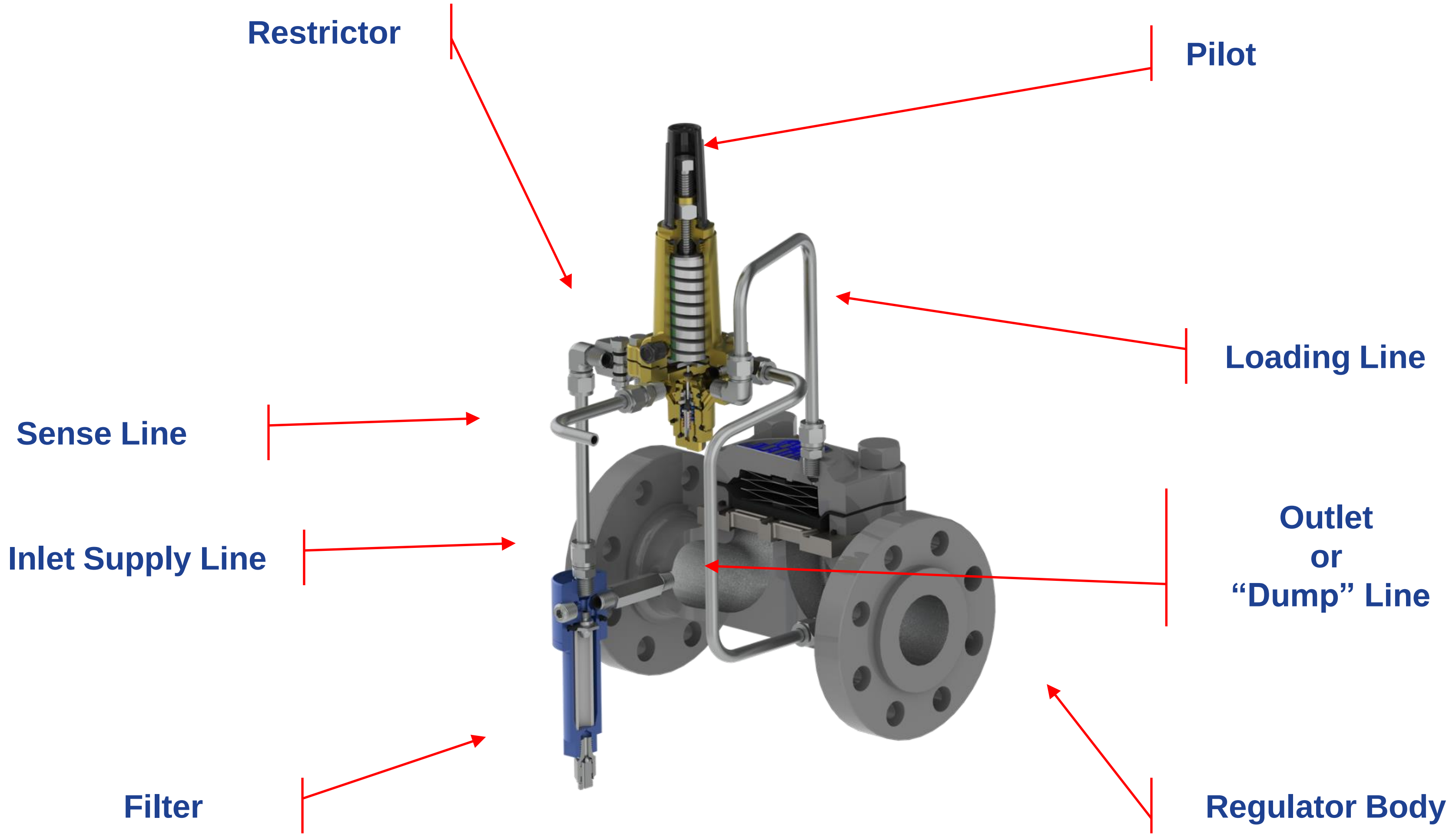
FlowGrid Design Goals

- Easy and Fast In-line Maintenance
- Consistent Low Minimum Differential
- Non Stretching Fabric Reinforced Diaphragm Throttling Element
- High Frequency Response and Turndown Ratio
- Redundancy or Increased Capacity with Dual Port Body

Components of the Flowgrid Regulator



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Basic Components

Cap Screws

Spring Case

Main Spring

Diaphragm

Throttle Plate

Body Seal

Body

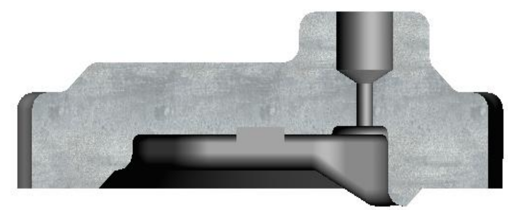
Basic Components

Body

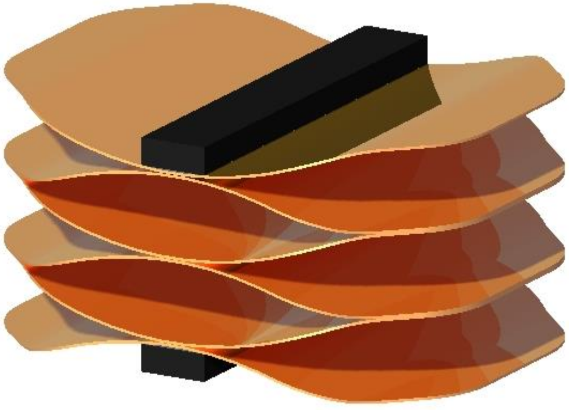
- A216 Grade WCB Steel
- Bi-directional
- Flanged, NPT, SWE, Buttweld, Flangeless, and Dual Ports

Spring Case

- A216 Grade WCB Steel
- Directional (1”, 2”, 3” sizes only)
- Recessed spring pocket



Basic Components



Spring

- Bias to aid in Shutoff
- Adds Support to Diaphragm
- Stainless Steel Construction
- Low differential model available

Diaphragm

- Fabric reinforced construction
  - Nitrile rubber (Buna-N) w/ Nylon fabric
  - Design flexes, does not stretch
- Available materials:
  - 60D / 75D Nitrile
  - 80D Hi-ACN & Lo-ACN Nitrile
  - Viton (limited sizes)

Diaphragm (Boot)

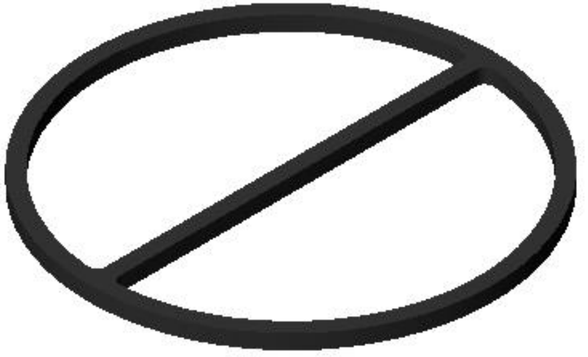
- Fabric reinforced construction consisting of Nylon Fabric and Nitrile (Buna N) rubber.
- Diaphragm Flexes, Does not Stretch
- 4 Durometers of Material available
  - 60 Durometer
  - 75 Durometer
  - 80 Durometer Hi-ACN
  - 80 Durometer Lo-ACN

Throttle Plate

- Standard Construction - 17-4PH Stainless Steel
- Available Restrictions
  - 35%
  - 50%
  - 75%

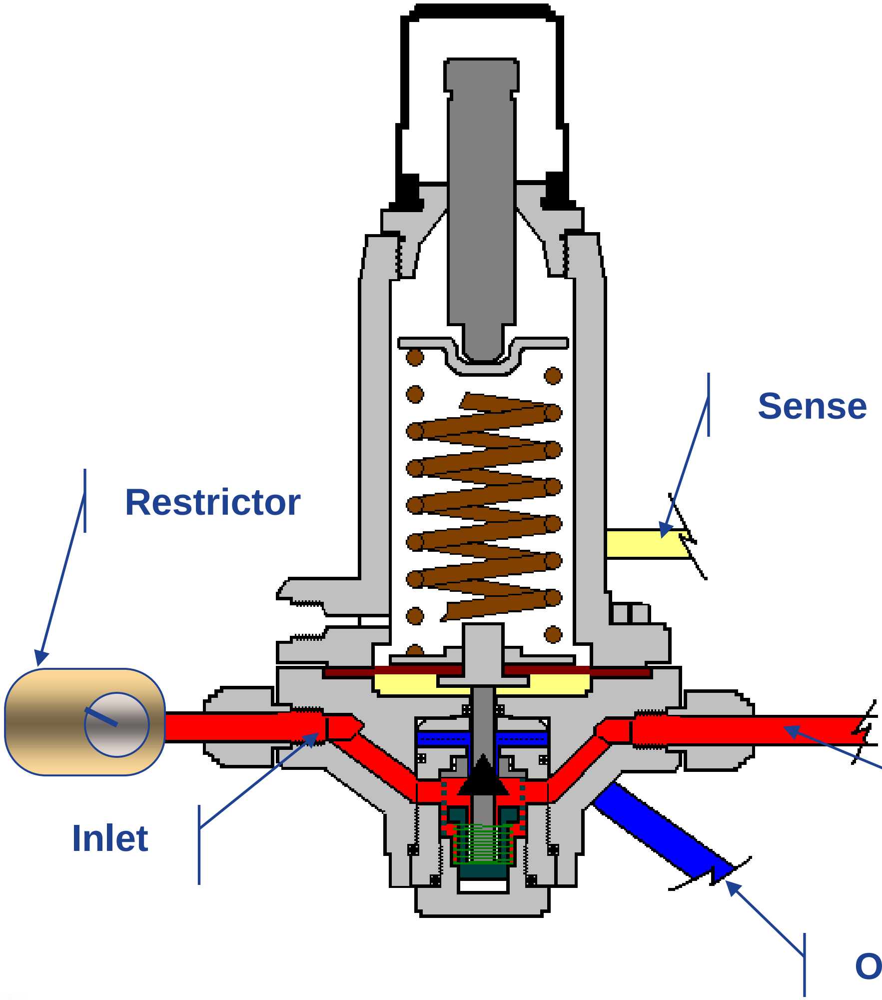
- Reversible and Bi-directional
- Drilled hole Throttle Plates available for high differential applications (greater than 400 psid). Standard in 600 CL Flanged and 8”, 12” regulators.

Seals



- Nitrile rubber
- Reusable
- “D” Seal is proprietary
- O-ring Seals are standard Parker seals
  - 3 Middle numbers represent the Parker seal number

Series 20 Pilot Connections



- Supply to Pilot INLET
- OUTLET port to outlet tap on FlowGrid® valve
- SENSE port 10 pd downstream of valve
- LOADING port to top of diaphragm

* Note that during static conditions inlet port pressure, loading port pressure, and upstream pressure P_1 are the same.

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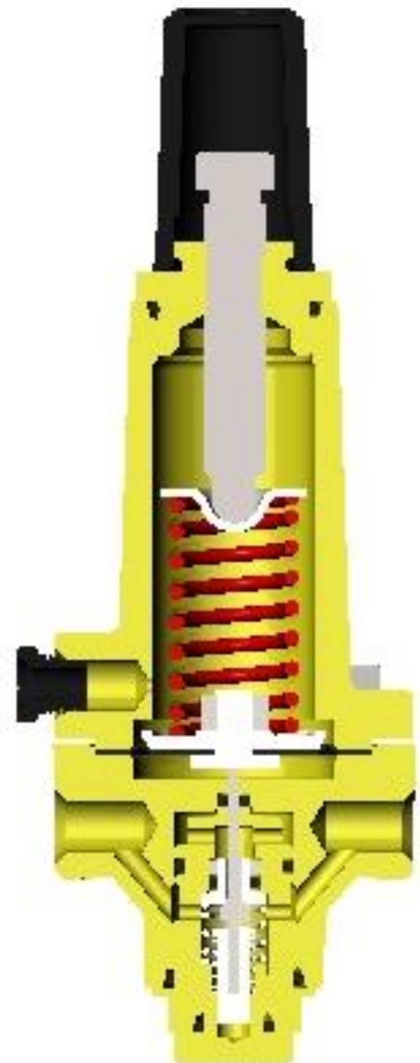
Series 20 Pilot Components

- Materials
  - Brass
  - Stainless Steel
- Spring Housing
- Body
- Insert Assembly



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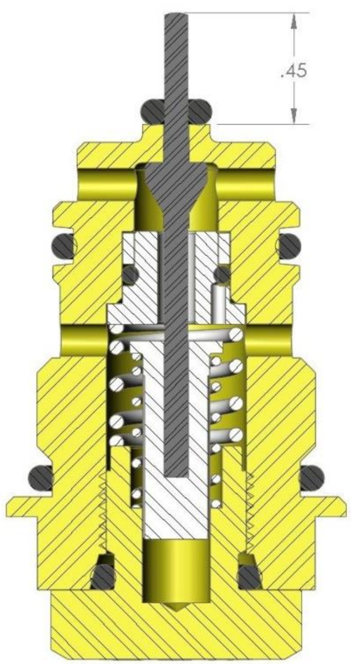
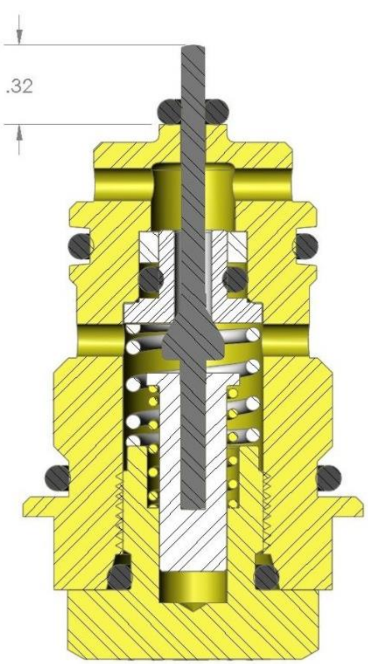
Modes of Operation

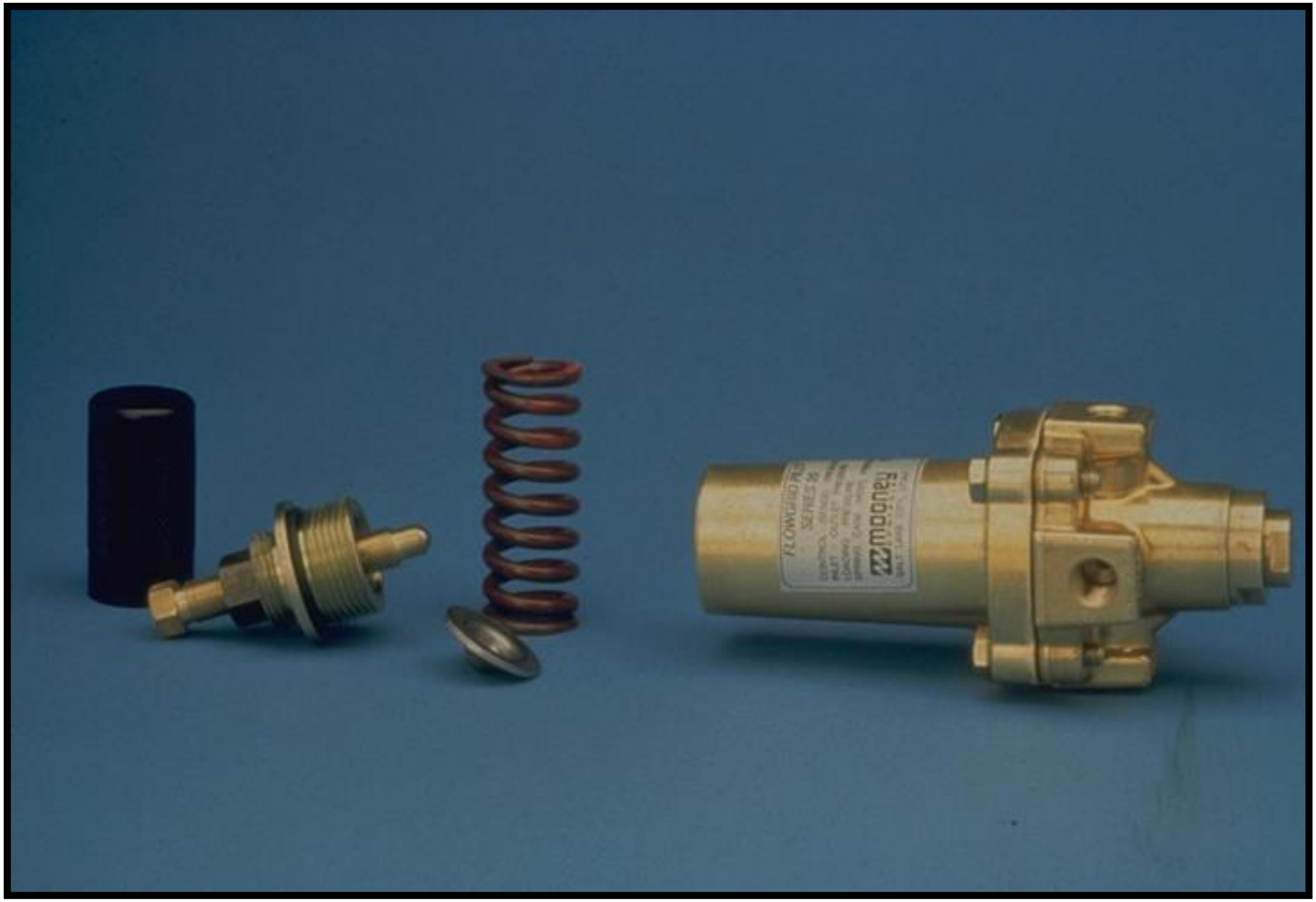
- Pressure Reducing (PRV)
- Back Pressure (BPV)
- Change made by reversing stem





