Introduction to Regulators

Master Pneumatic

Series 350

What is the purpose of a Regulator?

- Reduce a higher upstream pressure of a gas or liquid (from a compressor, pump, etc.) to a lower, stable pressure for the user's application.
- To maintain and control the outlet pressure as the inlet pressure changes.
- It is **NOT** to be used as a lock out device.
- Energy saving device.
- Prolong life of downstream components (cylinders, clamps, etc.)

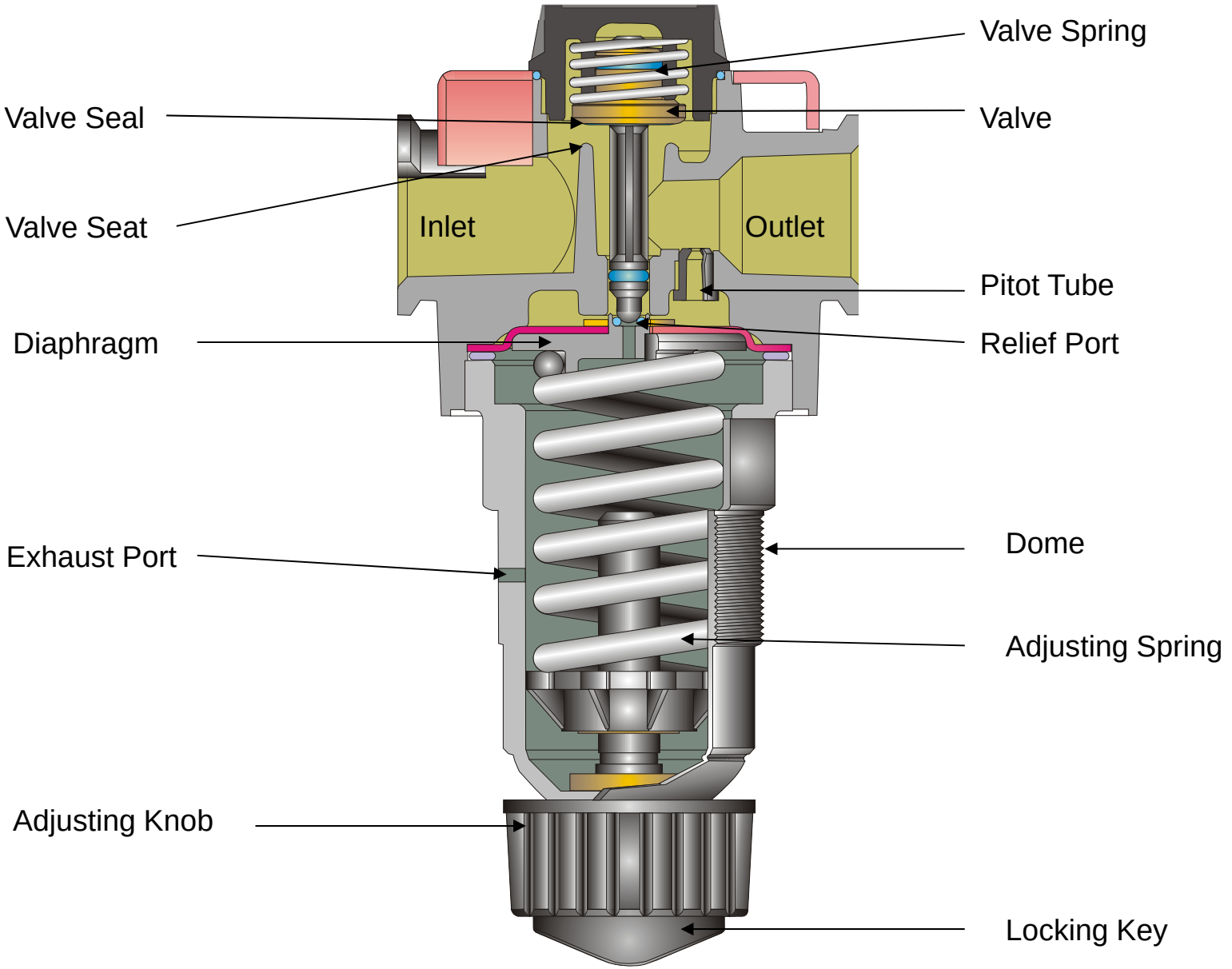
Series 380

Master Pneumatic Regulators

- General Purpose Regulators
- Precision Regulators
- Externally Piloted
- Externally Piloted HIGH RELIEF
- Internally Piloted
- Relief Valves
- Specialty (Water, CO2, Oxygen, etc.)

Series
380

380 Series Regulator Cross Section



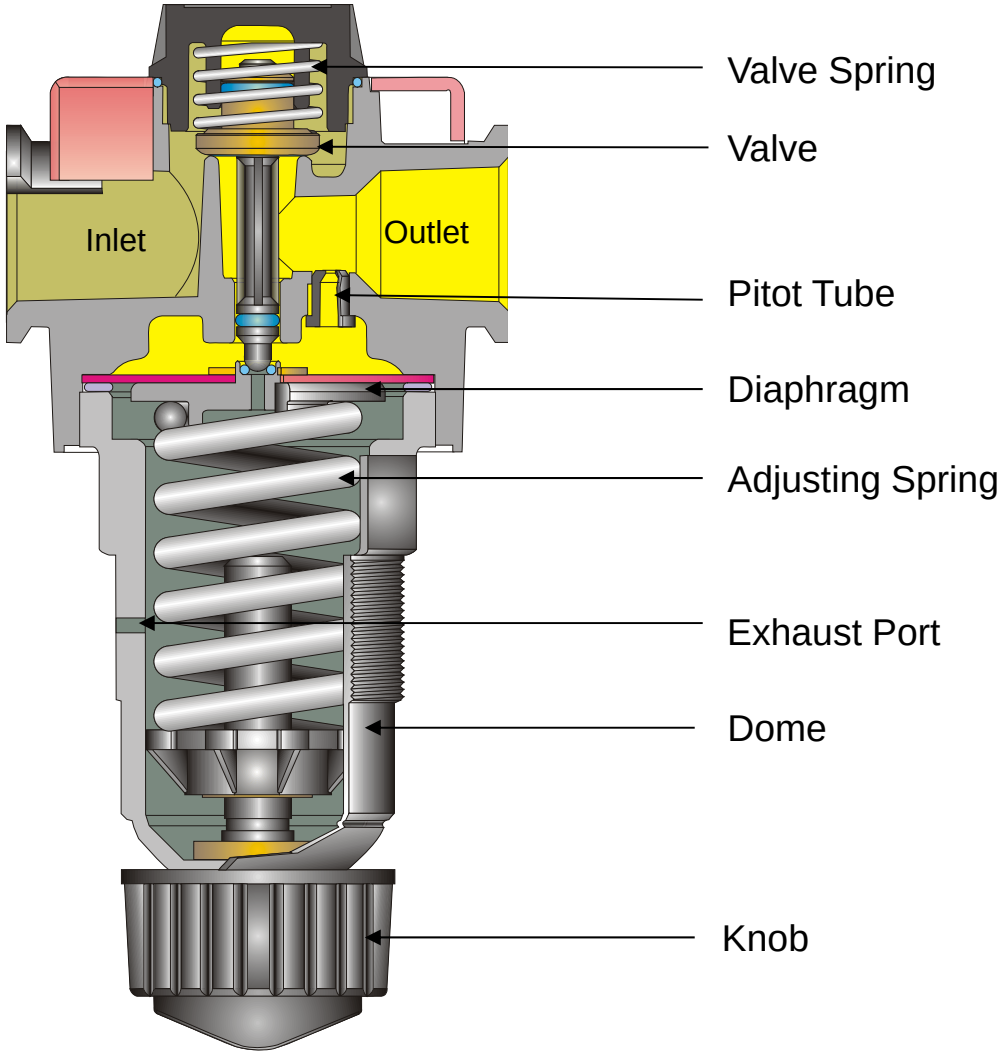
Vanguard

MP General Purpose Regulator

Neutral Position

(No Flow)

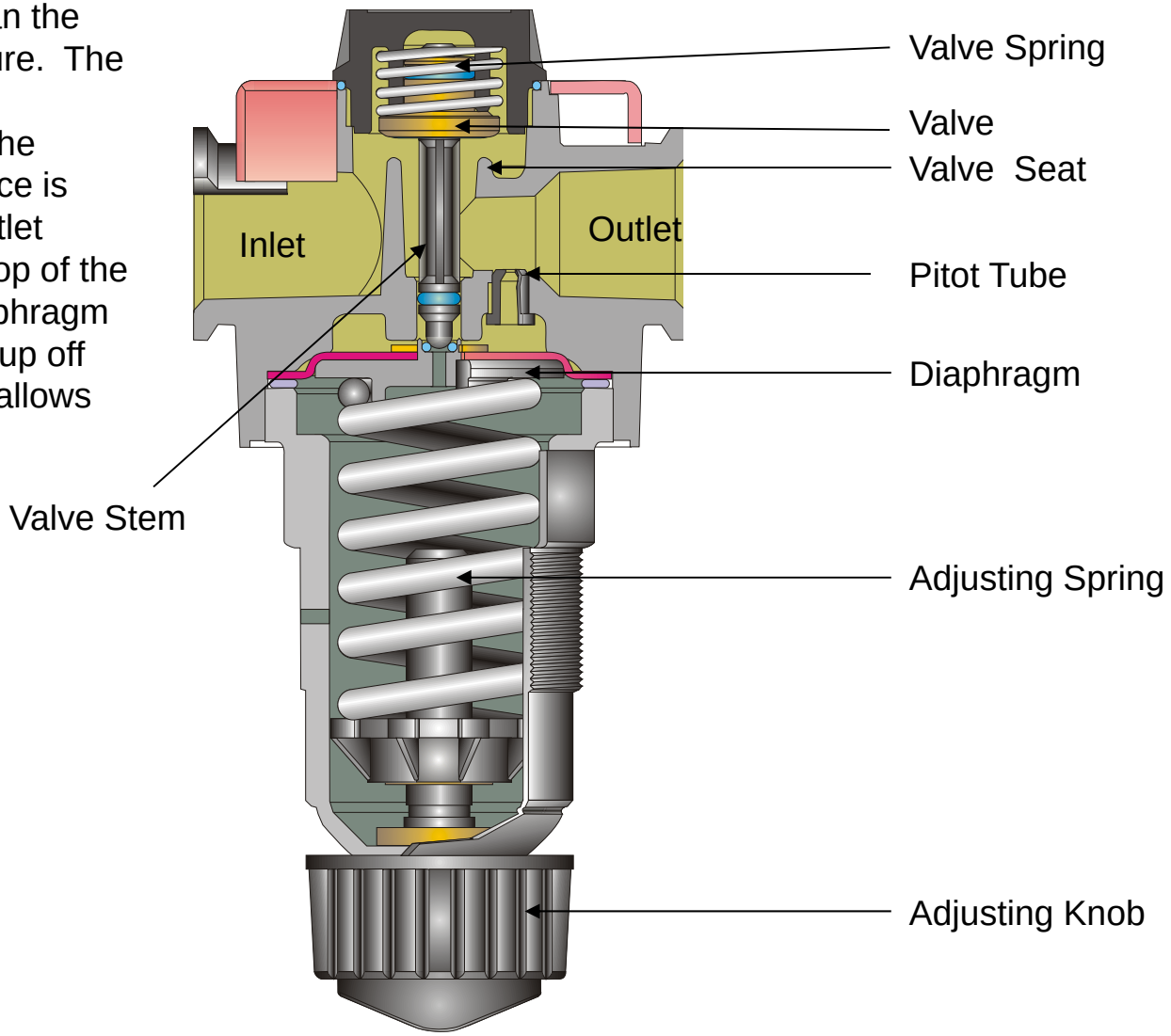
•When outlet pressure equals the set pressure. The valve is closed in this condition.



MP General Purpose Regulator

When there is downstream demand for air, the outlet pressure is less than the adjusted set pressure. The valve is in the open position. Because the adjusting spring force is greater than the outlet pressure force on top of the diaphragm, the diaphragm lifts the valve stem up off the valve seat and allows more air to flow downstream.

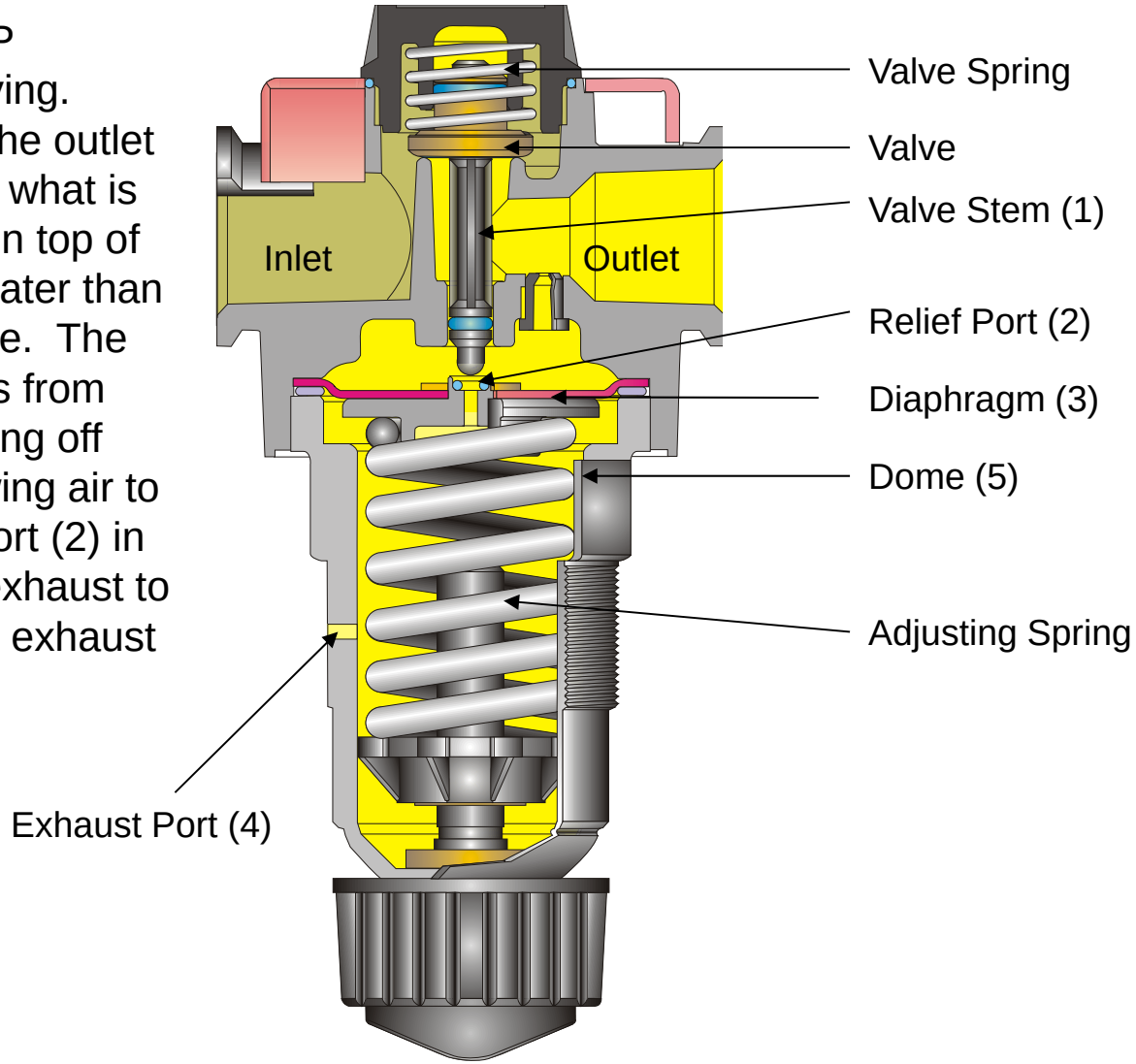
Flowing Position



MP General Purpose Regulator

All General Purpose M/P regulators are self-relieving. Relieving occurs when the outlet pressure is greater than what is was set for. The force on top of the diaphragm (3) is greater than the adjusting spring force. The diaphragm (3) separates from the valve stem (1) shutting off flow from inlet and allowing air to flow through the relief port (2) in the diaphragm (3) and exhaust to atmosphere through the exhaust port (4) in the dome (5).