Pilot with Cartridge removed

Pilot with Adjusting Spring Removed



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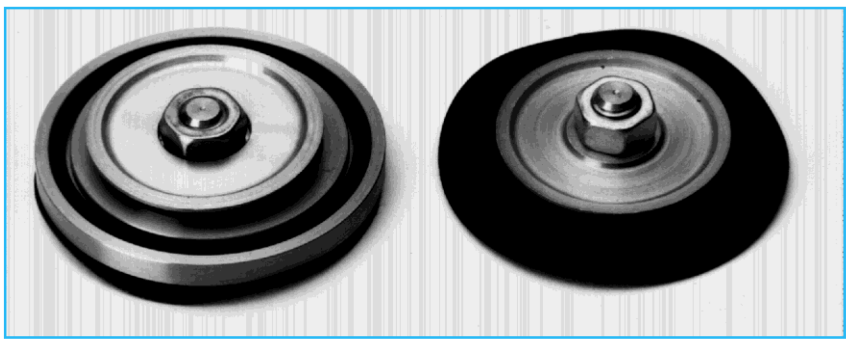
Springs

RED	20	3-12 psi
CADMIUM	20	10-40 psi
BLUE	20	25-90 psi
PURPLE	20	60-200 psi
BLACK	20	100-260 psi
GREEN	20	200-450 psi

Series 20 High Pressure Pilot

- Conversion pieces include
  - High pressure Diaphragm
  - Spacer Plate
  - Diaphragm Plate
- Springs

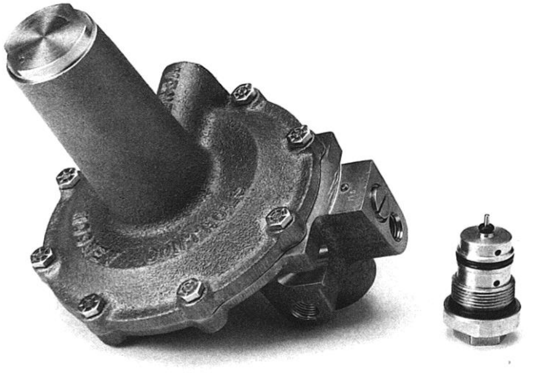
BLACK	20HP	200-520 psi
GREEN	20HP	400-900 psi



Series 20L Low Pressure Pilot

- Bronze or Aluminum Construction
- Max. Inlet Pressure: 750 psi
- Uses the standard Series 20 cartridge

Spring Color		Type 20™ Pilot	Outlet Pressure Range
WHITE		20L	5-15 i.w.c
BROWN		20L	10-40 i.w.c.
YELLOW		20L	1-3 psig
ORANGE		20L	2-5 psig
GRAY		20L	4-8 psig



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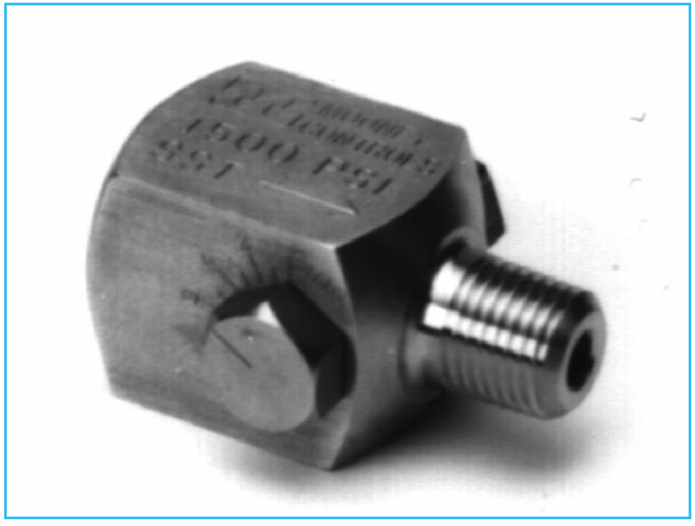
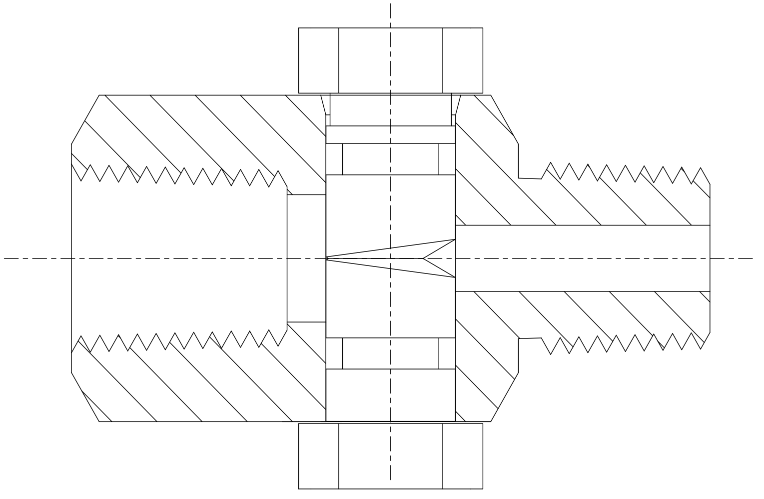
Series 20 Pilot Performance

MOONEY CONTROLS SERIES 20 PILOT		PRESSURE REDUCING MODE RESTRICTOR SET AT 4		
SPRING RANGE	COLOR	LOCK-UP (PSI)	DROOP (PSI) @ MAX CAPACITY	BOOST @ CONSTANT FLOW (PSI)
3-12	RED	1.0	0.3	0.7
10-40	CADMIUM	1.0	0.3	0.7
25-90	BLUE	2.0	0.6	0.7
60-200	PURPLE	2.0	1.30	0.7
100-260	BLACK	5.0	2.00	0.7
200-450	GREEN	10.0	4.00	0.7

Type 24 Restrictor

- Fixed orifice in the Pneumatic amplifier package
- Higher setting signifies less gain/less responsive





Tuning the Flowgrid Regulator

Restrictor Adjustment

- Larger setting for greater stability.
- Larger setting for faster shut-off.
- Smaller setting for increased sensitivity and accuracy.
- Leave margin of safety.
- Adjust setpoint last.

Accessories - Type 30 Filter

- Aluminum, Steel, or Stainless Steel
- 1/4” NPT connections
- Porous Polyethylene element
- 10 micron rating for air/gas service

Applications

- District Regulator
- Monitor Regulator
- Relief Valve (BPV)
- Compressor Fuel Gas
- Co-Generation Fuel Supply
- Boiler Fuel Gas

Control Limitations and Criteria

Minimum Differential

- See Differential Chart - Color Brochure pg.6

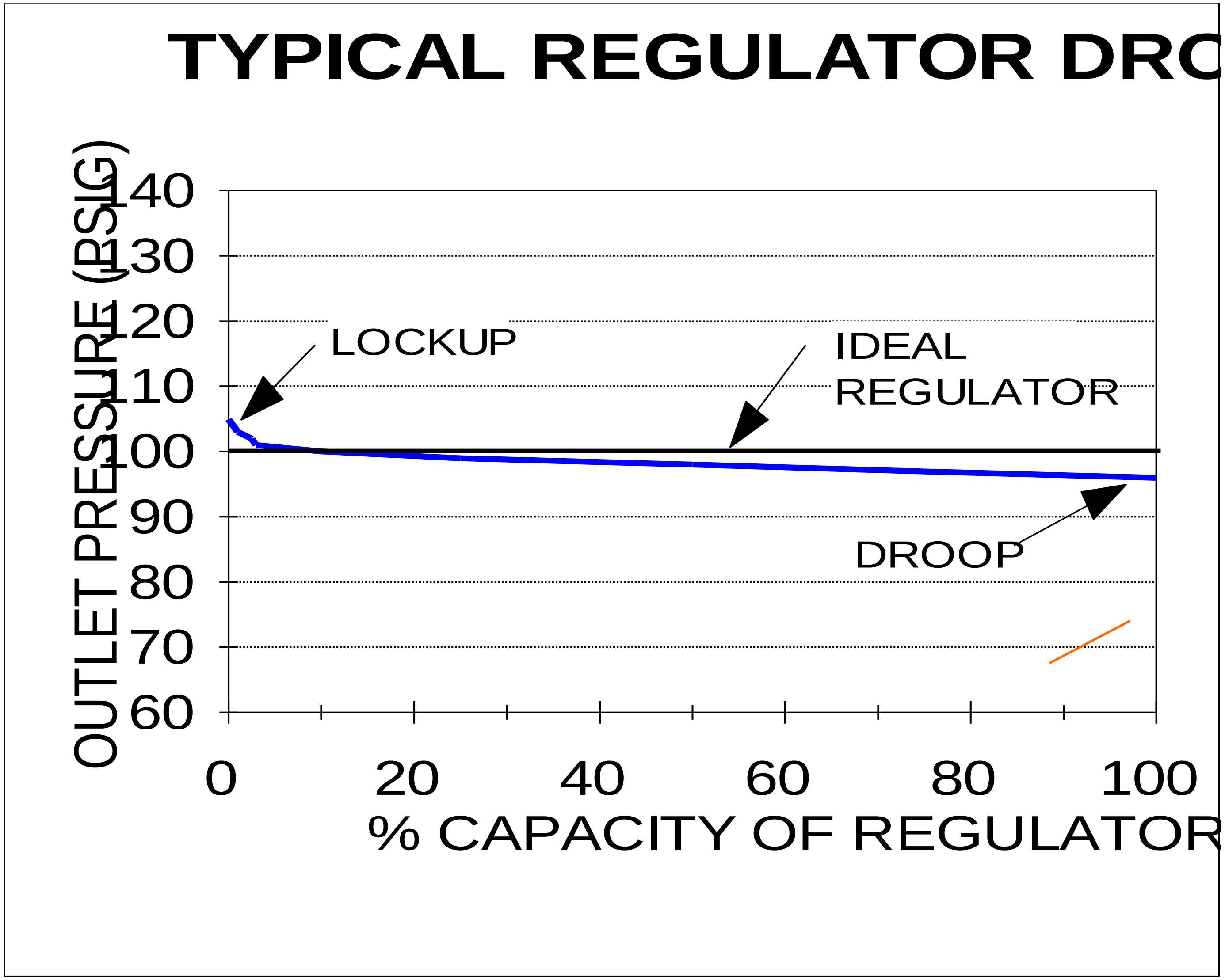
Maximum Differential

- 800 psid (1000 psid for 1”)

Sense Line Placement

- 8 to 10 Pipe Diameters from Regulator

Gain/Proportional Band



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Flowgrid Applications

Pressure Reducing Systems

- Single Regulator
- Standby Monitor
- Working Monitor

Back Pressure / Relief Systems

- Single Regulator

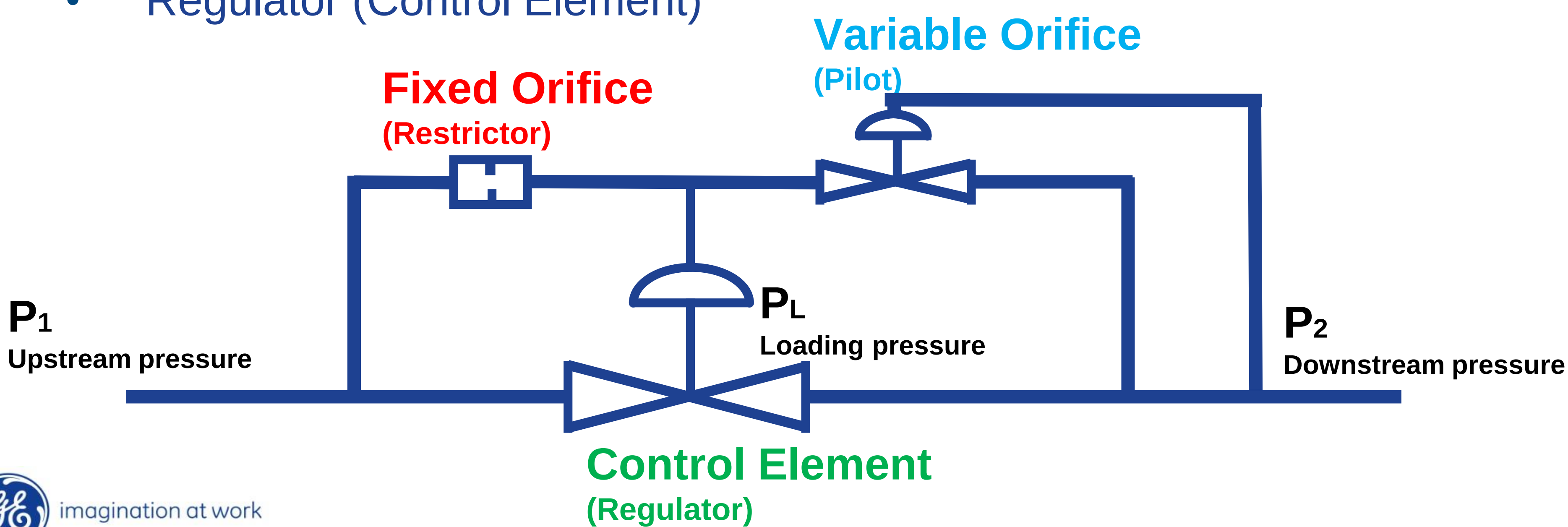
Principle of Operation of Pilot Operated Regulators with Unloading Type Pilot Systems

Basic Components

- Pilot (Variable Orifice)
- Restrictor (Fixed Orifice)
- Regulator (Control Element)

Combination of Components

- Pilot & restrictor work together to form a pneumatic amplifier.
- Unloading type system.



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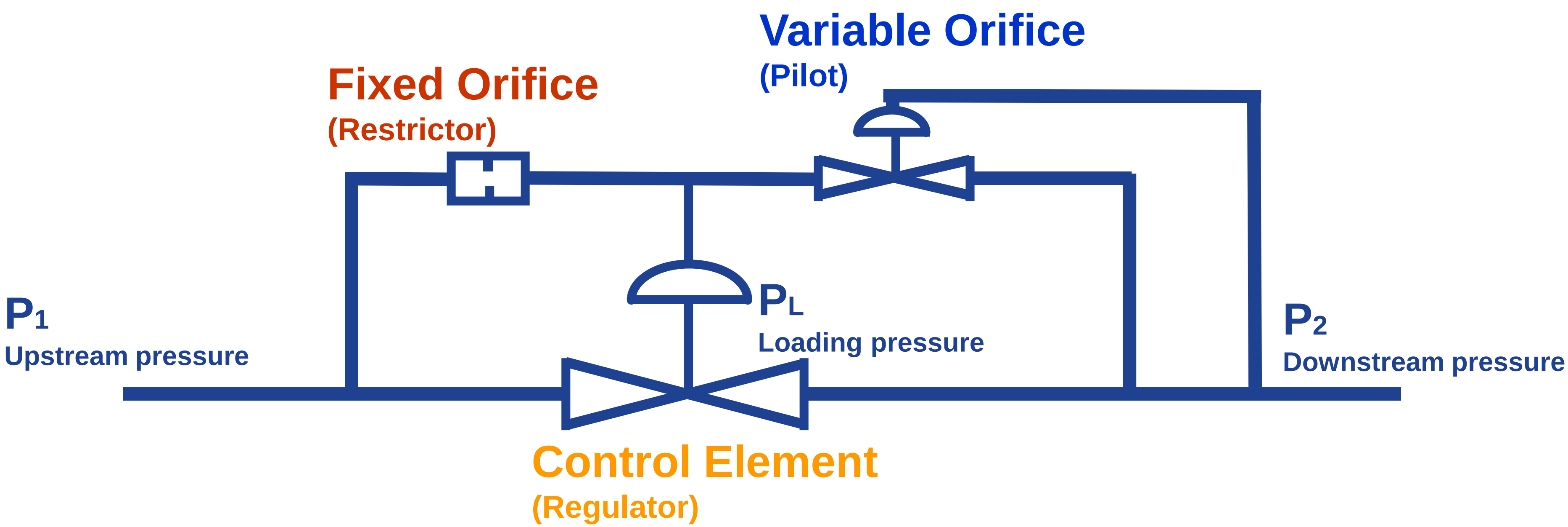
Principle of Operation of Pilot Operated Regulators with Unloading Type Pilot Systems

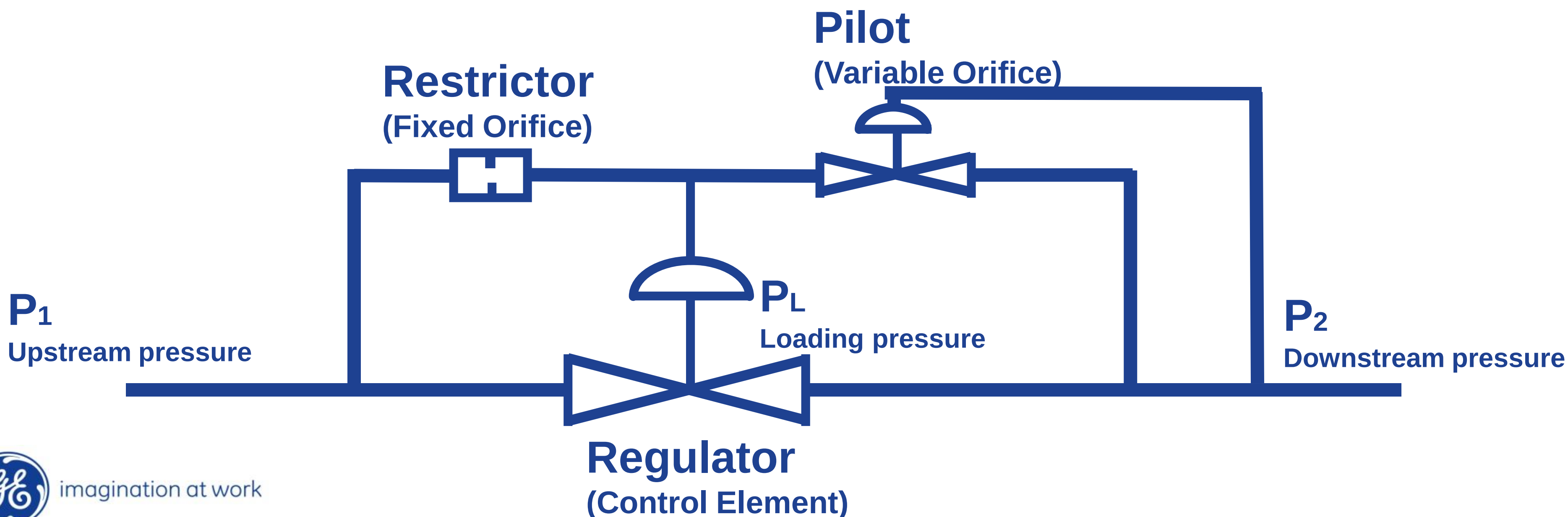
Amplification From Difference In Discharge Rates

When the variable orifice discharge rate is greater than the fixed orifice recharge rate we have amplification. The greater the difference between the fixed orifice and the variable orifice, the greater the amplification. Reducing the fixed orifice size magnifies this effect.