Relieving Position

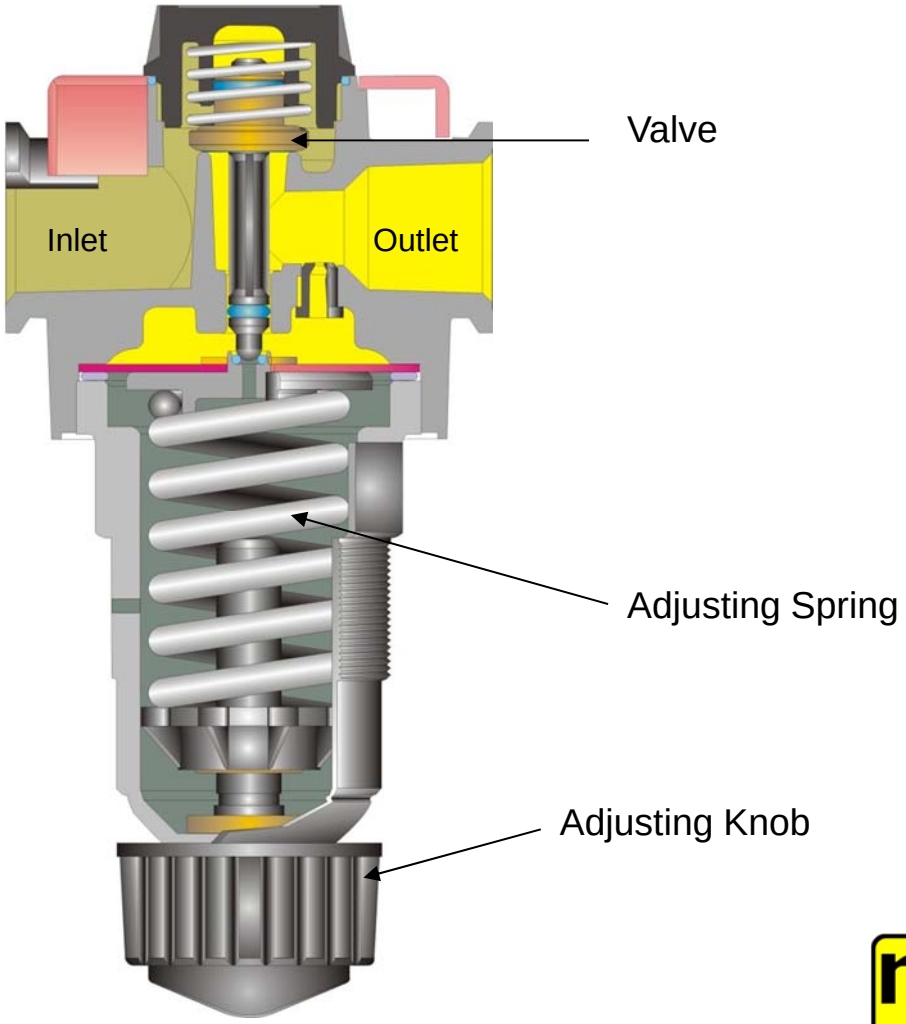


MP General Purpose Regulator

How to Adjust Pressure

- INCREASE PRESSURE
  - Turning the adjusting knob clockwise increases tension on the adjusting spring which supplies upward force on the diaphragm. The diaphragm pushes the valve off the valve seat allowing inlet pressure to pass to outlet.

- REDUCE PRESSURE
  - Turning adjusting knob counterclockwise relieves tension on the adjusting spring allowing the diaphragm to move away from the valve stem and relieve off excess pressure to atmosphere.



MP General Purpose Regulators
Manually Operated

Sentry

Miniature

Series 350

High-Flow
Vanguard

Vanguard

Series 380

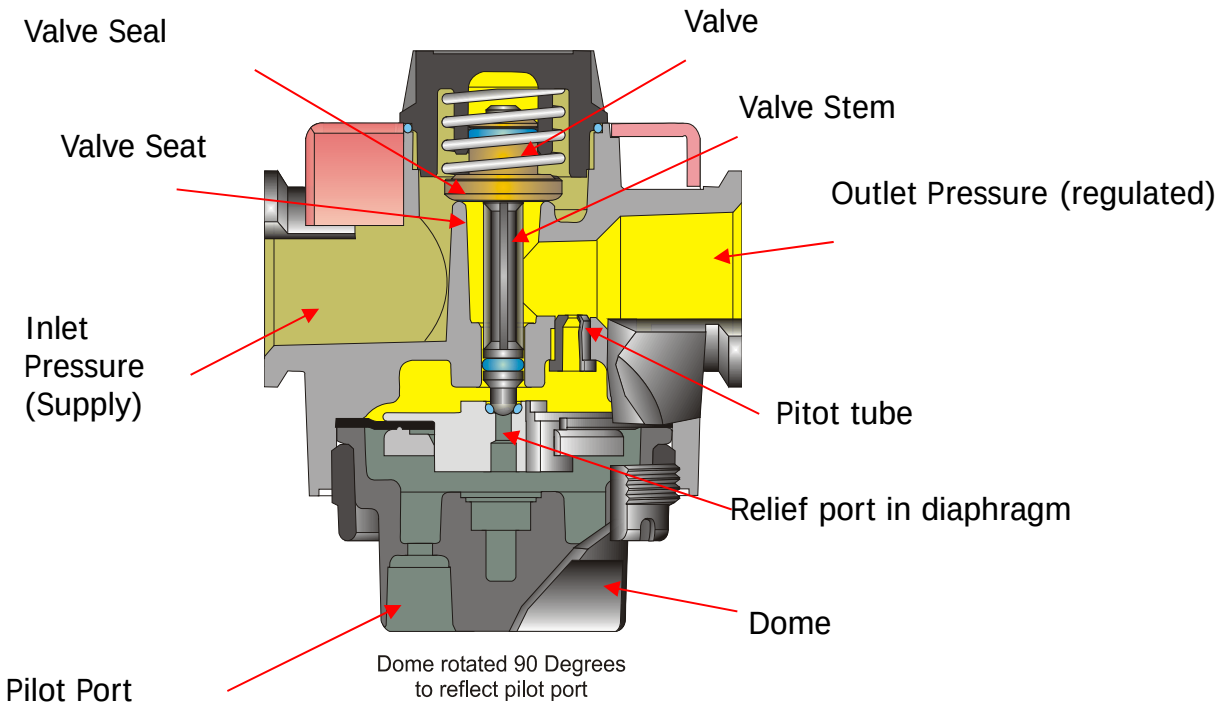
High Flow
Vanguard

External Pilot Regulators

- Allow remote adjusting of regulator with air
- Pilot signal can be provided by any M/P regulator
- Pilot control regulator installed away from the main regulator for convenient, remote adjusting
- Fast response, good sensitivity, and long service life
- Self-relieving through control regulator. Except for PRH,HPR, R200 and PR300.

MP Pilot Regulator
How Does It Work?

High Flow
Vanguard



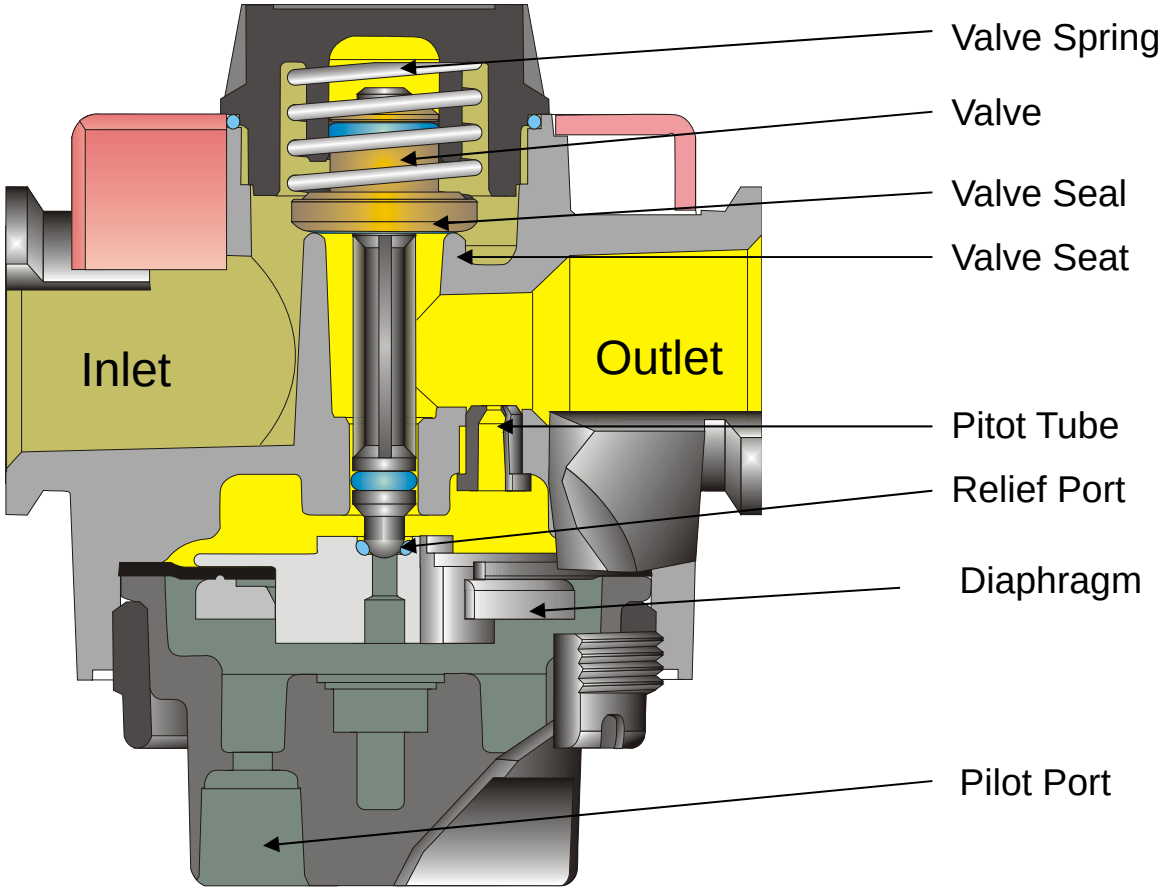
The above graphic illustrates the **Closed Mode**, no flow.
(Pilot pressure is approximately equal to outlet pressure)

Series 380

MP Pilot Regulator
How Does It Work?