Principle of Operation of Pilot Operated Regulators with Unloading Type Pilot Systems

Decreasing fixed orifice size increases gain. Higher gain means greater "accuracy" or ability to maintain downstream pressure. However, higher gain also increases sensitivity to instability.



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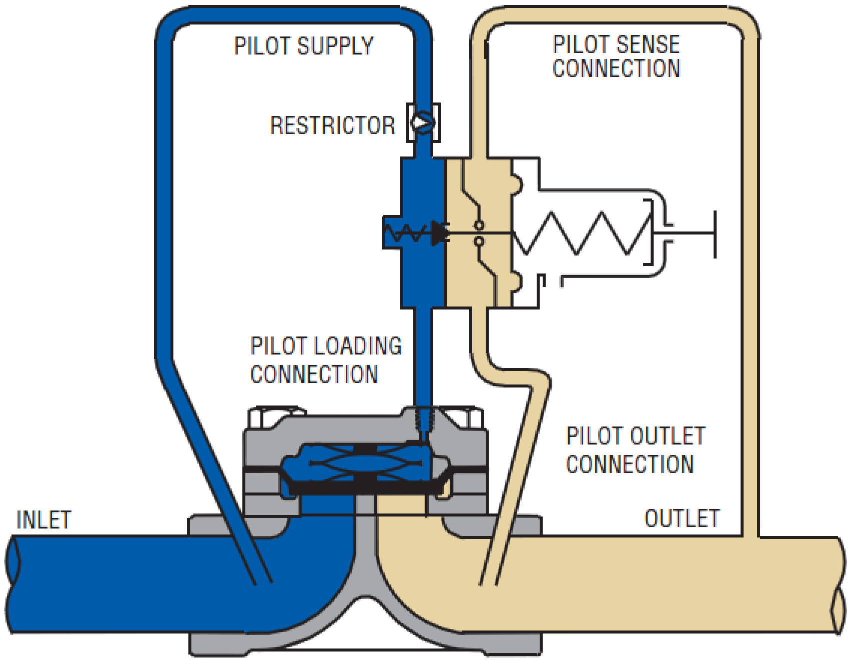
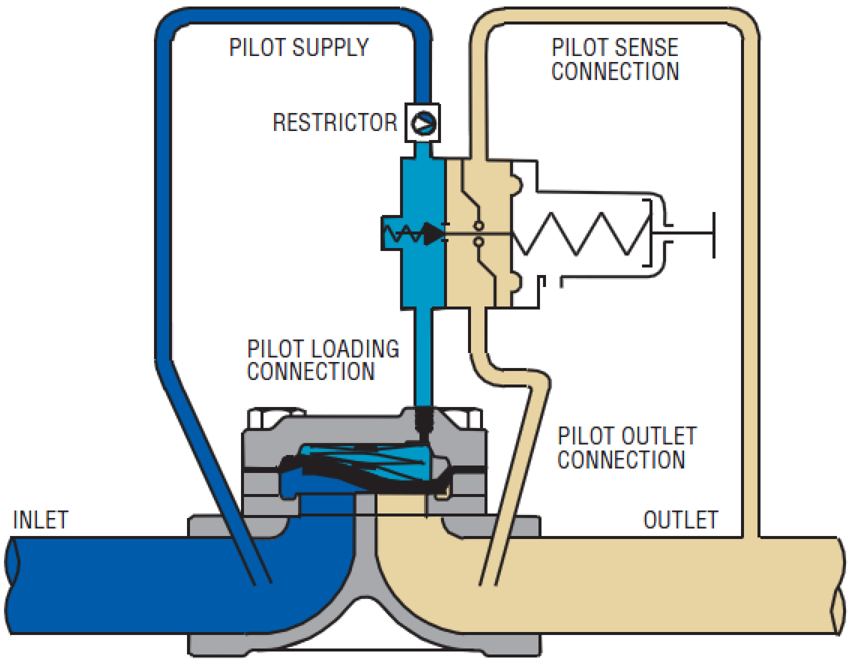
Pressure Reducing Application - Single Regulator



Fully Closed



Partially Opened

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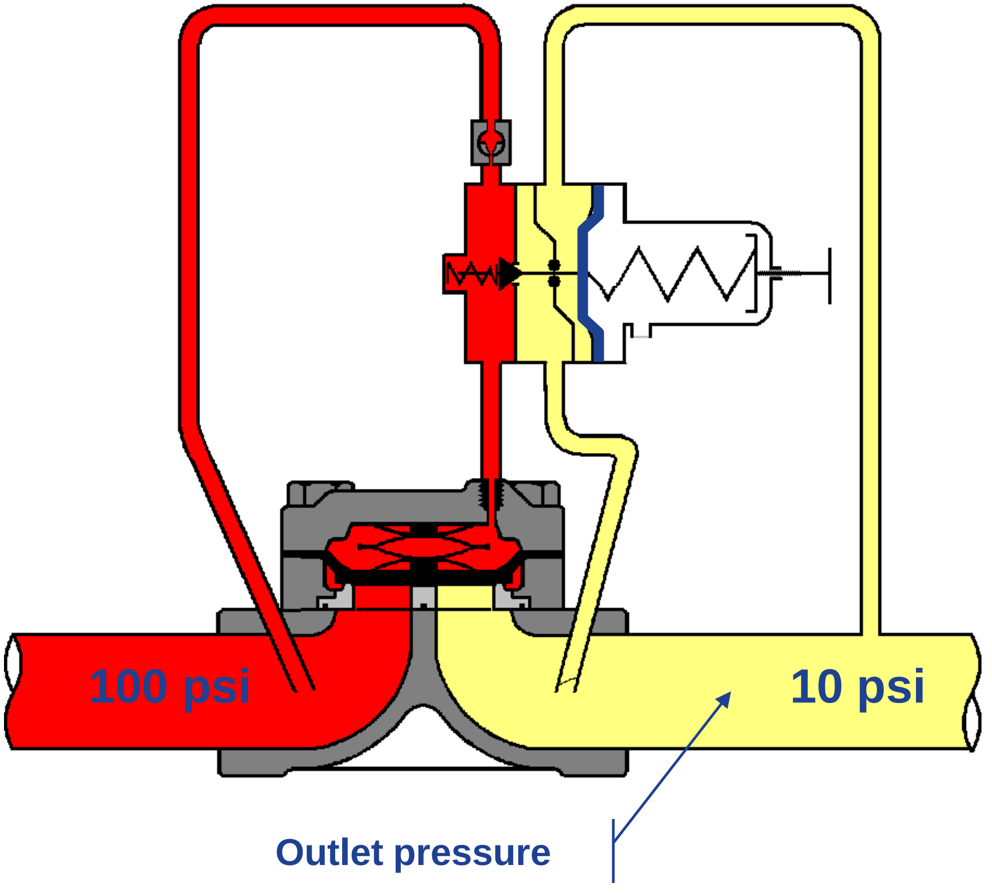
Principle of Operation

Pressure Reducing Configuration (PRV)

Closed Position

- Outlet pressure above pilot set point.
- Pilot Closed.
- Full inlet pressure loads valve main spring case.
- Pressure forces valve diaphragm tight against valve outlet.

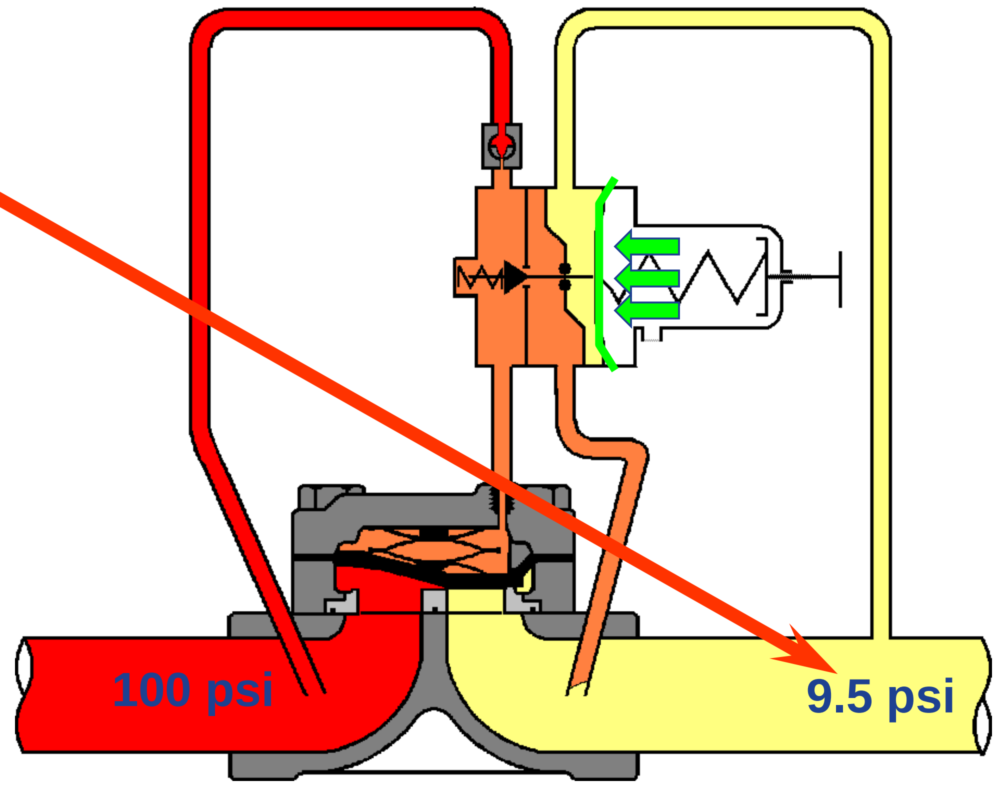


Principle of Operation

Pressure Reducing Configuration (PRV)

As downstream demand occurs

- Outlet pressure drops.

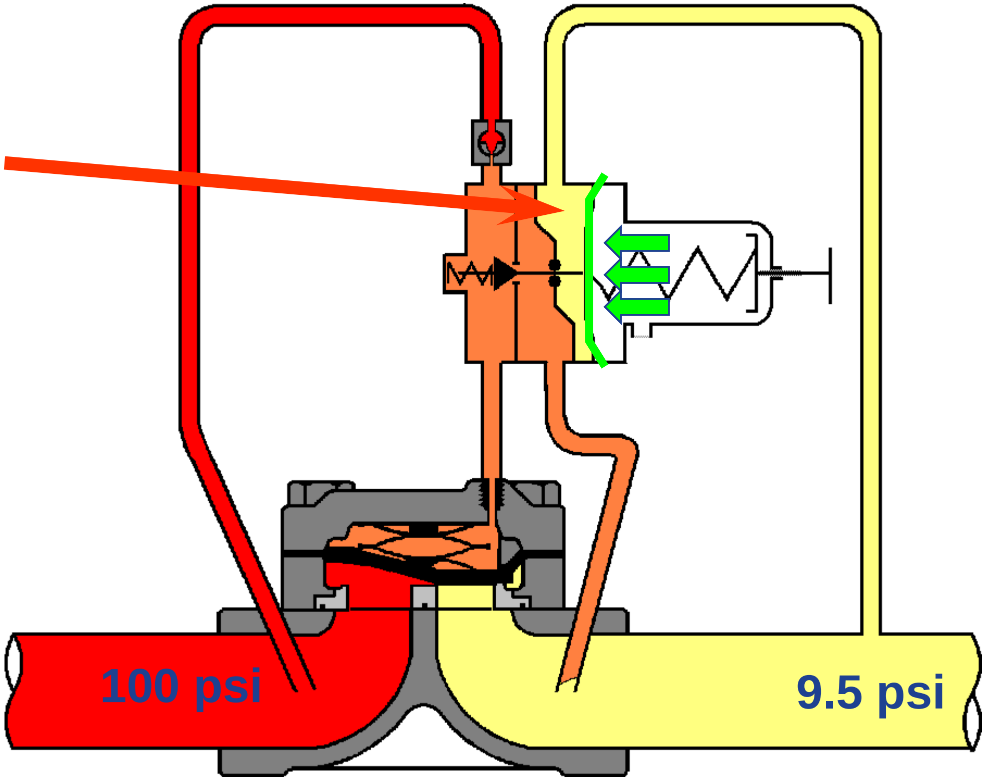


Principle of Operation

Pressure Reducing Configuration (PRV)

As downstream demand occurs

- Outlet pressure drops.
- Pressure below pilot diaphragm is reduced.

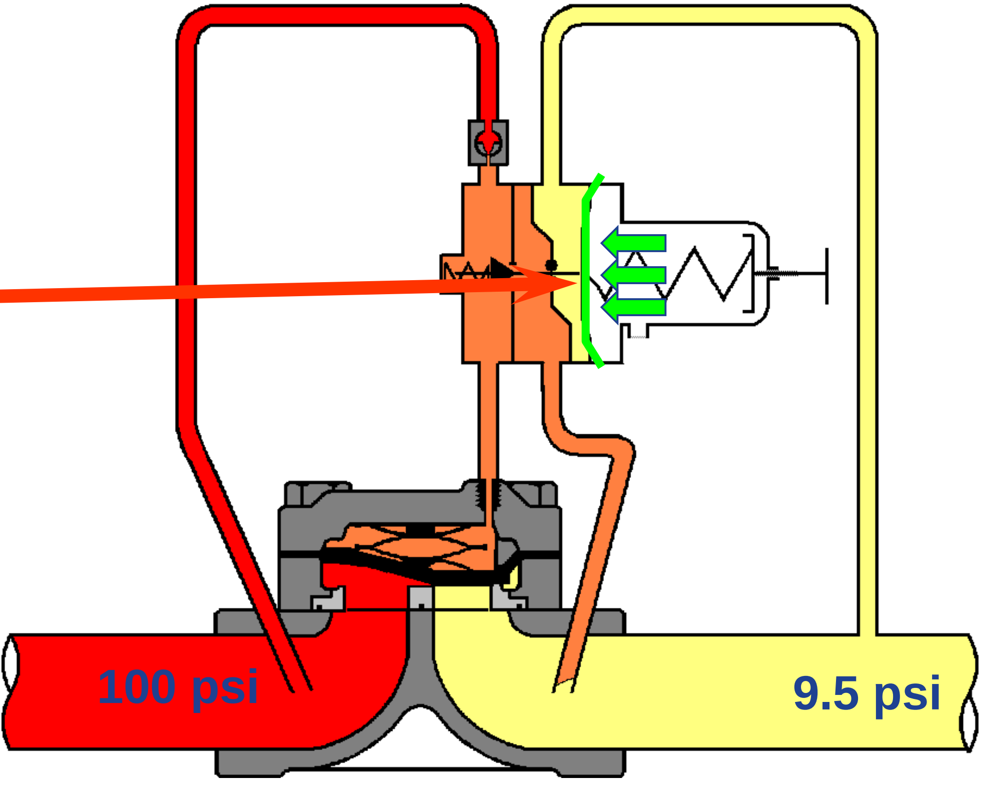


Principle of Operation

Pressure Reducing Configuration (PRV)

As downstream demand occurs

- Outlet pressure drops.
- Pressure below pilot diaphragm is reduced.
- Spring force above pilot diaphragm overcomes pressure below.

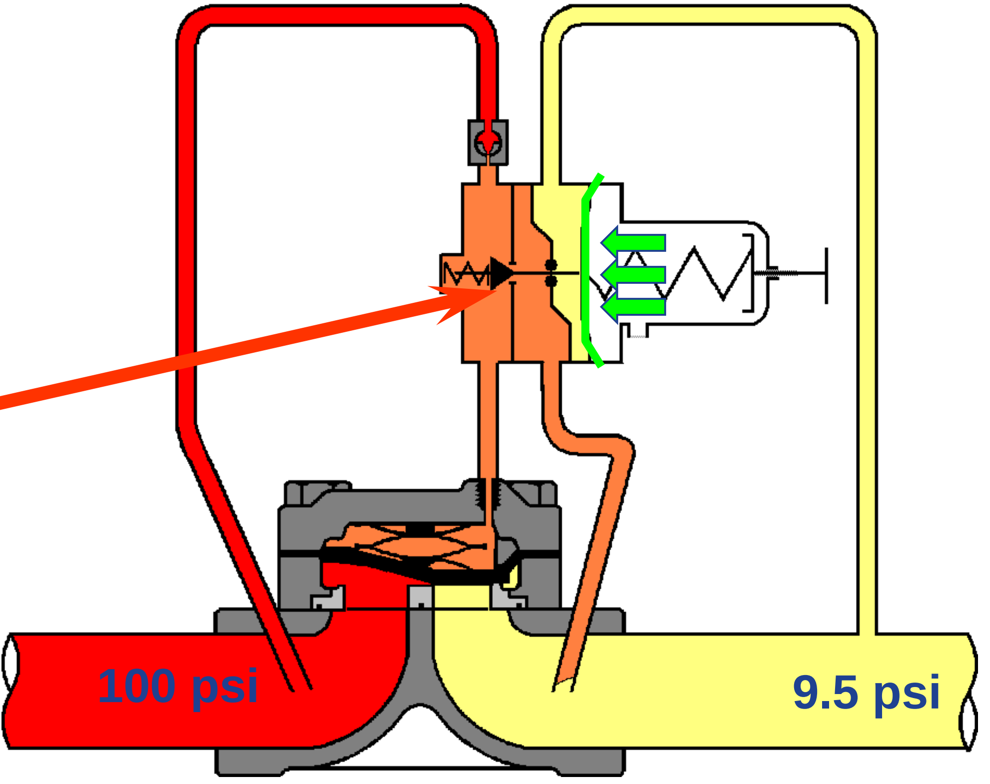


Principle of Operation

Pressure Reducing Configuration (PRV)

As downstream demand occurs

- Outlet pressure drops.
- Pressure below pilot diaphragm is reduced.
- Spring force above pilot diaphragm overcomes pressure below.
- Pilot begins to open, releasing pressure from valve spring case.