Neutral Position

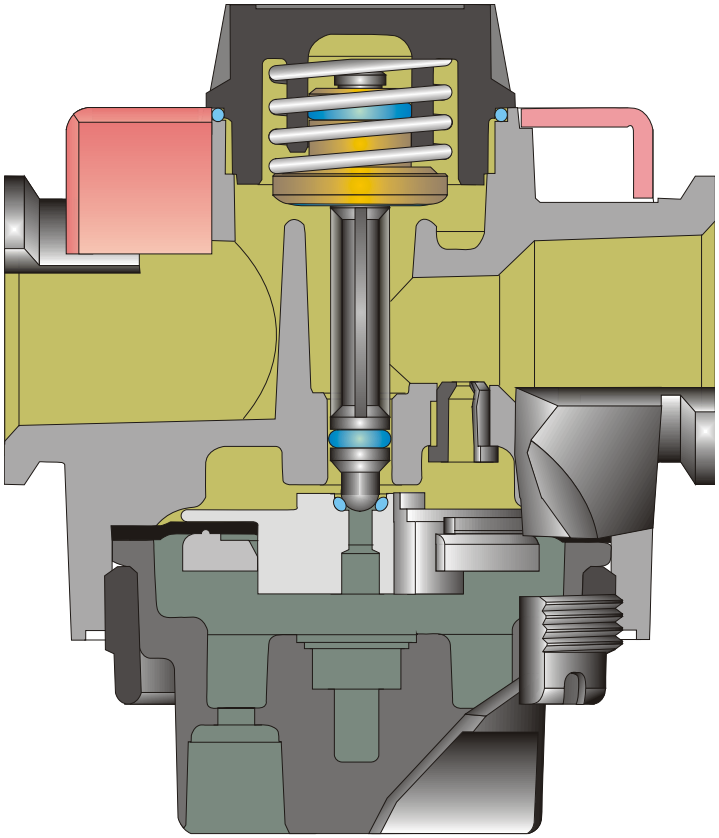
•When the outlet pressure equals the set pressure the valve will be in a closed position. The set pressure is controlled by the external control regulator via the Pilot Port.



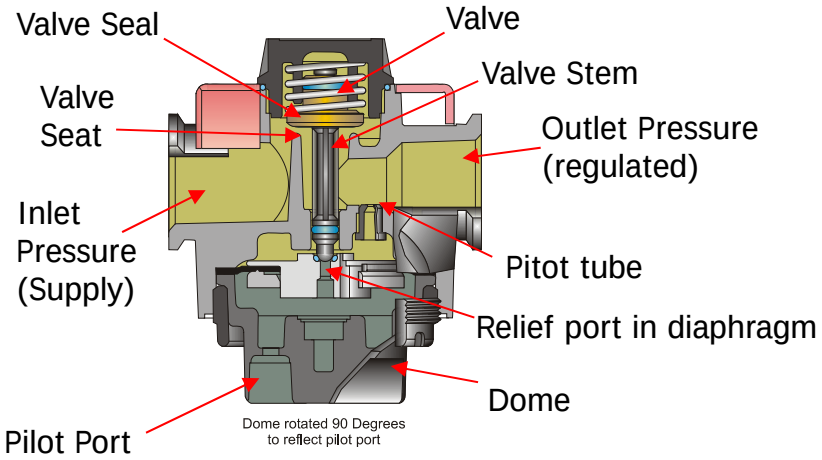
Dome rotated 90 Degrees
to reflect pilot port

High Flow
Vanguard

MP Pilot Regulator How Does It Work?



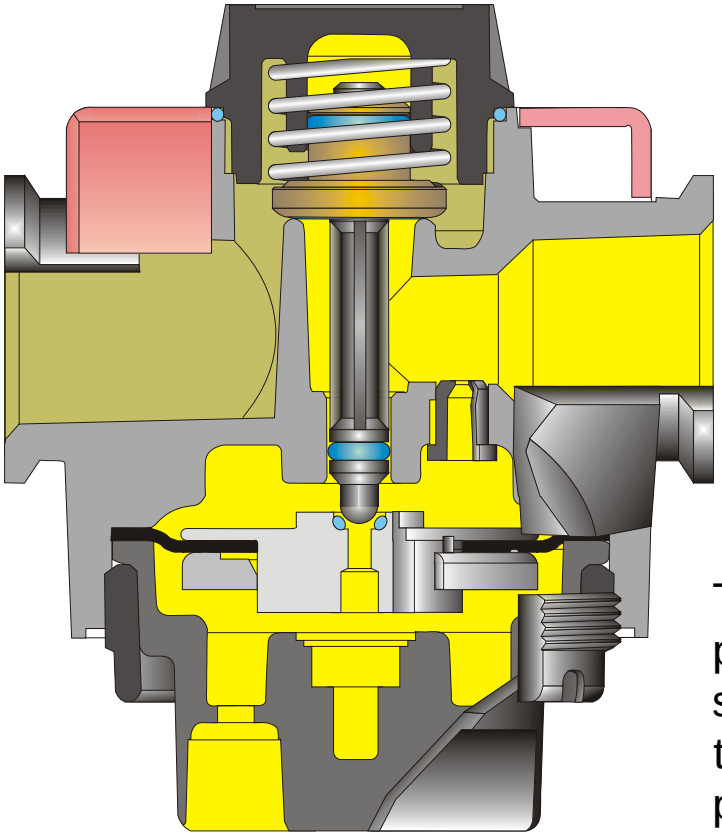
Dome rotated 90 Degrees
to reflect pilot port



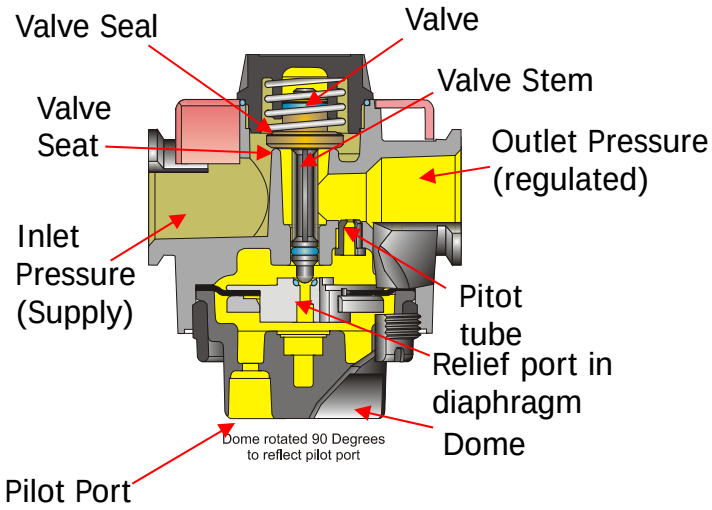
Open Mode, air is passing from the inlet to the outlet. The air pressure supplied through the pilot port to the diaphragm determines the pressure set point of the outlet air.
(Pilot pressure is higher than outlet pressure)

Vanguard

MP Pilot Regulator How Does It Work?



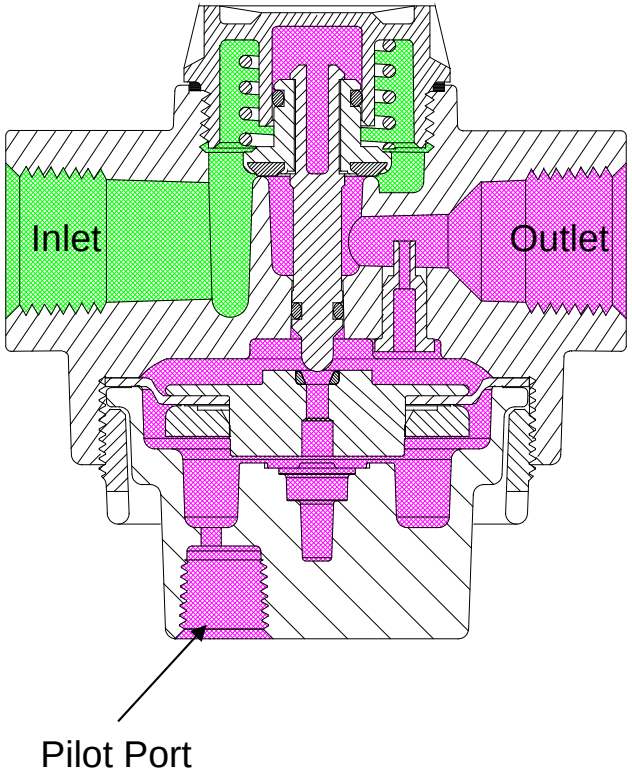
Dome rotated 90 Degrees
to reflect pilot port