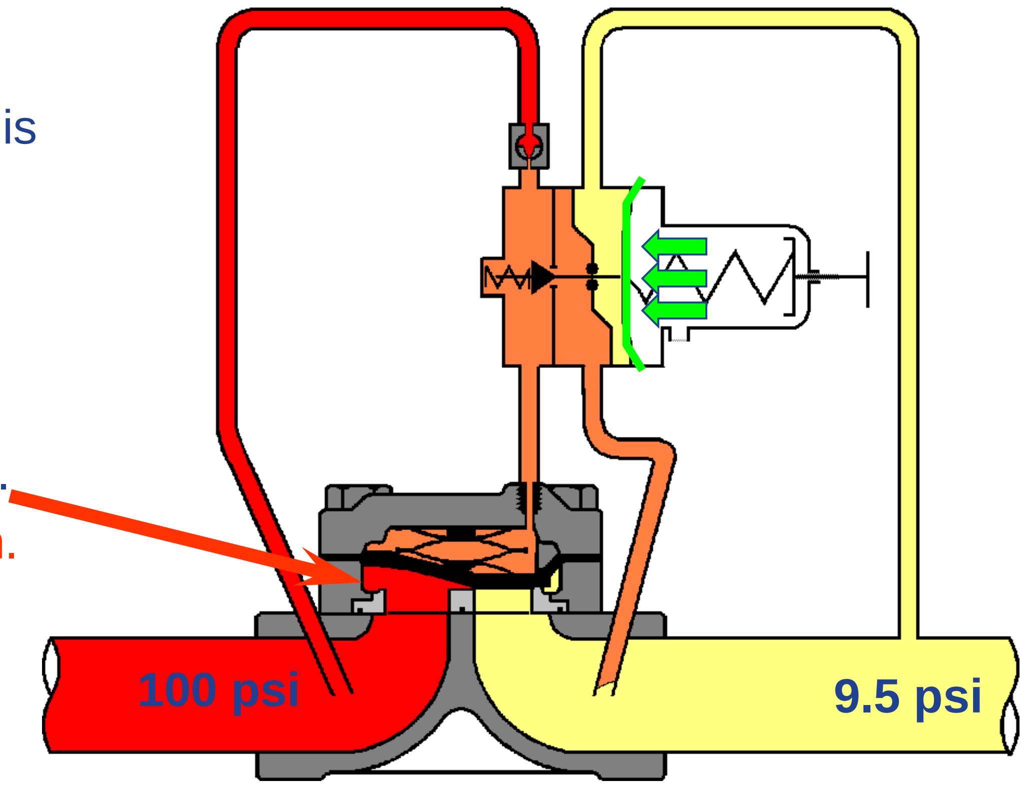


Principle of Operation

Pressure Reducing Configuration (PRV)

As downstream demand occurs

- Outlet pressure drops.
- Pressure below pilot diaphragm is reduced.
- Spring force above pilot diaphragm overcomes pressure below.
- Pilot begins to open, releasing pressure from valve spring case.
- Valve diaphragm begins to open.

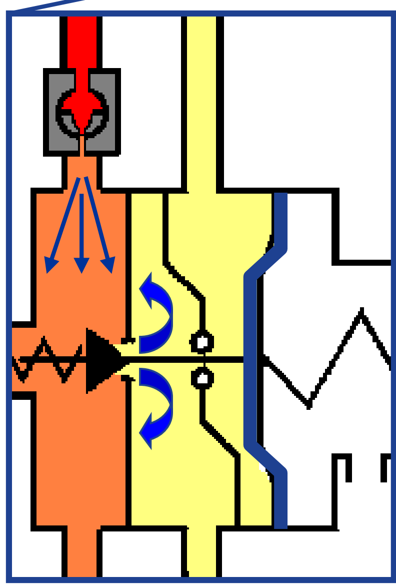


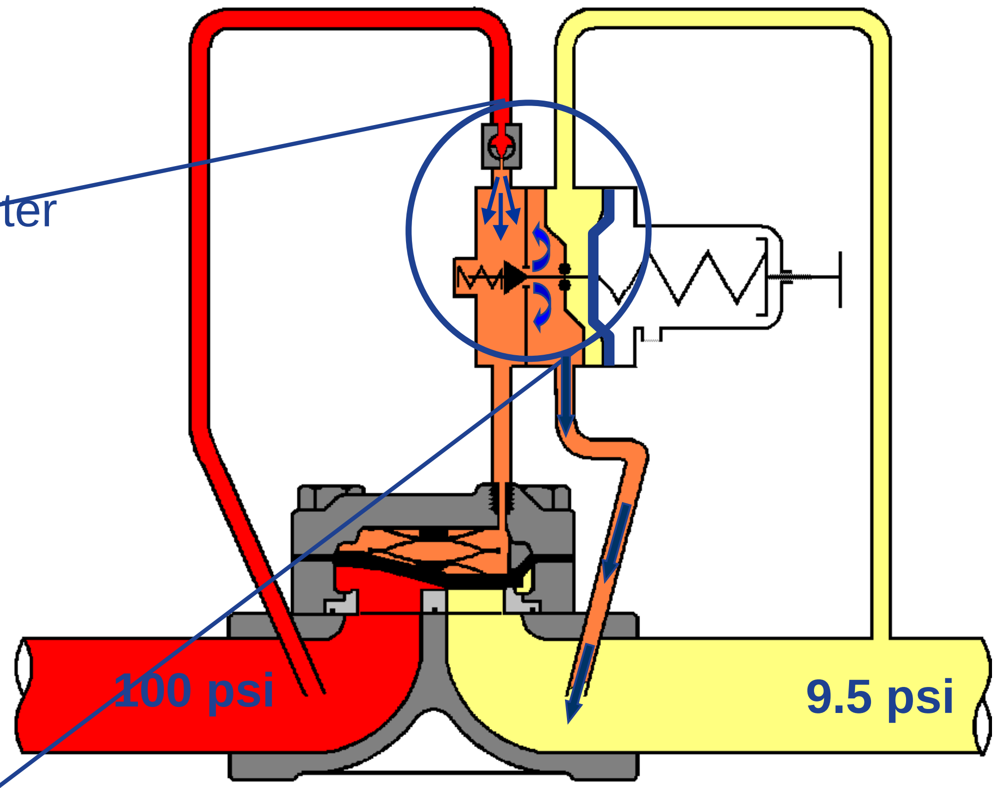
Principle of Operation

Pressure Reducing Configuration (PRV)

…as demand continues

- Pilot bleeds gas out of valve spring case faster than it can enter through restrictor.



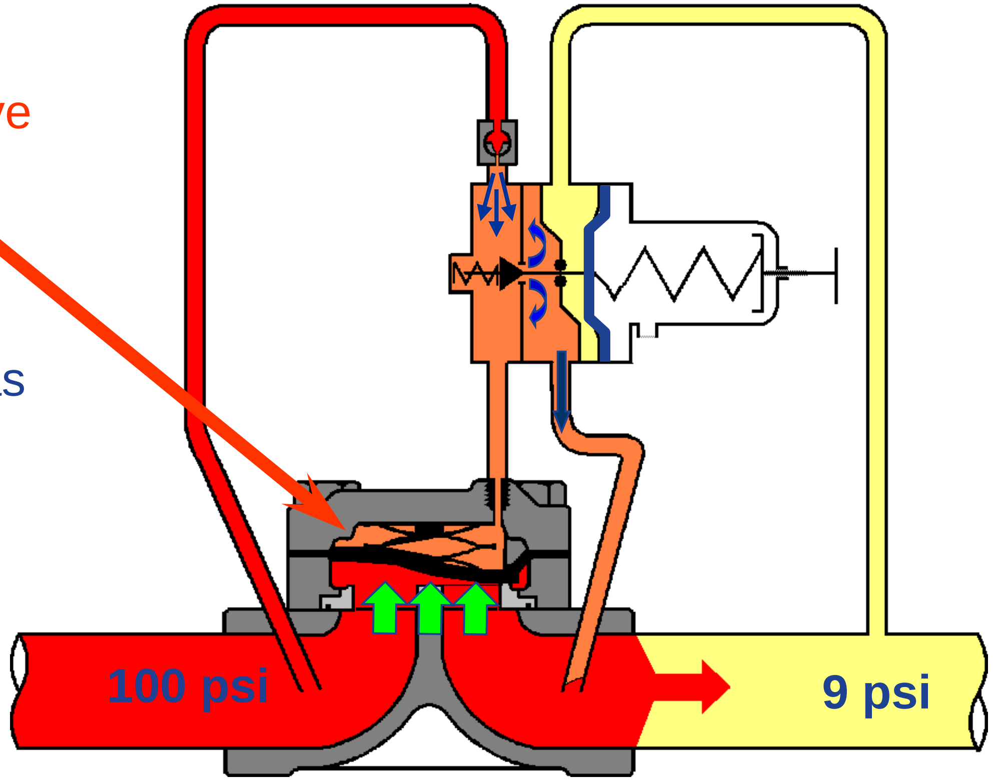


Principle of Operation

Pressure Reducing Configuration (PRV)

…demand increases

- Reducing loading pressure above valve diaphragm allows inlet pressure differential to lift valve diaphragm off throttle plate.
- Valve will remain open as long as needed to satisfy demand.

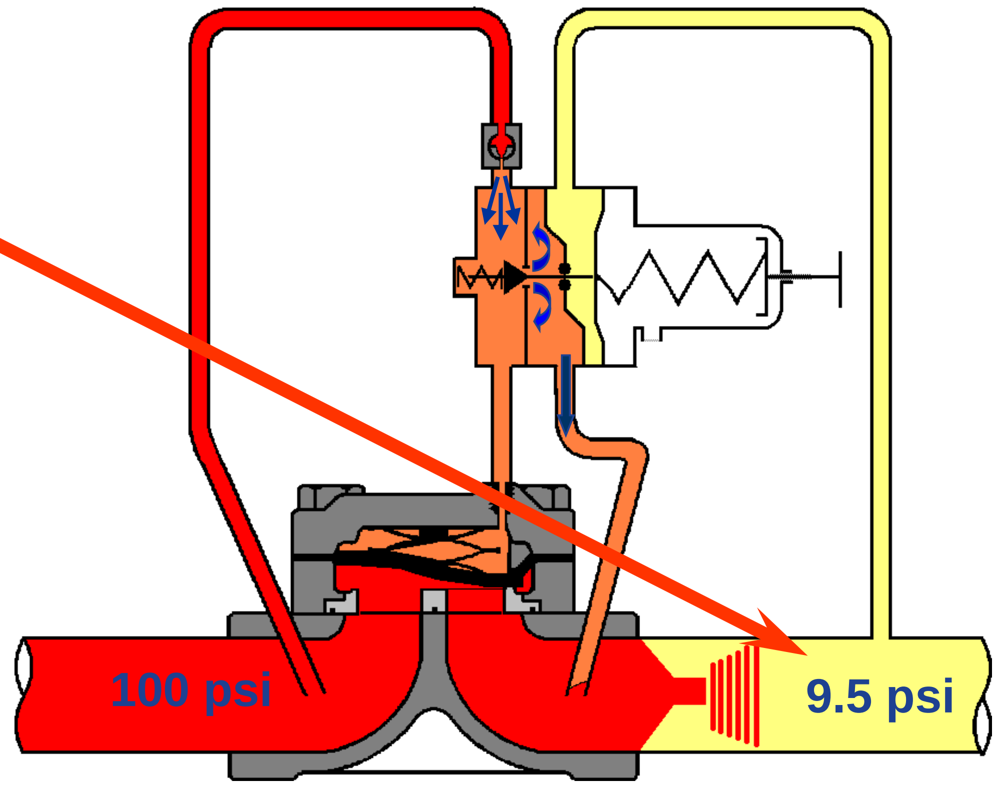


Principle of Operation

Pressure Reducing Configuration (PRV)

…as demand is satisfied

- Outlet pressure increases.

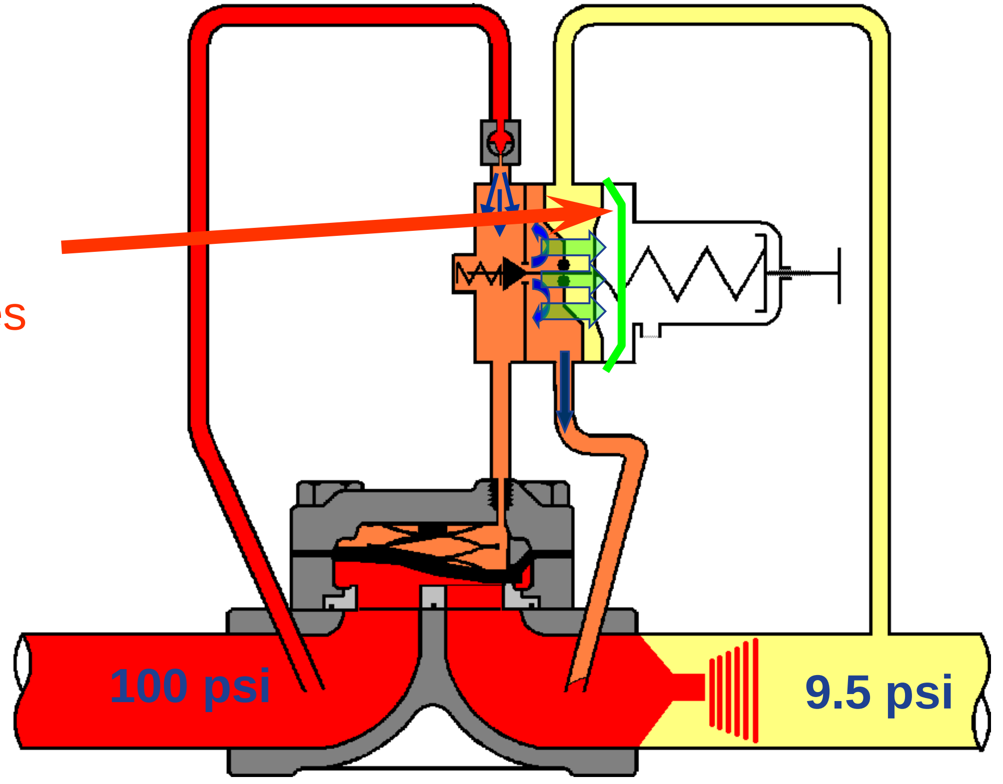


Principle of Operation

Pressure Reducing Configuration (PRV)

…as demand is satisfied

- Outlet pressure rises.
- Pressure below the pilot diaphragm builds and overcomes pilot spring force.

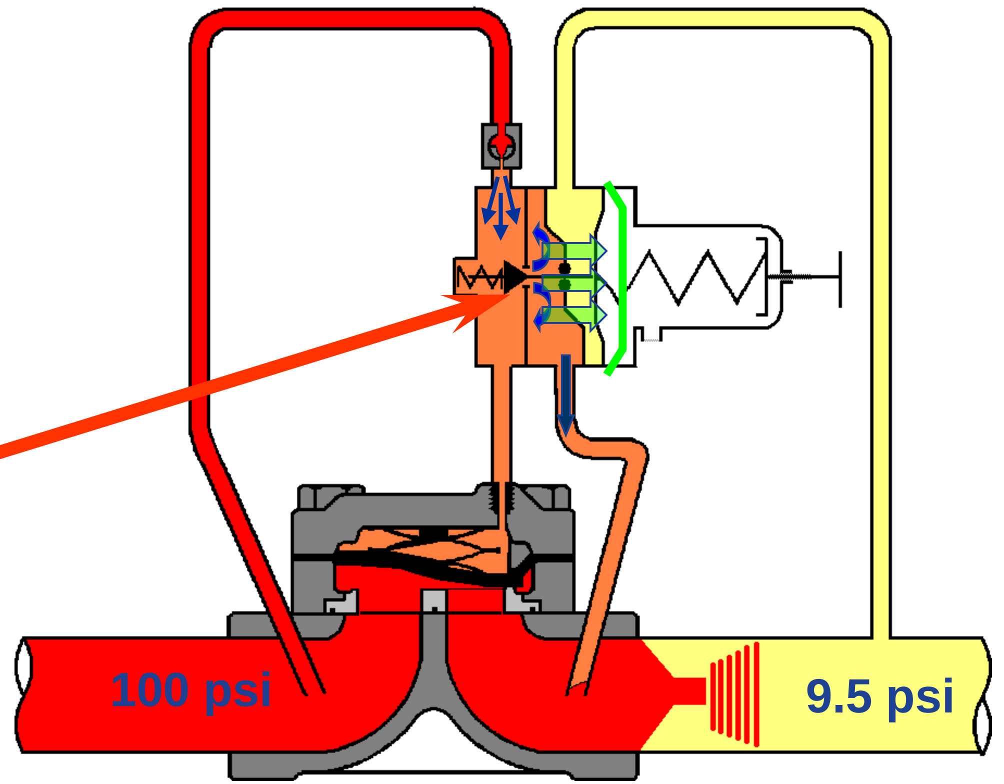


Principle of Operation

Pressure Reducing Configuration (PRV)

…as demand is satisfied

- Outlet pressure rises.
- Pressure below the pilot diaphragm begins to build overcoming spring force.
- Pilot begins to close, no longer releasing pressure from valve spring case.