The **Relieving Mode**, no flow to outlet port. When outlet air pressure exceeds the set point, it forces the diaphragm down off the valve stem. The valve closes which prevents the inlet air from passing, and the outlet air passing through diaphragm flows back to the pilot regulator (not shown) and typically is relieved to atmosphere.
(Pilot pressure is lower than outlet pressure)

Sentry

MP PR Pilot Regulator

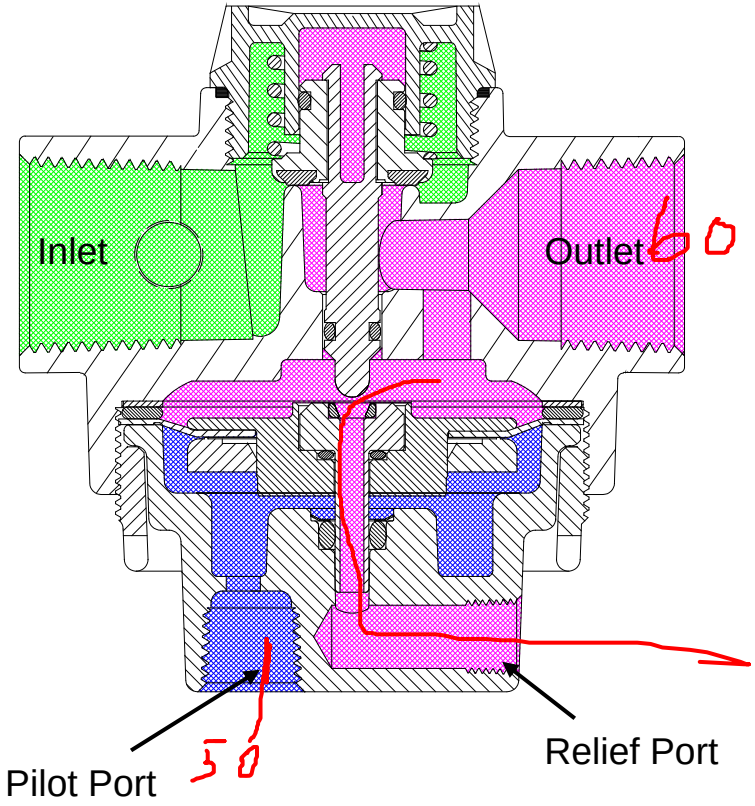


PR Regulator in the **Relieving Mode**, no flow to outlet port. When outlet air pressure exceeds the set point, it forces the diaphragm down off the valve stem. The valve closes which prevents the inlet air from passing, and the outlet air passing through diaphragm flows back to the pilot regulator (not shown) and typically is relieved to atmosphere.

(Pilot pressure is lower than outlet pressure)

MP Pilot Regulator - High Relief

High Flow
Vanguard



PRH, HPR, R200 & PR300 Regulator (High Relief) in the **Relieving Mode**, no flow to outlet port. When outlet air pressure exceeds the set point, it forces the diaphragm or piston down off the valve stem. The valve closes which prevents the inlet air from passing, and the outlet air passing through diaphragm flows back to an external port and is relieved to atmosphere. (Pilot pressure is lower than outlet pressure)

These have the ability to relieve (dump) significantly more air, faster, than the standard PR regulator without affecting the pilot pressure.

HPR251

MP Externally Piloted Regulators

- Miniature
- Vanguard
- Vanguard High Capacity
- 380 Series
- HPR100, HPR180 and R200
- HPR251
- PR300

External Pilot Regulators
Selection of Control Regulator

- Determine the adjusting range (PSI or BAR).
- Control accuracy of downstream air
- Control regulators are all ¼” port

Examples of Control Regulators

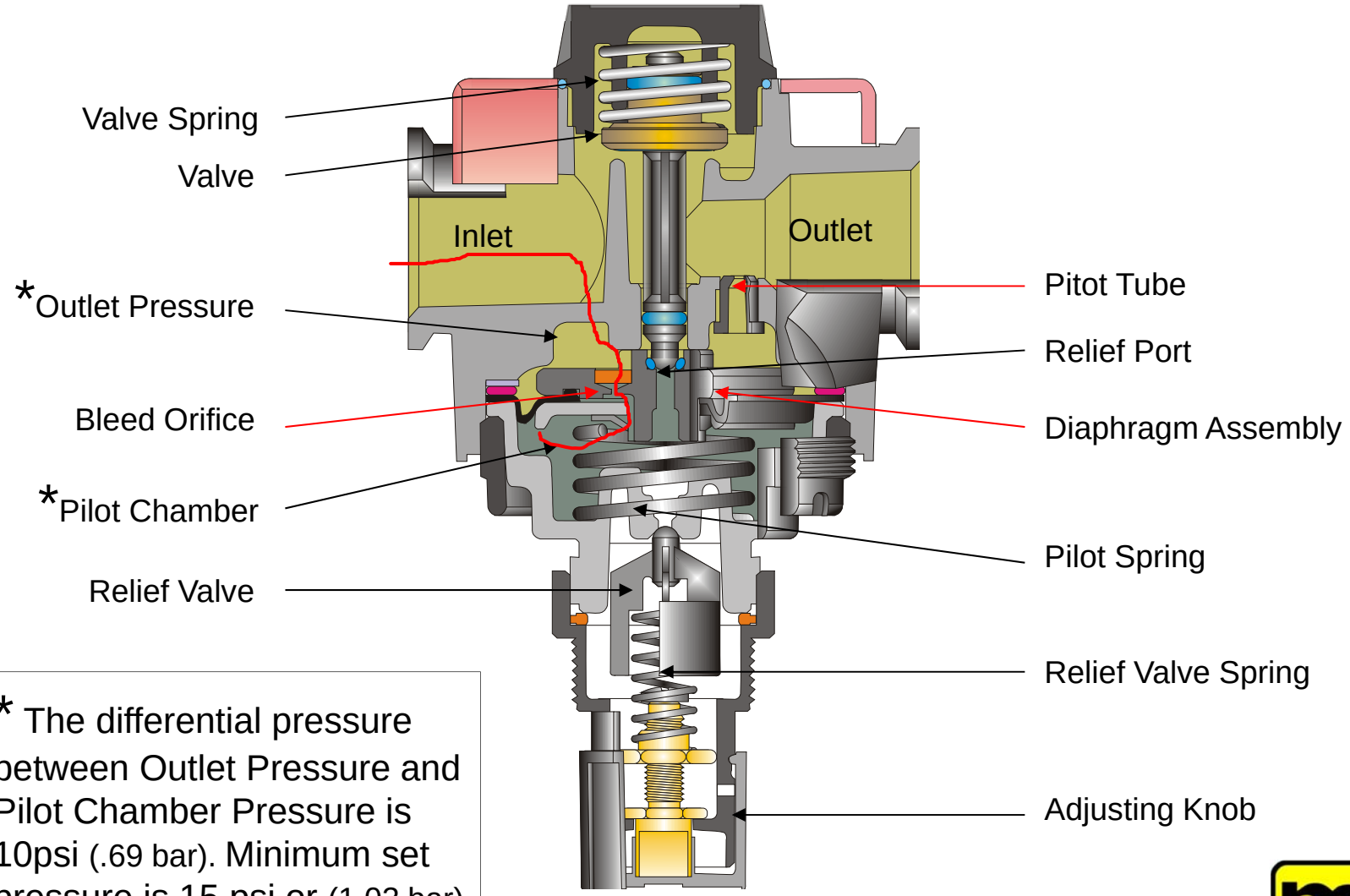
- R57M-2 0-60 psi / 0-4.1 bar (Low pressure precision regulator)
- R55M-2 0-125 psi / 0-8.6 bar (Piston Style)
- R56M-2 0-125 psi / 0-8.6 bar (Diaphragm style)
- R100-2 0-175 psi / 0-12 bar
- IR100-2 15-250 psi / 1.03-17.2 bar (constant bleed)

Vanguard

Internally Piloted Precision Regulators

- Maintains outlet pressure within 5 psi (0.34 bar) of it's set pressure for most of it's flow capacity range.
- Effortless finger adjustment, from minimum to maximum pressures, with several turns of the adjusting dial.
- Repeatability: +/- 0.5 psi (0.034 bar)
- Constant bleed from outlet to atmosphere
- Large change in Inlet Pressure minimally affects the outlet pressure
- Improved flow characteristics because there is no loss in force from spring opening valve