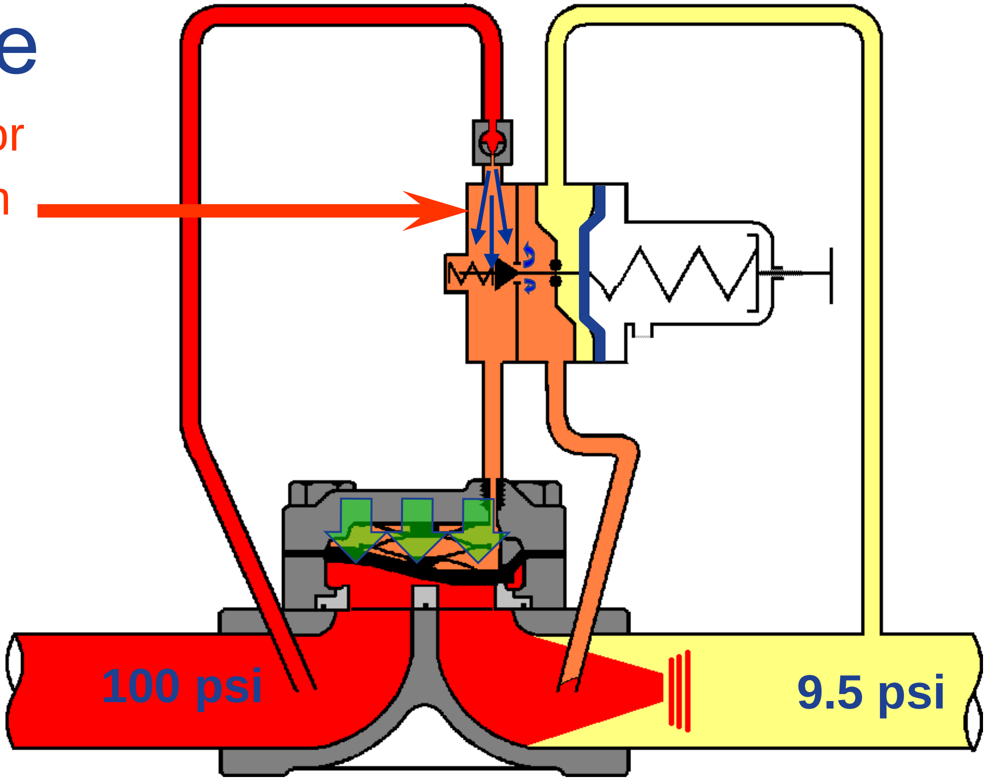


Principle of Operation

Pressure Reducing Configuration (PRV)

…pilot begins to close

- Gas now enters through restrictor faster than it can escape through the pilot orifice.

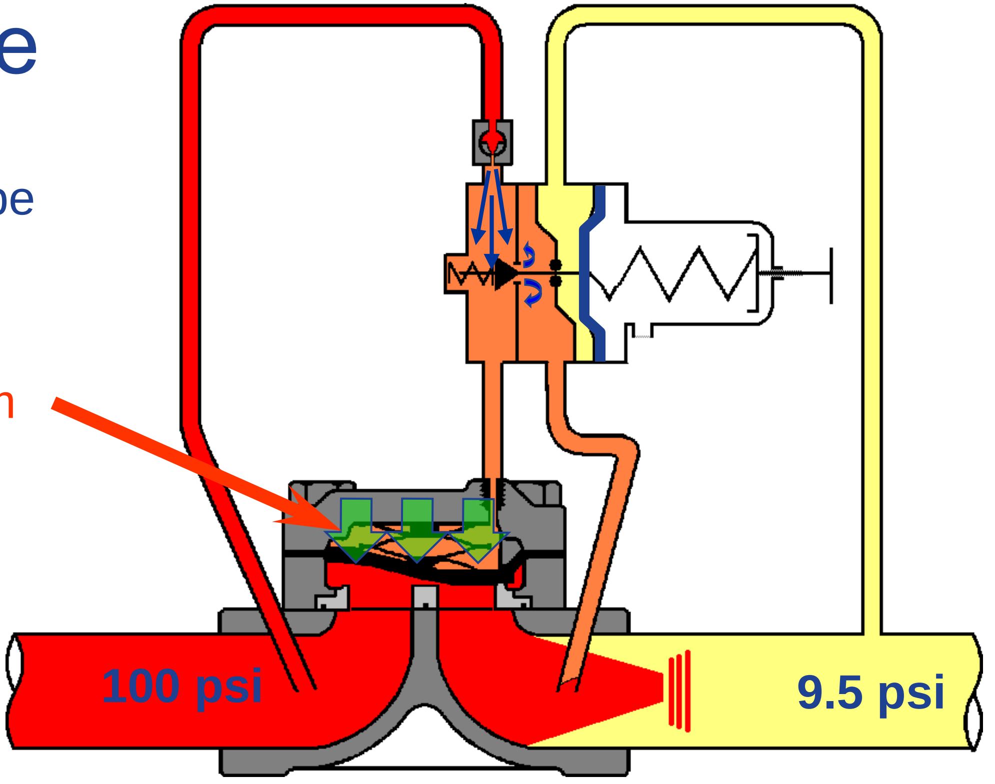


Principle of Operation

Pressure Reducing Configuration (PRV)

…pilot begins to close

- Gas now enters through the restrictor faster than it can escape through the pilot orifice.
- Pressure builds above the valve diaphragm forcing the diaphragm toward the throttle plate.

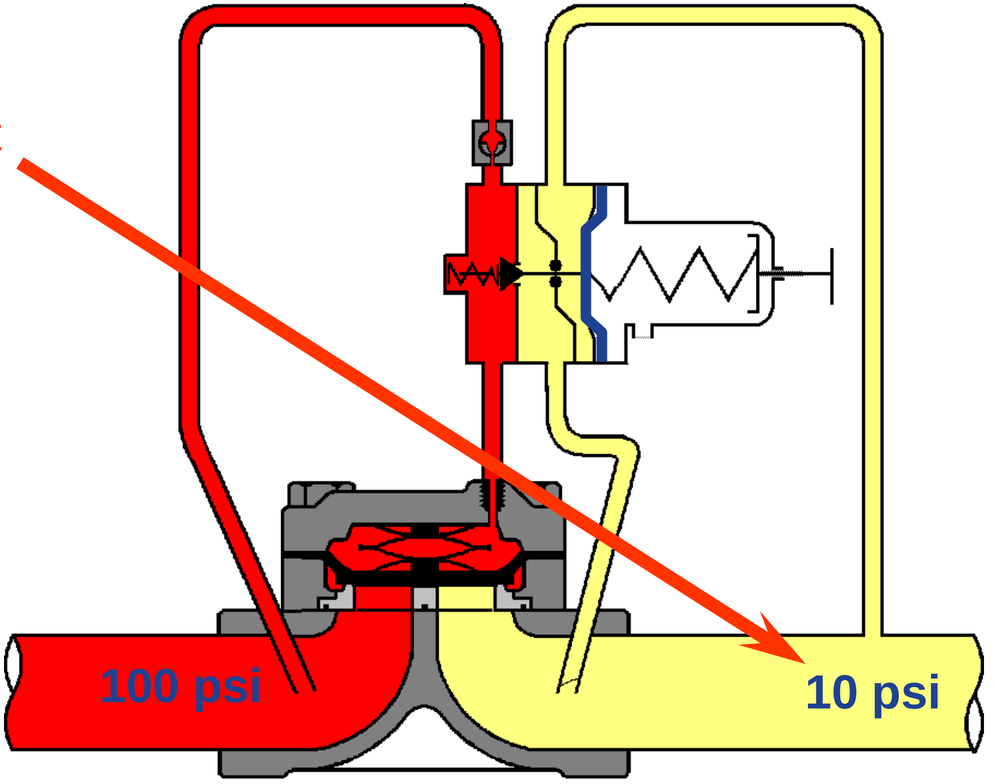


Principle of Operation

Pressure Reducing Configuration (PRV)

…pilot closes.

- Outlet pressure reaches pilot set point.

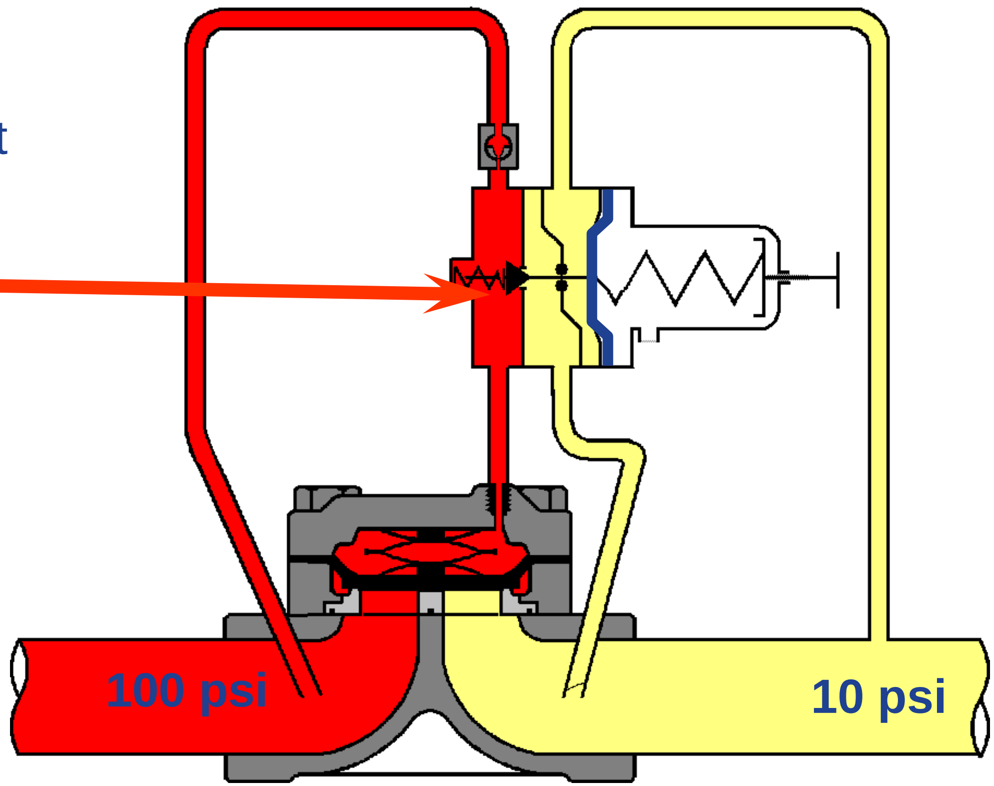


Principle of Operation

Pressure Reducing Configuration (PRV)

…pilot closes.

- Outlet pressure reaches pilot set point.
- Pilot Closed.

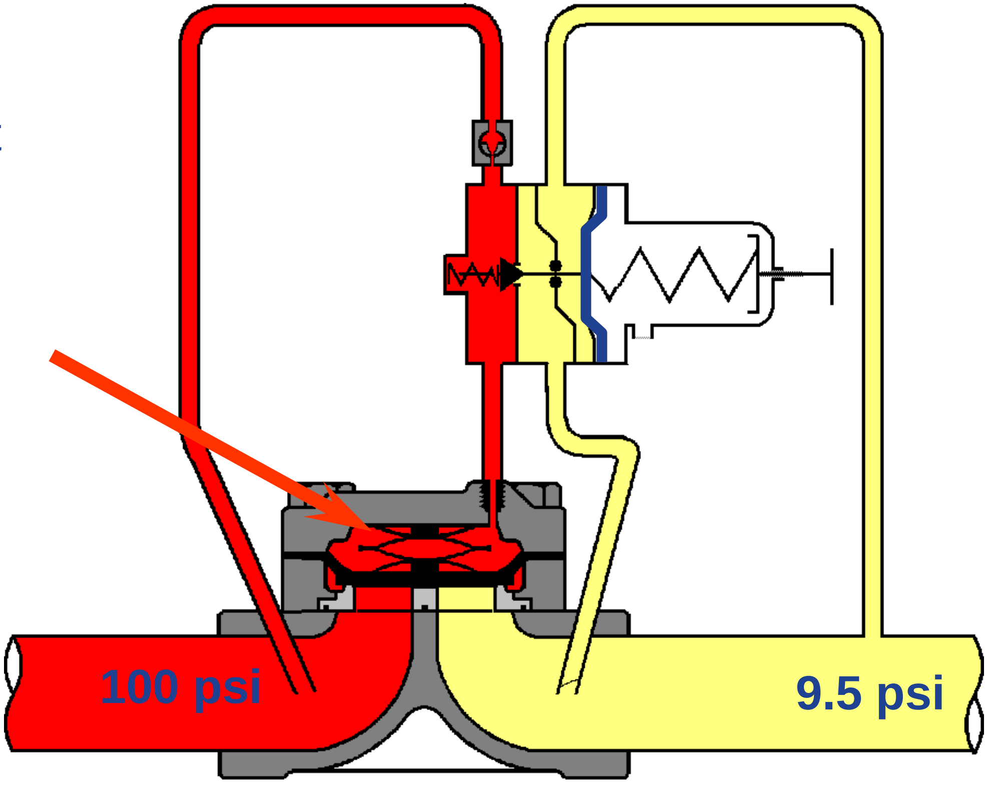


Principle of Operation

Pressure Reducing Configuration (PRV)

…pilot closes.

- Outlet pressure reaches pilot set point.
- Pilot Closed.
- Full inlet pressure loads valve main spring casing.



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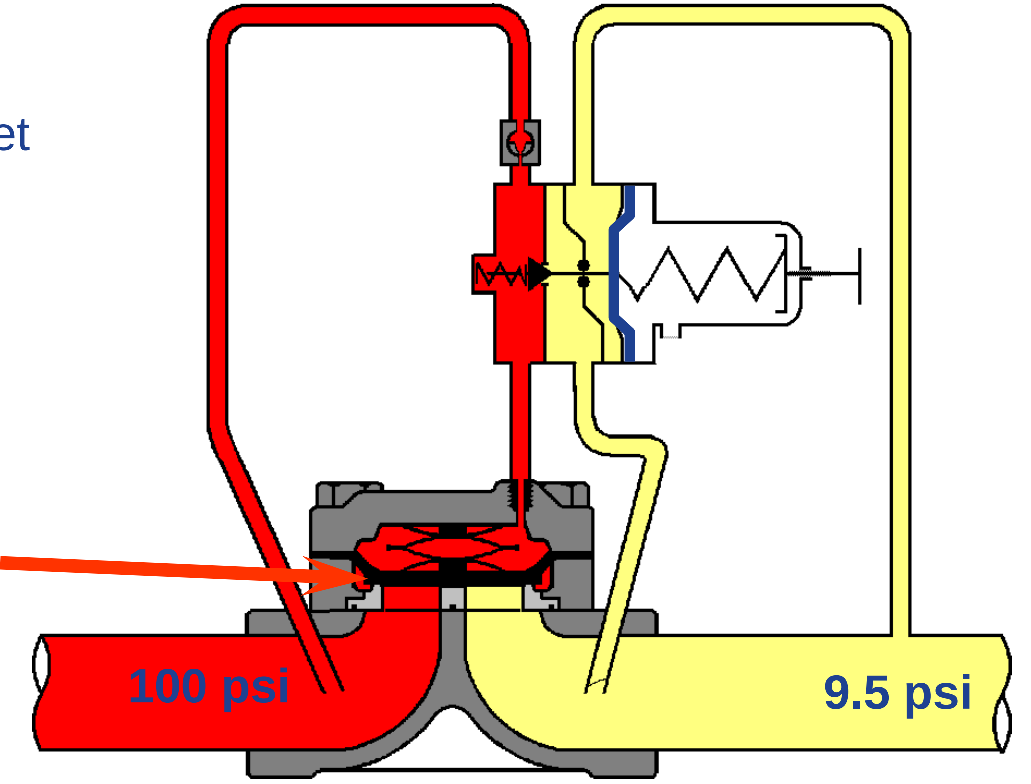
Principle of Operation

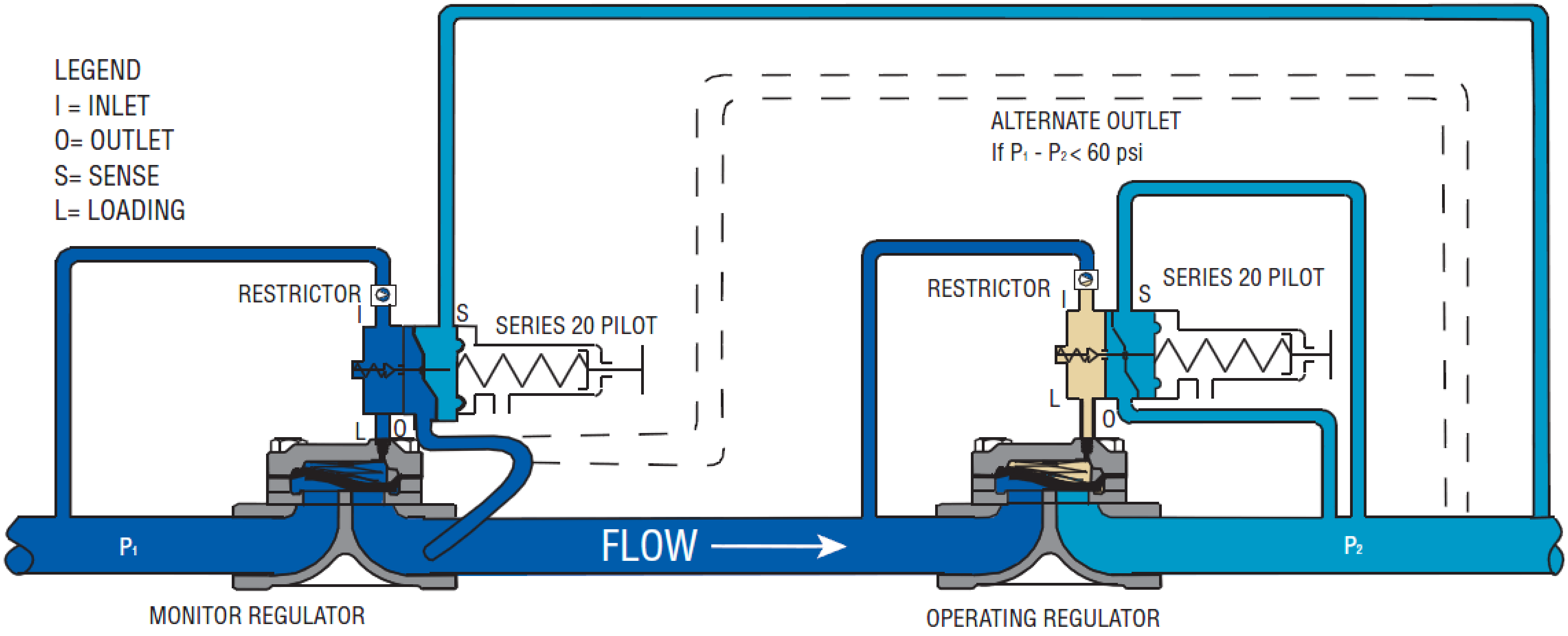
Pressure Reducing Configuration (PRV)

…pilot closes.

- Outlet pressure reaches pilot set point.
- Pilot Closed.
- Full inlet pressure loads valve main spring casing.
- Pressure differential forces diaphragm tight against throttle plate stopping flow.



Pressure Reducing Application - Standby Monitor

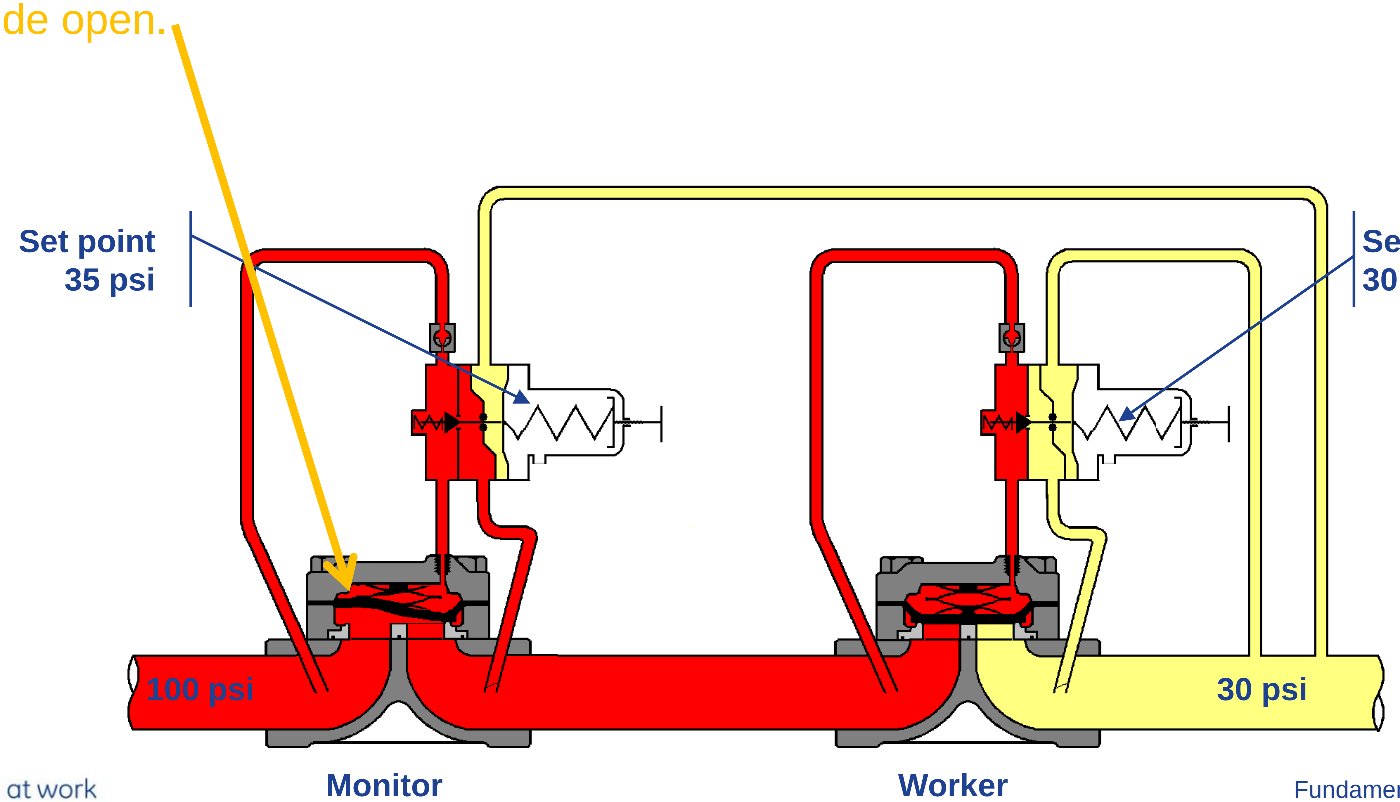


Pressure Reducing Application - Standby Monitor

Principle of Operation

Closed Position

- When outlet pressure is less than the set point of monitor regulator, monitor remains wide open.

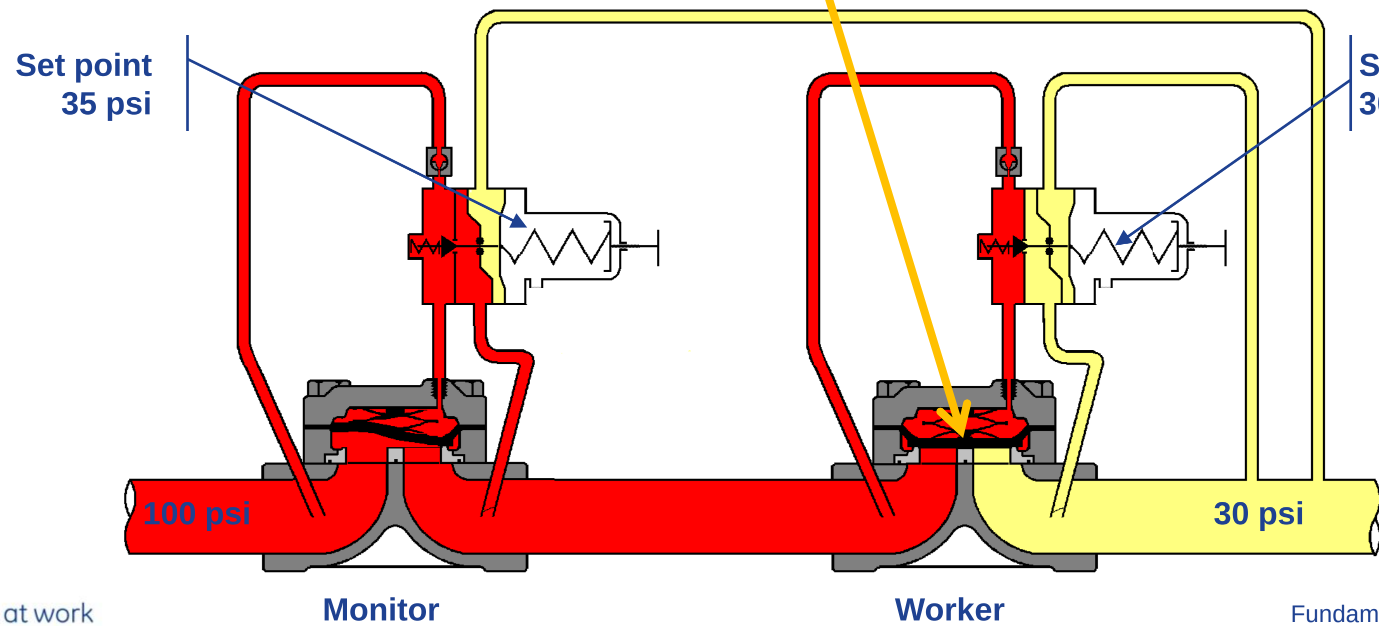


Pressure Reducing Application - Standby Monitor

Principle of Operation

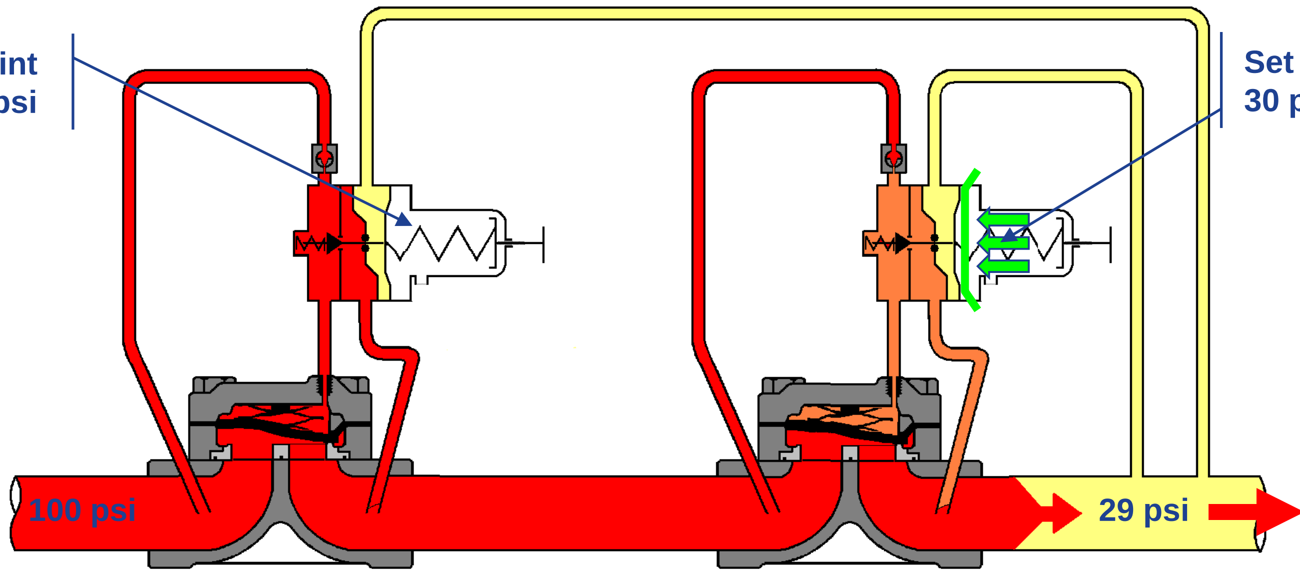
Closed Position

- When outlet pressure is less than the set point of monitor regulator, monitor remains wide open.
- Worker regulator is closed because outlet pressure is greater than or equal to set point



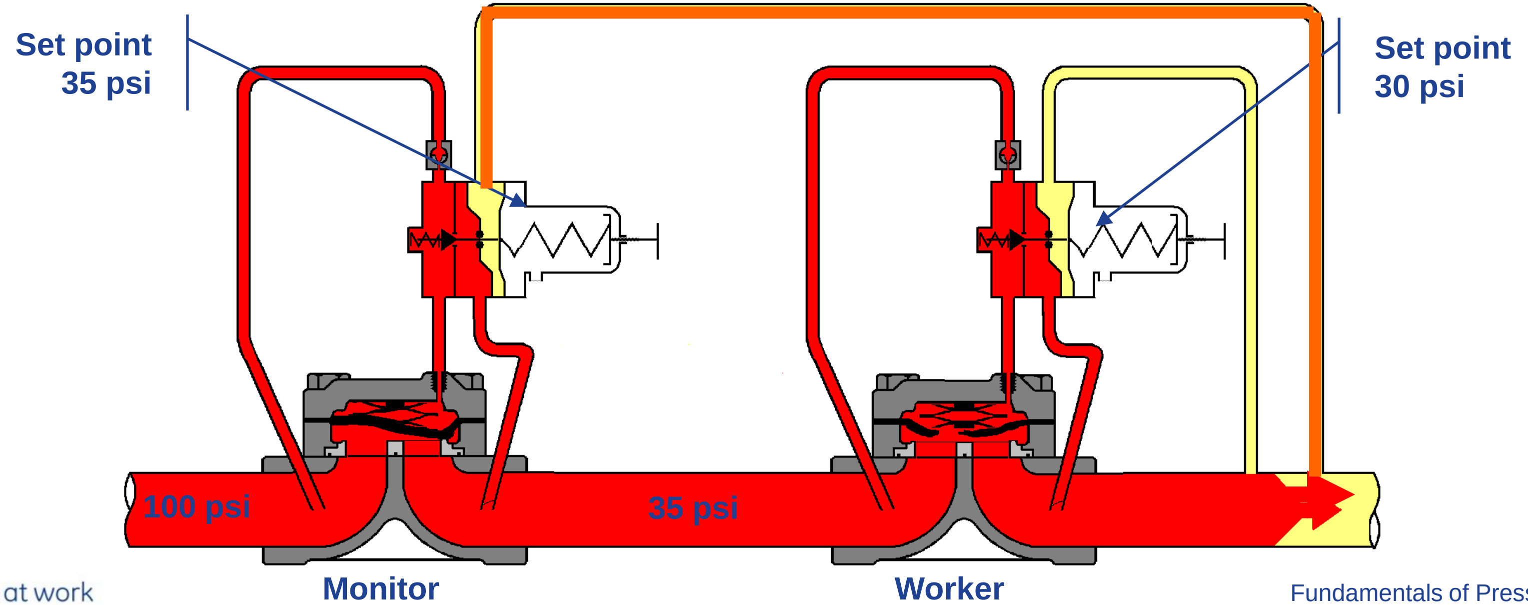
Downstream Demand

- When demand occurs outlet pressure begins to drop, opening worker pilot, allowing worker regulator to open and satisfy demand
- Monitor regulator remains open because downstream pressure is below set point.



Worker Regulator Failure

- Worker regulator loses ability to control sending high pressure gas downstream.
- Monitor regulator senses the increase in downstream pressure and takes control at 35 psi.

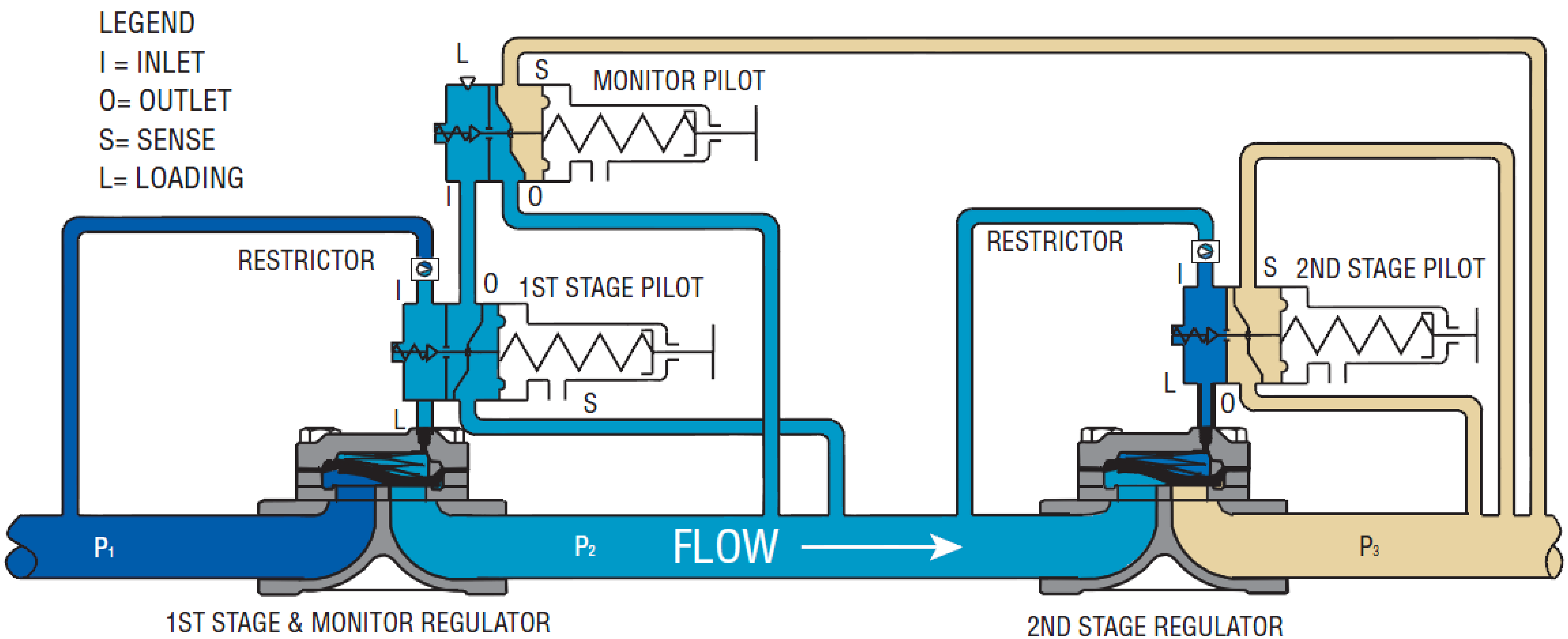


Standby Monitor Advantages

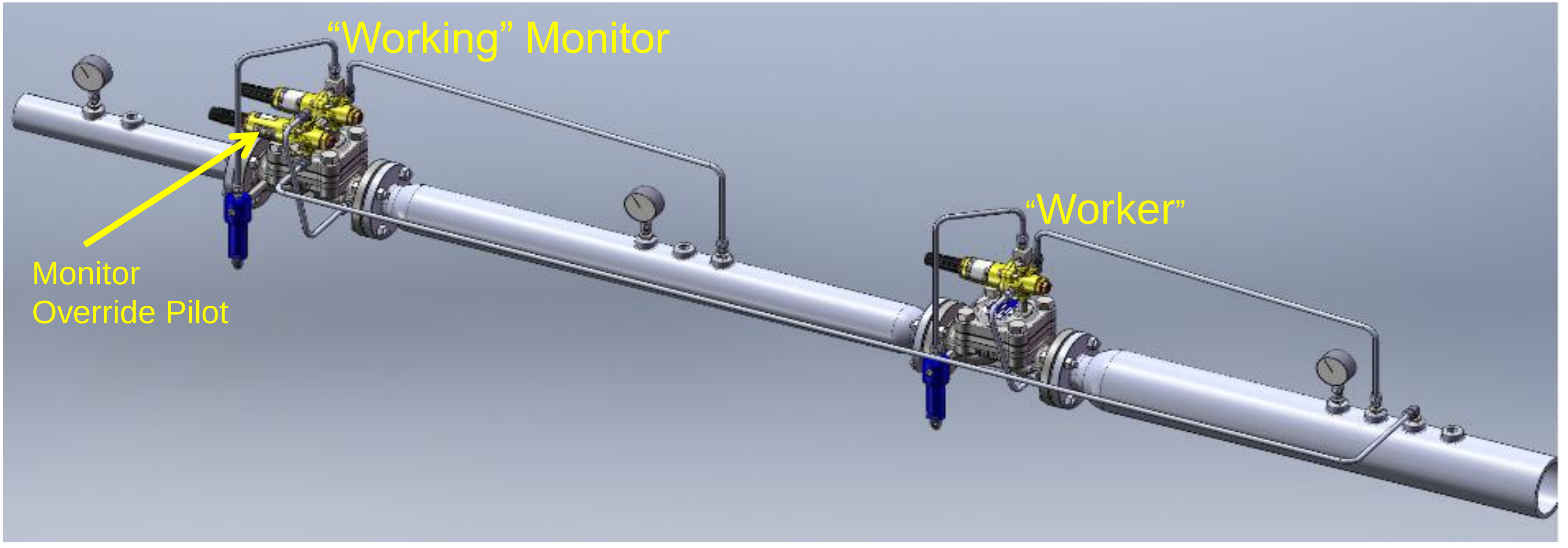
- Normally lower ΔP across monitor reduces wear in monitor.
- Upstream worker may catch debris before monitor.
- Downstream worker more accurate and responsive.
- Lower flow of gas through monitor pilot system.
- Low cost build.
- Monitor always in position to take over control.