MP Internally Piloted Precision Regulator

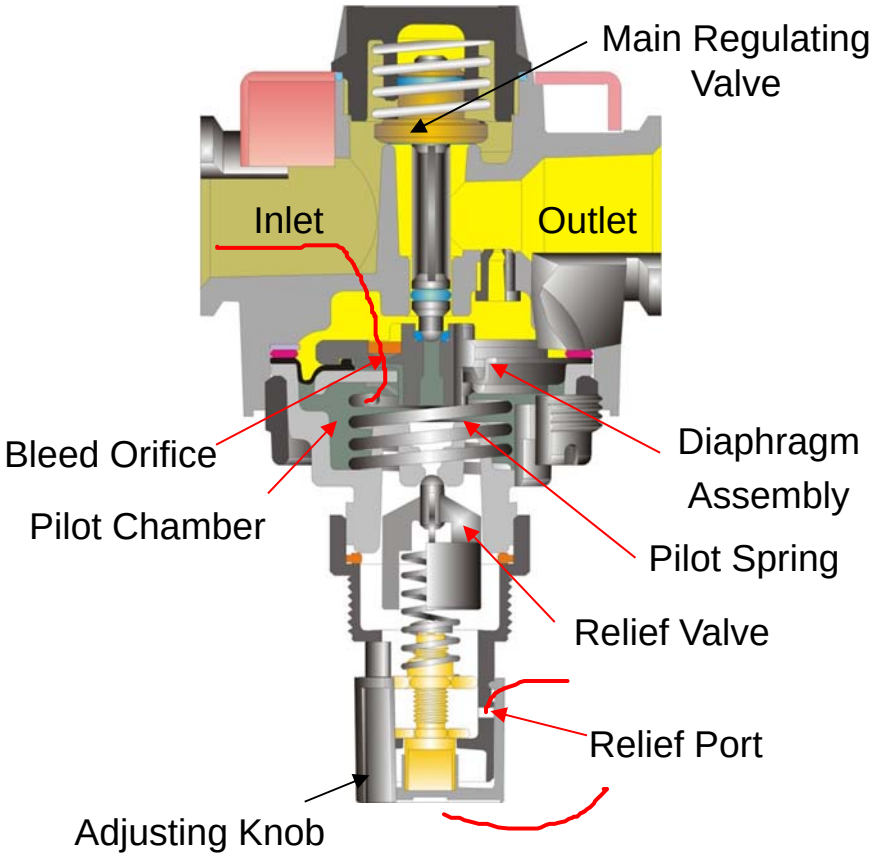


* The differential pressure between Outlet Pressure and Pilot Chamber Pressure is 10psi (.69 bar). Minimum set pressure is 15 psi or (1.03 bar)

Series 380

MP Internally Piloted Precision Regulator

- When inlet pressure exceeds 15psi (1.03bar), a 10psi (.69bar) Pilot Spring moves the Diaphragm Assembly up which opens the Main Regulating Valve.
- Regulated pressure (outlet) bleeds through the Bleed Orifice and pressurizes the Pilot Chamber.
- The Relief Valve maintains the Pilot Chamber pressure at the correct pressure to maintain the desired outlet pressure. It also provides the constant bleed to atmosphere .18-.33 SCFM (.085-.156 l/s) @ 80psi (5.5bar) outlet.
- The adjustable Relief Valve cracking pressure controls Pilot Pressure which determines Outlet Pressure.



MP Internally Piloted Precision Regulators

100 Series

380 Series

180 Series

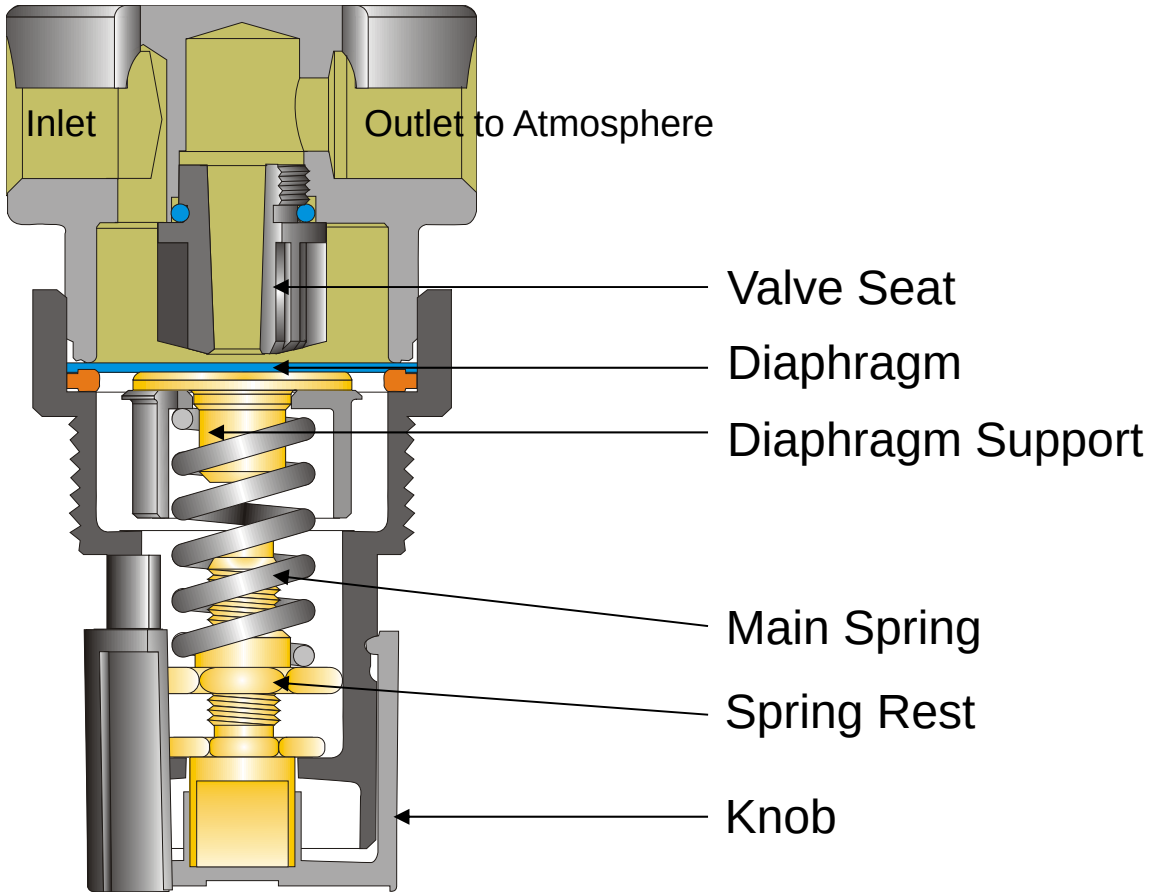
- Effortless turning of the adjustment knob
- Excellent adjusting resolution on both increasing and decreasing outlet pressure
- Bleed-air exhaust noise virtually inaudible
- Bleed orifice has built-in filter
- High precision

Miniature

MP Relief Valves

CO2
Miniature

- To prevent over pressurization.
- Allows system air to exhaust to atmosphere
- Installed after the valve and before the cylinder



Miniature

What to Consider When Choosing a Regulator

- Port Size
- Locking Adjustment Knob
- Inlet PSI Ranges
- **Flow Capacity** (see next slide for “ball-parking”)
- Outlet Pressure Ranges Available
- Body Materials – Brass, Alum., Zinc or SS
- Sensing – Diaphragm or Piston
- Relieving or Non-relieving
- Spring, Air, or Electronic Adjustment of Outlet Pressure
- Repeatability

What to Consider When Choosing a Regulator (Cont'd)

Many users do not know what their flow requirements are…..

To get them in the "Ballpark"

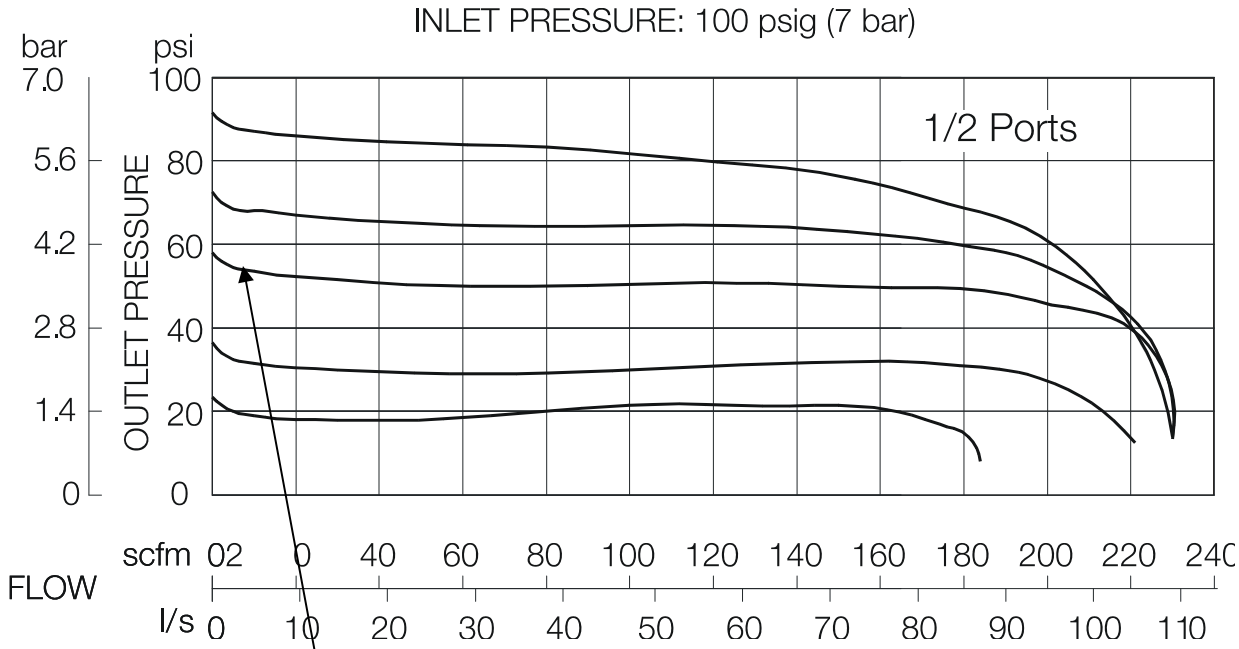
- What is the Cv of the valve in the circuit?
  - Multiply Cv x 25 = approximate SCFM