Note: Token relief is recommended on all short or dead end systems.

Pressure Reducing Application - Working Monitor System

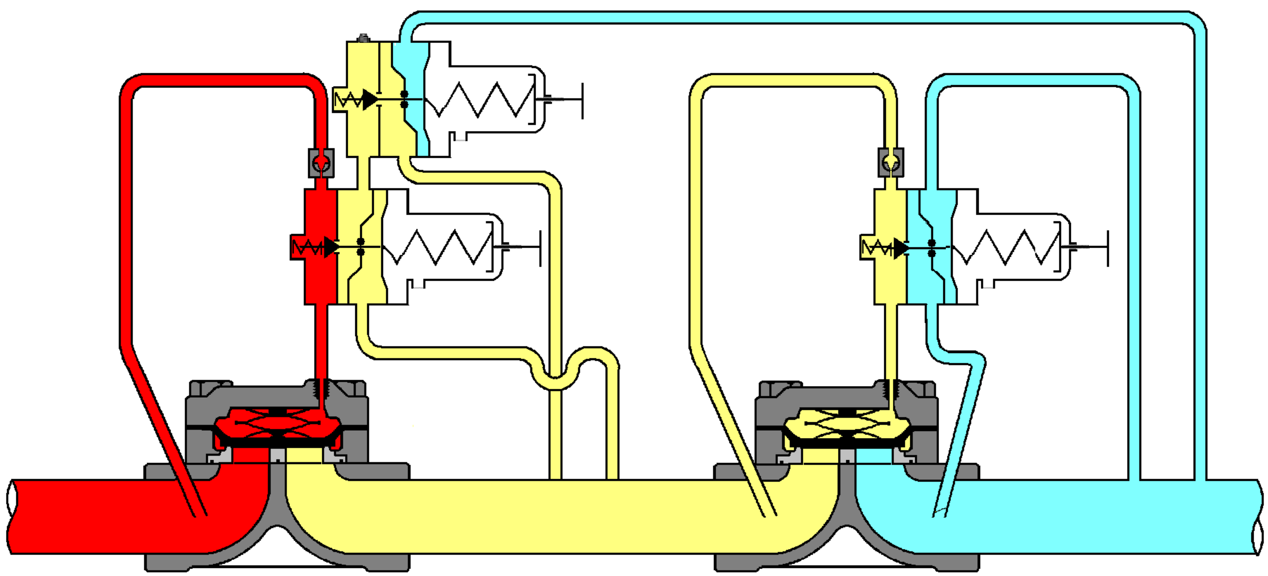


Pressure Reducing Application - Working Monitor System



Pressure Reducing Application - Working Monitor

Principle of Operation

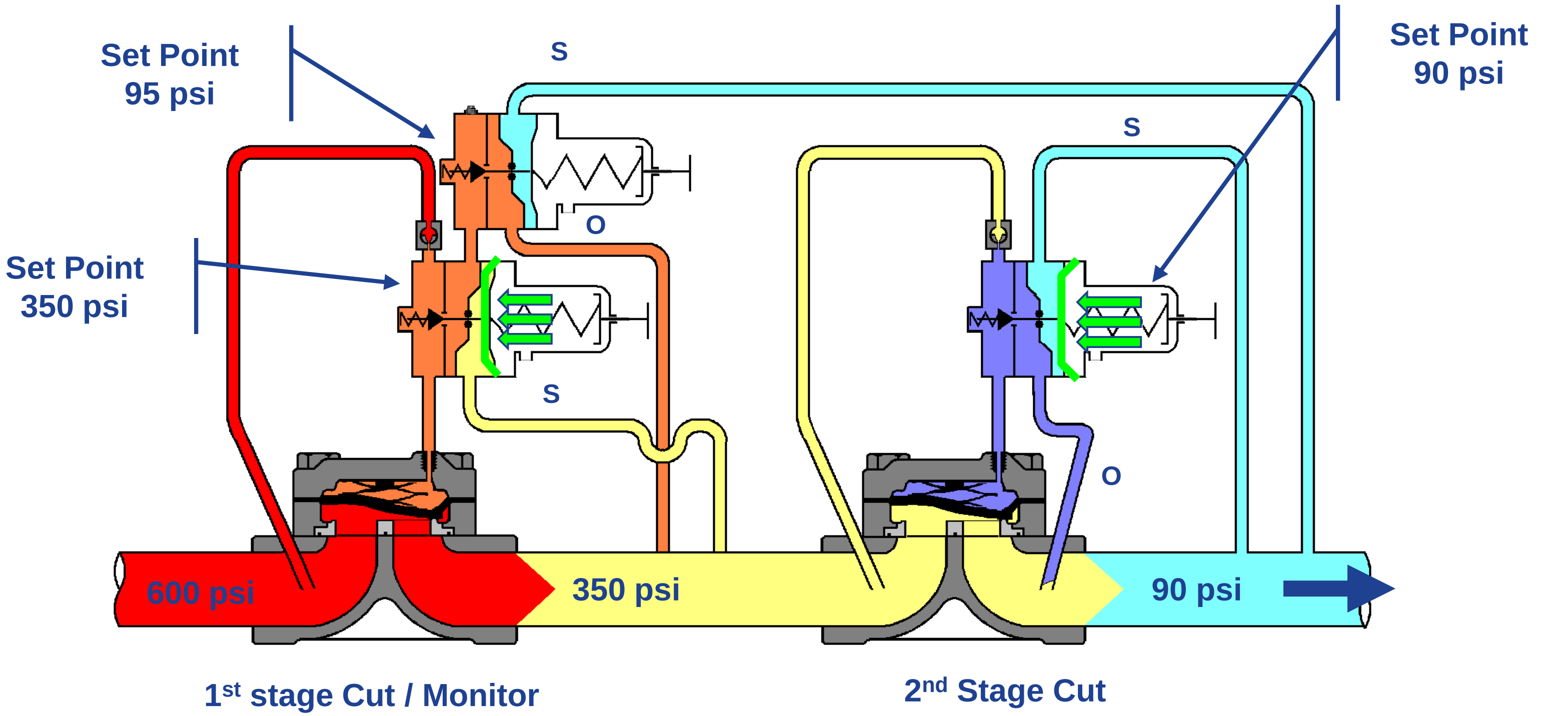


1st stage Cut / Monitor

2nd Stage Cut

Pressure Reducing Application - Working Monitor

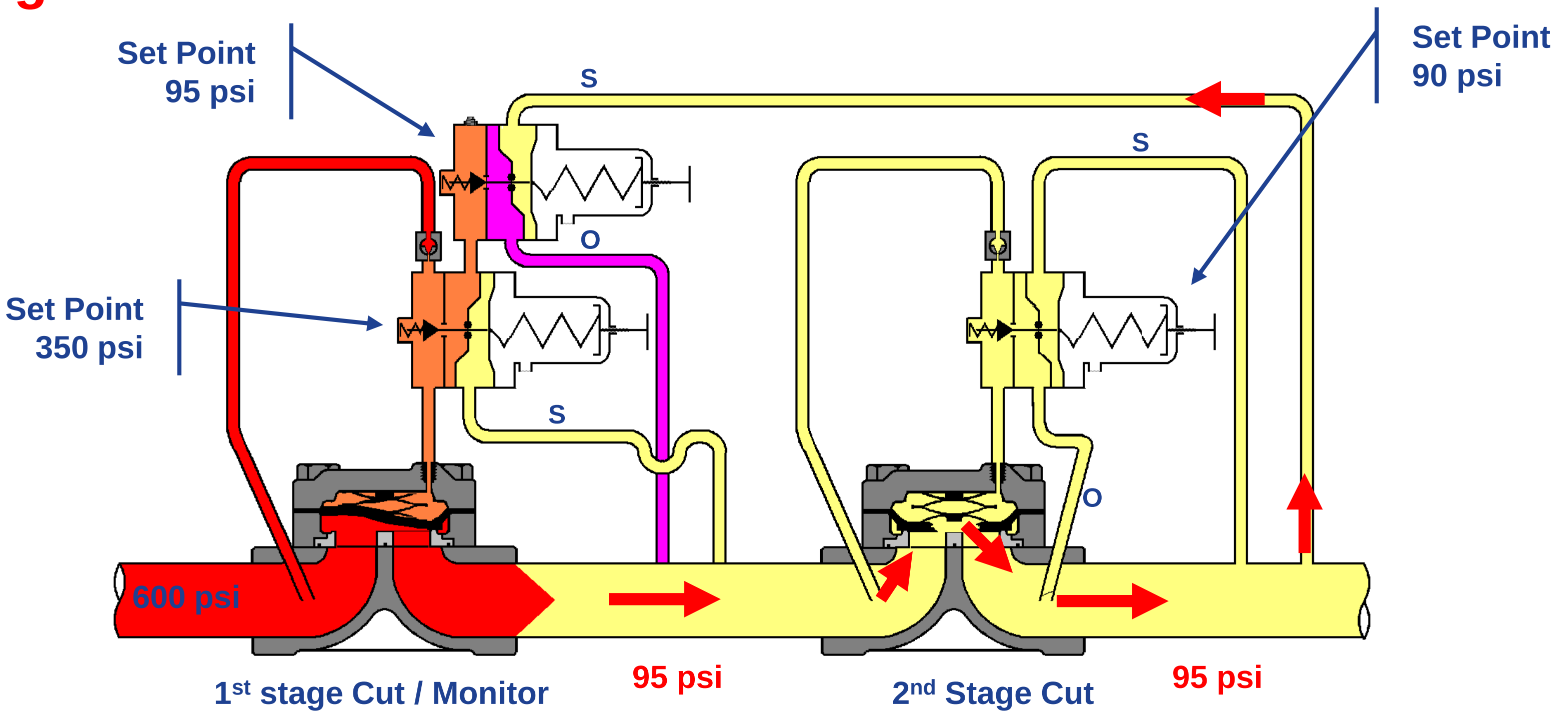
Principle of Operation



Pressure Reducing Application - Working Monitor

Should 2nd Stage regulator fail the 1st stage regulator can handle the complete load requirements

2nd Stage Failure!

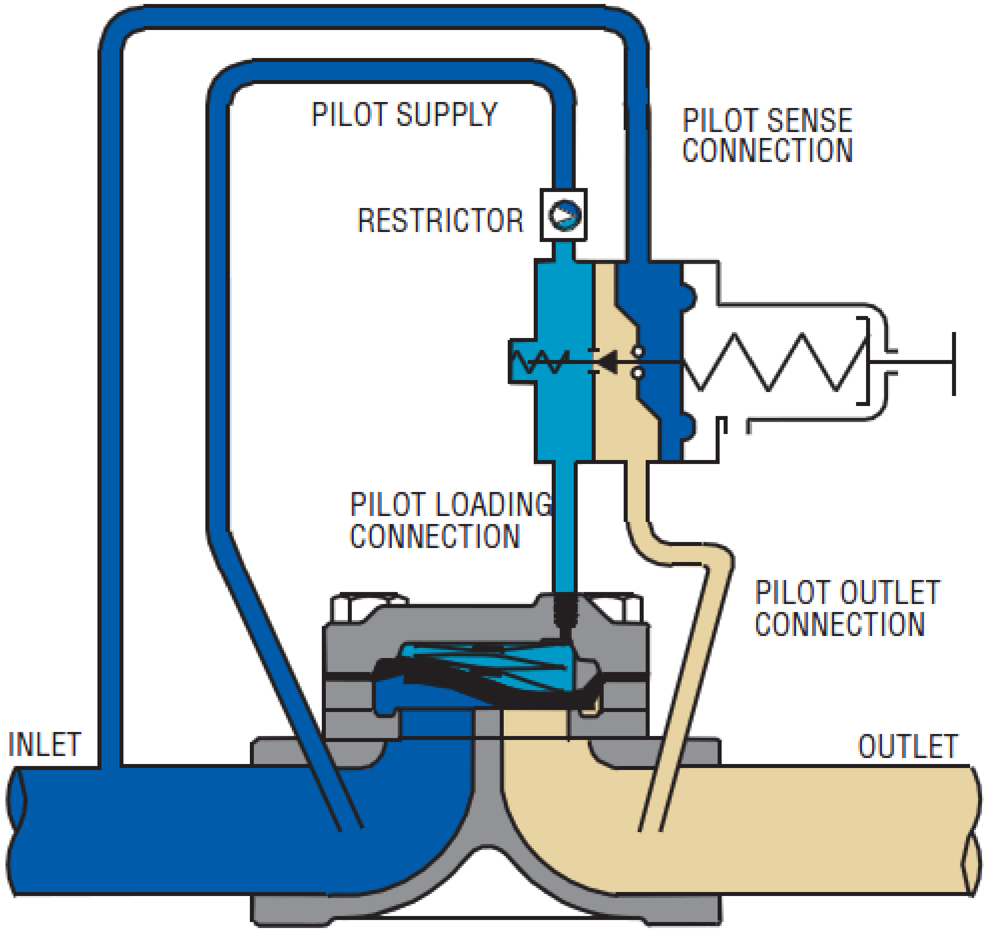


Working Monitor Advantages

- 2-stage pressure cut reduces stress on regulators by distributing workload.
- Distributed workload reduces system maintenance frequency.
- Reduced system noise for same mass flow.
- Performance of each regulator can be continuously monitored.
- Condition of monitor regulator can be determined before emergency condition arises.
- Cost effective long term.

Note: Token relief is recommended on all short or dead end systems.