  OR*****

- What is the Compressor Horsepower?
  - Multiply 4-4.5 x HP = approximate SCFM

Master Pneumatic Regulators

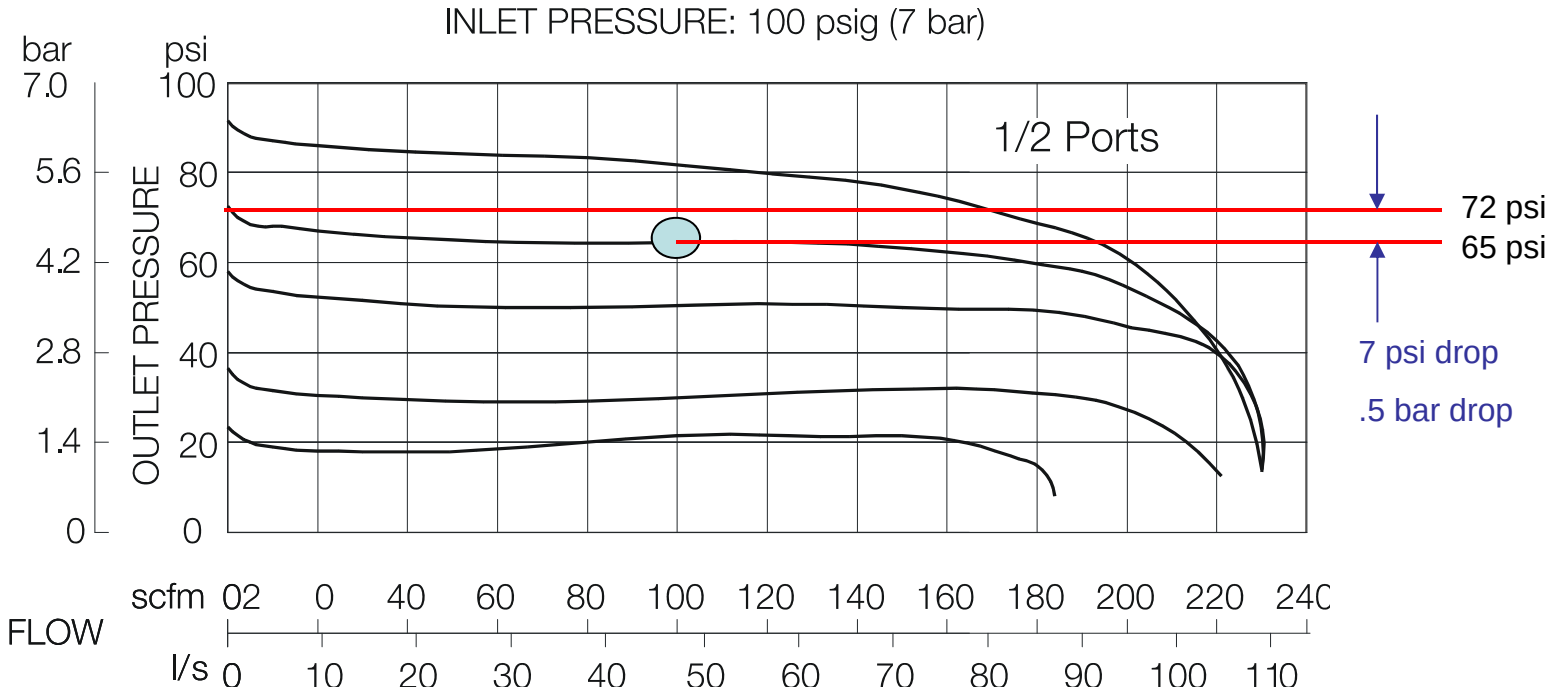
Understanding Flow Charts



Initial pressure drop is called “Droop”. This is the result of the spring compression and frictional losses.

Master Pneumatic Regulators

Understanding Flow Charts



Example: If 65 psi (4.5bar) outlet is required at 100 scfm (47 l/s), and inlet pressure is 100 psi (6.9bar), the regulator would need to be set at approximately 72 psi (5bar). This is due to the approximate 7 psi (.5bar) drop at 100 scfm (47 l/s) as shown on graph.

General Purpose Regulator & Port Sizes.

(Approximate size relationship as shown)

R10M / R11M
Sentry Modular (air)
NPTF & BSPP Port Sizes:
1/8, 1/4
Tubing Sizes: 1/4, 3/8, 4mm, 6mm, 8mm, & 10mm

R13M / R14M
Sentry Modular (water)
NPTF & BSPP Port Sizes:
1/8, 1/4
Tubing Sizes: 1/4, 3/8, 4mm, 6mm, 8mm, & 10mm

RS3MB / RS4MB
Miniature Brass (water)
NPTF & BSPP Port Sizes:
1/8, 1/4

RS5M / RS6M
Miniature Aluminum (air)
NPTF & BSPP Port Sizes:
1/8, 1/4

RVS6 Relief Valve
Miniature (air)
NPTF & BSPP Port Sizes:
1/8, 1/4

RS6S Stainless Steel Miniature (air)
NPTF & BSPP Port Sizes:
1/8, 1/4

RS7M Precision Miniature (air)
NPTF & BSPP Port Sizes:
1/8, 1/4

R67 High Pressure (air)
NPTF & BSPP Port Sizes:
1/8, 1/4 and 3/8

R60 Modular (air)
NPTF & BSPP Port Sizes:
1/4, 3/8, and 1/2

R7S Metal Dome Modular (air)
NPTF & BSPP Port Sizes:
1/4, 3/8, and 1/2

R350 Modular (air)
NPTF & BSPP Port Sizes:
1/4, 3/8 and 1/2

R100 Modular (air)
NPTF & BSPP Port Sizes:
1/4, 3/8, 1/2 and 3/4

R380 Modular (air)
NPTF & BSPP Port Sizes:
3/8, 1/2 and 3/4

R180M (air)
NPTF & BSPP Port Sizes:
3/4, and 1

R180 (air)
NPTF & BSPP Port Sizes:
1-1/4 and 1-1/2

MASTER PNEUMATIC
8701 - 18 Mile Rd | Sterling Heights, MI 48314
Phone: (586) 254-1000 | **Fax:** (586) 254-6055
Website: www.masterpneumatic.com
Email: mp@masterpneumatic.com

This slide and the next slide are also available as a 1 page, front & back handout.

The “Complete Product Sheet” gives an overall picture of MP’s range of regulators. See catalog for more detailed information.

General Purpose Regulator & Port Sizes.

Boxes that are marked with yellow are available options for the product listed. Numbers and letters inside each yellow box reflects the proper suffix / prefix needed. See Master Pneumatic catalog for complete product breakdown chart.

FLOW RATE

	Port Size	Inlet PSIG	Set Pressure PSIG	PSIG pressure drop	Flow SCFM	Cv/m
R10M	1/4	100	80	15	17.5	
R11M	1/4	100	80	15	15	
R13M	1/4	100	80	15		2
R14M	1/4	100	80	15		1.5
R55M	1/4	100	80	15	18	
R56M	1/4	100	80	15	14	
R53MB	1/4	100	80	15		2
R54MB	1/4	100	80	15		1.5
R66S	1/4	100	78	15	12	
R57M	1/4	91	36	15	4.1	
R67	3/8	400	350	15	10	
R90	1/4 3/8 1/2	100	78	15	68 88 100	
R75	1/4 3/8 1/2	100	78	15	67 88 102	
R350	1/4 3/8 1/2	91.3	72.5	15	70 89 107	
R100	1/4 3/8 1/2 3/4	91 100 100 100	70 90 90 90	15	78 78 136 140	
R380	3/8 1/2 3/4	100	90	15	130 160 162	
R180M	3/4 1	91	75	15	440 500	
R180	1-1/4 1-1/2	91	75	15	500	