Back Pressure Application - Single Regulator



Fully Closed

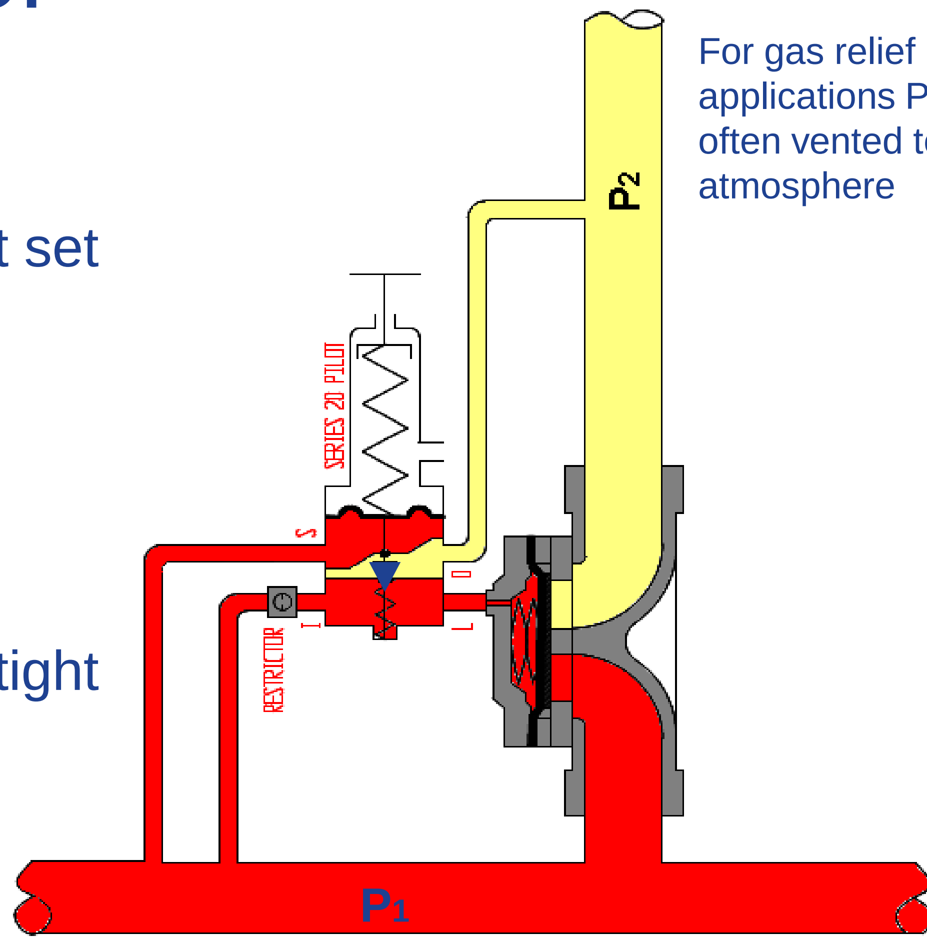
imagination at work

Back Pressure (BPV) Application - Single Regulator

Principle of Operation

<u>Closed Position</u>

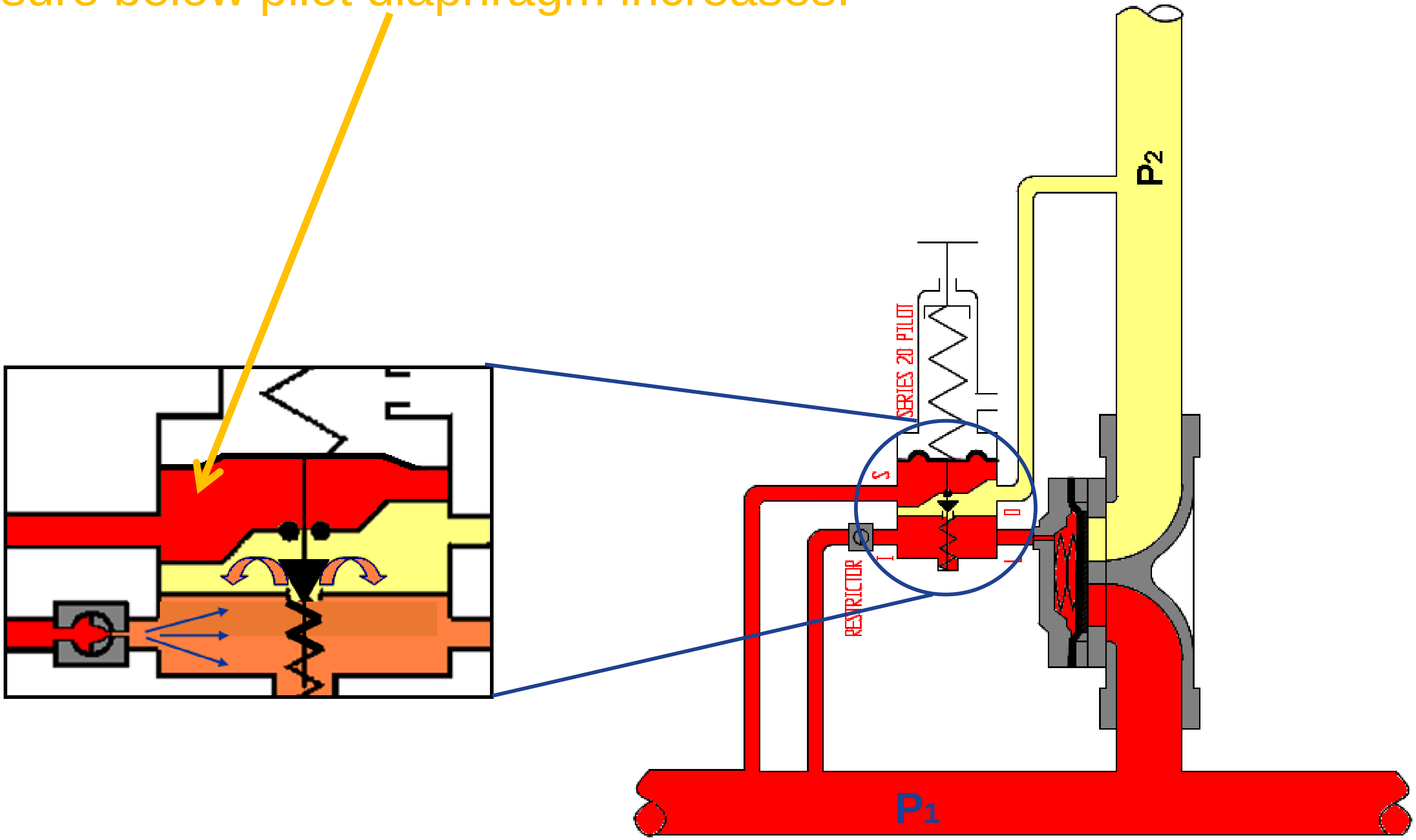
- Inlet P1 pressure below pilot set point.
- Pilot closed.
- Full inlet pressure loads regulator spring case and diaphragm.
- Pressure forces diaphragm tight against throttle plate.



For gas relief applications P2 is often vented to atmosphere

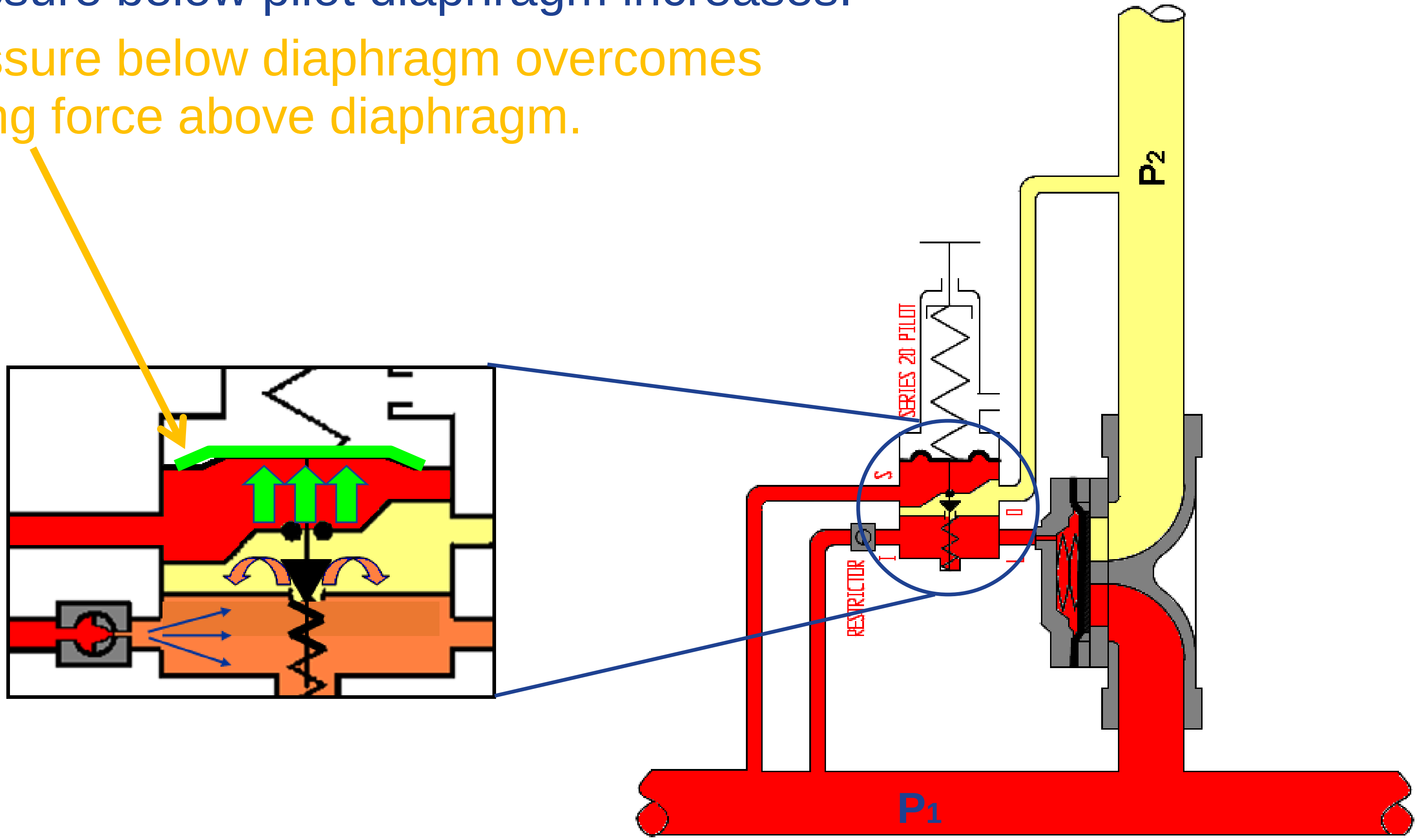
As upstream pressure increases …

- Pressure below pilot diaphragm increases.



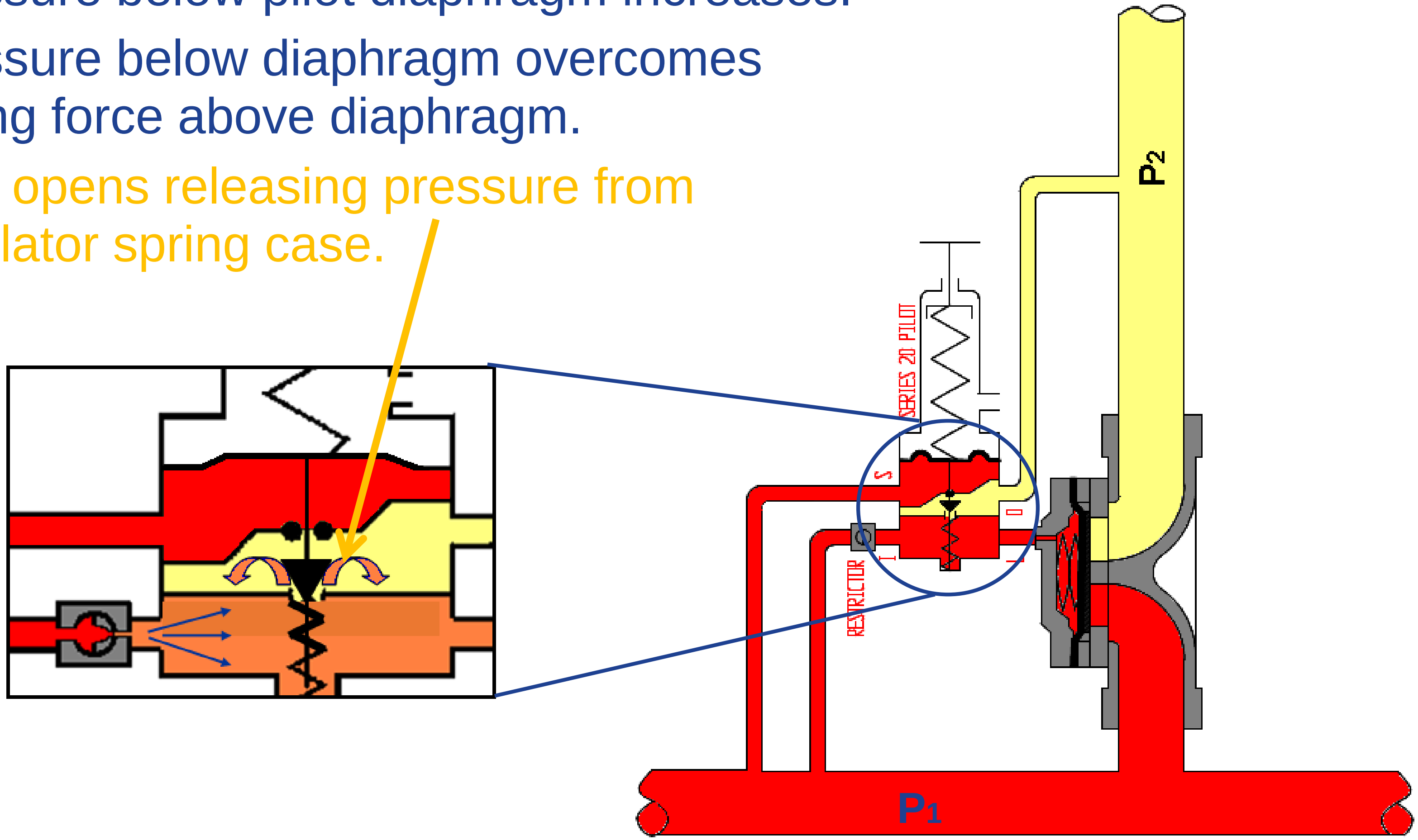
As upstream pressure increases …

- Pressure below pilot diaphragm increases.
- Pressure below diaphragm overcomes spring force above diaphragm.



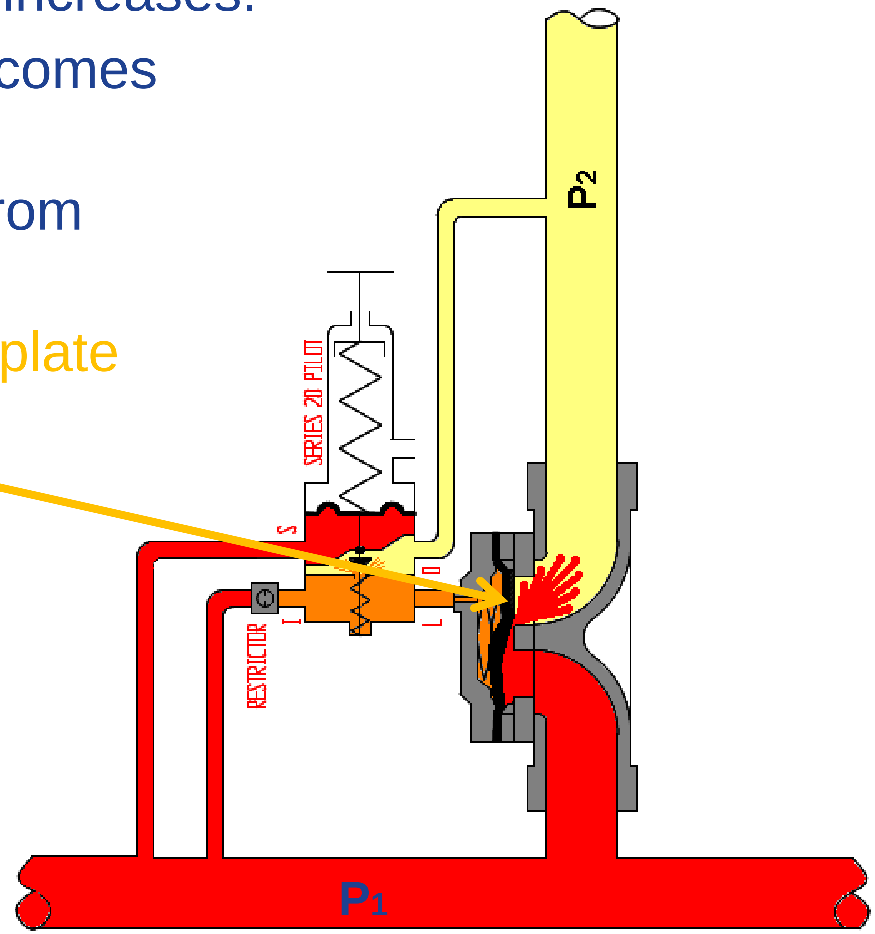
As upstream pressure increases …

- Pressure below pilot diaphragm increases.
- Pressure below diaphragm overcomes spring force above diaphragm.
- Pilot opens releasing pressure from regulator spring case.



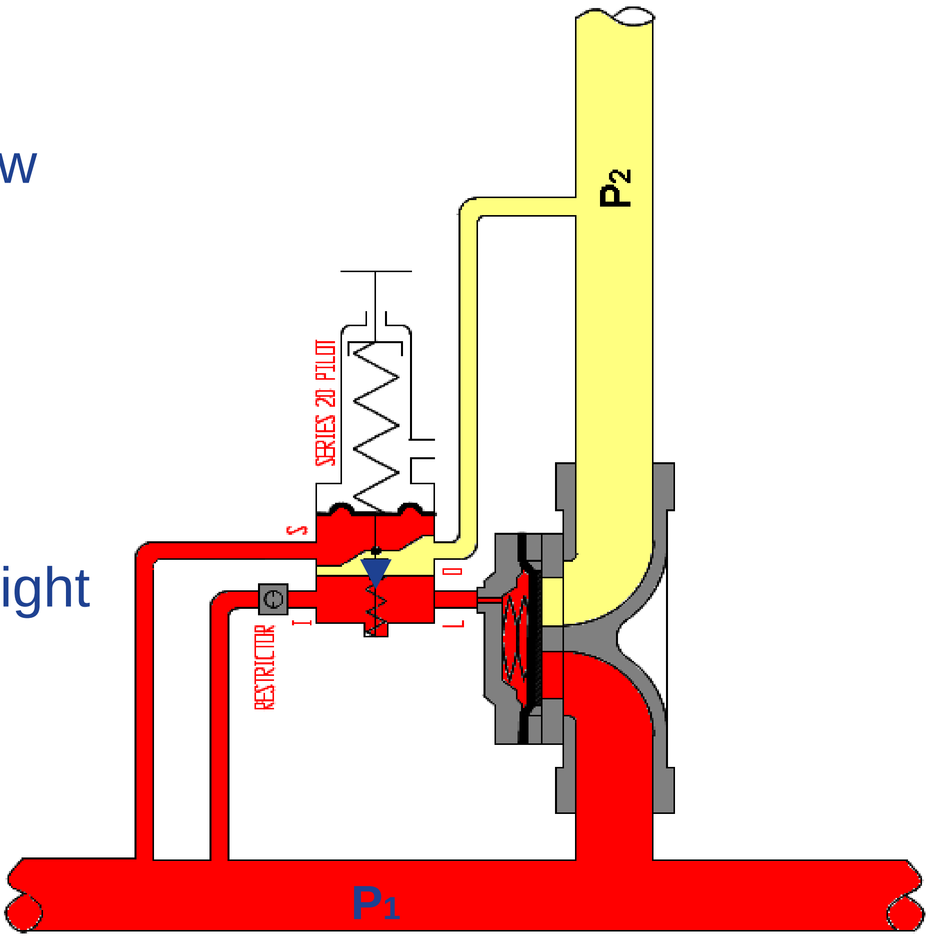
As upstream pressure increases …

- Pressure below pilot diaphragm increases.
- Pressure below diaphragm overcomes spring force above diaphragm.
- Pilot opens releasing pressure from regulator spring case.
- Valve diaphragm lifts off throttle plate allowing gas to flow.



As upstream pressure decreases …

- Inlet P1 pressure drops below pilot set point.
- Pilot closed.
- Full inlet pressure loads regulator spring case and diaphragm.
- Pressure forces diaphragm tight against throttle plate.
- Flow stops.



Advantages of Monitor vs. Relief

Advantages

- No gas is vented to atmosphere.
- Gas is continuously supplied to system at a safe level.
- Easy maintenance.
- Accurate control.
- Reduced noise with monitor (should relieve blow).
- Public is unaware the monitor takes over control.
- Accurate sizing is not required.
- Very cost effective.