OPTIONS CHART

	R10M / R11M	R13M / R14M	R55M / R56M	R53MB / R54MB	R66S	R57M	R67	R90	R75	R350	R100	R380	R180M	R180
REGULATOR TYPE (prefix)														
Piston	R10M	R13M	R55M	R53MB										
Diaphragm	R11M	R14M	R56M	R54MB										
HEAD MATERIAL (Prefix)														
Acetal														
Aluminum														
Brass			B	B										
Stainless Steel					S									
Zinc														
SPRING RANGE (suffix)														
0-5 PSI							L5							
0-8 PSI	L8		L8											
0-10 PSI							L10							
0-15 PSI	L15		L15		L15	L15								
0-20 PSI							L20				L20	L20	L20	L20
0-30 PSI	L30	L30	L30	L30	L30	L30								
0-60 PSI	L	L	L	L	L	L		L	L	L	L	L	L	L
0-80 PSI							H							
0-100 PSI								L100			L100			
0-125 PSI	H	H	H	H	H	H								
0-150 PSI									H				H	H
0-175 PSI												H	H	
0-200 PSI								L200		H	H			
0-390 PSI														
RELIEVING (suffix)														
Self relieving														
Non relieving	A	A	A	A	A		A	A	A	A	A	A	A	A
SEALS AND O-RINGS (suffix)														
Nitrile														
Viton	V		V		V		V	V						

PIPE SIZE CHART

	TUBING						NPTF and BSPP PIPE THREADS						
	1/4	3/8	4mm	6mm	8mm	10mm	1/8	1/4	3/8	1/2	3/4	1	1-1/4 1-1/2
R10M / R11M	04	06	M4	M6	M8	M10	1	2					
R13M / R14M	04	06	M4	M6	M8	M10	1	2					
R55M / R56M							1	2					
R53M / R54MB							1	2					
R66S							1	2					
RV56							1	2					
R57M							1	2					
R67							1	2	3				
R90								2	3	4			
R75								2	3	4			
R350								2	3	4			
R100								2	3	4	6		
R380									3	4	6		
R180M											6	8	
R180												10	12

MASTER PNEUMATIC
6701 - 18 Mile Rd | Sterling Heights, MI 48314
Phone: (586) 254-1000 | **Fax:** (586) 254-8055
Website: www.masterpneumatic.com
Email: mp@masterpneumatic.com

To download go to:
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Catalog & Literature tab;
English Version;
Catalog;
Complete Product Sheets

This slide and the next slide are also available as a 1 page, front & back handout.

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Piloted Regulator & Port Sizes.

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PIPE SIZE CHART

	TUBING						NPTF AND BSPP PIPE THREADS									
	1/4	3/8	4mm	6mm	8mm	10mm	1/8	1/4	3/8	1/2	3/4	1	1-1/4	1-1/2	2	3
[illegible]	04	06	M4	M6	M8	M10	1	2								
PR55M / PR56M	04	06	M4	M6	M8	M10	1	2								
PR100								2	3	4	6					
PRH100								2	3	4	6					
HPR100								2	3	4	6					
IR100								2	3	4	6					
PR380									3	4	6					
PRH380									3	4	6					
IR380									3	4	6					
PR180M											6	8	10	12		
PRH180M											6	8	10	12		
HPR180M											6	8	10	12		
IR180M											6	8	10	12		
R200														12	16	24
PR300																24

OPTIONS CHART

	PR11M	PR55M / PR56M	PR100	PRH100	HPR100	IR100	PR380	PRH380	IR380	PR180M	PRH180M	HPR180M	IR180M	R200	PR300
REGULATOR TYPE (prefix)															
Piston		PR55M													
Diaphragm		PR56M													
HEAD MATERIAL (prefix)															
Acetal															
Aluminum															
Brass		B													
Zinc															
SPRING RANGE (suffix)															
15-100 PSI						L			L				L		
0-125 PSI															
0-200 PSI															
15-200 PSI															
15-250 PSI						H			H				H		
RELIEVING (suffix)															
Self Relieving															
Non Relieving	A	A	A				A	A		A				A	A
SEALS AND O-RINGS (suffix)															
Nitrile															
Viton				V										V	V

FLOW RATE

	PORT SIZE	Inlet PSIG, set pressure PSIG, 15 PSIG pressure drop flow of SCFM
PR55M / PR56M	1/8 1/4	Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 24 SCFM
PR100	1/4 3/8 1/2	Inlet 100 psig, Set pressure 100 psig, At 15 psig drop flow 80 SCFM Inlet 100 psig, Set pressure 100 psig, At 15 psig drop flow 90 SCFM Inlet 100 psig, Set pressure 100 psig, At 15 psig drop flow 135 SCFM
PRH100	1/4 1/2 3/4	Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 80 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 138 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 138 SCFM
HPR100	1/4 3/8 1/2	Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 94 SCFM Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 100 SCFM Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 127 SCFM
IR100	1/4 3/8 1/2 3/4	Inlet 100 psig, Set pressure 80 psig, At 15 psig drop flow 80 SCFM Inlet 100 psig, Set pressure 80 psig, At 15 psig drop flow 90 SCFM Inlet 100 psig, Set pressure 80 psig, At 15 psig drop flow 165 SCFM Inlet 100 psig, Set pressure 80 psig, At 15 psig drop flow 170 SCFM
PR380	3/8 1/2 3/4	Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 165 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 165 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 165 SCFM
PRH380	3/8 1/2 3/4	Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 159 SCFM Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 159 SCFM Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 165 SCFM
IR380	3/8 1/2 3/4	Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 160 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 160 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 150 SCFM
PR180M	3/4 1 1-1/4 1-1/2	Inlet 100 psig, Set pressure 80 psig, At 15 psig drop flow 390 SCFM Inlet 100 psig, Set pressure 80 psig, At 15 psig drop flow 390 SCFM Inlet 100 psig, Set pressure 80 psig, At 15 psig drop flow 640 SCFM Inlet 100 psig, Set pressure 80 psig, At 15 psig drop flow 640 SCFM
PRH180M	3/4 1 1-1/4 1-1/2	Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 400 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 520 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 550 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 550 SCFM
HPR180M	3/4 1 1-1/4	Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 290 SCFM Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 335 SCFM Inlet 91.3 psig, Set pressure 72.5 psig, At 15 psig drop flow 335 SCFM
IR180M	3/4 1 1-1/4 1-1/2	Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 460 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 620 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 640 SCFM Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 640 SCFM
R200	1-1/2 2	Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 1800 SCFM
PR300	3	Inlet 91 psig, Set pressure 72 psig, At 15 psig drop flow 3500 SCFM

MASTER PNEUMATIC
6701 - 18 Mile Rd | Sterling Heights, MI 48314
Phone: (586) 254-1000 | Fax: (586) 254-8055
Website: www.masterpneumatic.com
Email: mp@masterpneumatic.com

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Common Regulator Terms

•**Accuracy** – The variation in outlet pressure which occurs under steady state conditions within the control range of a regulator.

•**Balanced Valve** – A main valve which has been designed to be pressure balanced, hence the main valve spring provides the shut-off force when inlet pressure is approximately equal to outlet pressure. Better compensates for changes in supply pressure.

•**Diaphragm** – One of several types of sensing elements. The diaphragm style doesn't have the inherent friction of piston o-rings, therefore is very sensitive in reacting to outlet pressure changes.

•**Droop** – The outlet pressure change from the "set pressure" which occurs as flow rate increases. Caused by static friction, force biased to seal valve to seat, poor lubrication, and spring rate.

•**Hysteresis –** The difference in pressure, at a given flow rate, when flow is increasing versus when flow is decreasing.

•**Inlet pressure** (P1) – The pressure of the fluid media, gas, or liquid to the supply port of a regulator. Also referred to as Primary Pressure & Supply Pressure.

•**Leakage external** – The loss of fluid to external surfaces or joints of a regulator.

•**Outlet Pressure –** Also referred to as P2, Secondary, Regulated Pressure.

Common Regulator Terms, cont.

•**Pilot Pressure** – One method of controlling outlet pressure. A gas is put into the dome of a regulator at a pressure approximately equal to the outlet pressure desired**.**

•**Piston** – One type of sensing element. Typically used in larger regulators where higher flows are present

•**Relieving Regulator** – A feature incorporated in certain pressure reducing regulators which enables the unit to vent the outlet pressure when it exceeds the set pressure.

•**Repeatability** – The ability of a regulator to return to the same set pressure subsequent to being subjected to various flow demands.

•**Sensing Element** – One of the three basic elements of a pressure reducing regulator. It senses the changes in the outlet pressure permitting the regulator to react and attempt to return to the original “set pressure” by increasing or decreasing pressure. This could be a diaphragm or a piston.

•**Set pressure** – The desired operational outlet pressure for a regulator, normally stated at NO FLOW conditions.

•**Unbalanced main valve** – The most basic main valve design. Inlet pressure provides the majority of the shut-off force.

MP Regulator - Benefits

- **M/P stands behind the product with exceptional warranty (7 YEARS) and quick service**
- **Vast technical knowledge with over 60 years in business.**
- **Products have been proven with many years of service.**
- **Designed for durability and performance**
- **100% Acceptance Testing**
- **Custom Designs**
- **Water, Oxygen Clean, etc.**

Thank you for your time and your business!

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