



**Installation and Operation Instructions**

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## SAFETY Warnings

SENTINEL products should only be installed, operated and repaired by experienced and trained professional mechanics. Read and observe all instructions and safety warnings in this Manual before installing, operating or repairing products.

### Safety Symbols

The following symbols indicate cautions, warnings and notes that must be observed for safe and satisfactory installation, operation and maintenance of SENTINEL products.

-  **WARNINGS** Danger of serious injury or death could occur if these warnings are ignored.
-  **CAUTIONS** Equipment damage, injury or death could occur if these cautions are not observed.
-  **NOTES** Special instructions for safe and satisfactory installation, operation and maintenance.

### General Safety

- Observe all safety symbols in installation and operation instructions.
- **DO NOT** exceed maximum pressure specified on product serial tag or label. If missing, **DO NOT** use without consulting distributor or factory for maximum pressure rating.
- Always make sure safety shutoff valves, regulators, pressure relief valves, gauges, etc. are working properly before starting system or assembly.
- Verify product model received against purchase order and shipper.
- Before starting a system or assembly make certain the discharge point of the piping system is clear and safe, and all persons have been warned to stand clear.
- **DO NOT** put your face or body near product when the system or assembly is operating or product is pressurized.
- **DO NOT** operate if product is leaking, damaged, corroded or otherwise unable to contain internal fluid, air or gas pressure.
- **DO NOT** pump incompatible fluids through product. Consult distributor or factory if you are not sure of the compatibility of system fluids with product materials.
- Remove all pressure from product and pumping system before disassembly, removal or maintenance.

### Equipment Misuse Hazard

#### General Safety

**DO NOT** misuse product, including but not limited to over-pressurization, modification of parts, using incompatible chemicals, or operating with worn or damaged parts. Any misuse could result in serious bodily injury, death, fire, explosion or property damage.

#### Over-Pressurization

Never exceed the maximum pressure rating for the model being used. Maximum pressure is specified on product serial tag or label. Maximum pressure is rated at 70°F (21°C).

#### Temperature Limits

**DO NOT** exceed the operating temperature limits for the body and/ or elastomer materials being used. Excessive temperature will result in product failure. For temperature limits, refer to the "Temperature Limits" section of this Manual. Temperature limits are stated at zero psi/bar.

#### Temperature & Pressure Hazard

Temperature and pressure reduce the strength and chemical resistance of plastic, metal, elastomers and PTFE.


#### Diaphragm Failure

Products use an elastomeric or PTFE diaphragm to separate system fluid from the non-wetted housing. When failure occurs, system fluid may be expelled from product. Always perform preventive maintenance and replace diaphragm and any sealing O-rings before excessive wear occurs. It is recommended that O-rings be replaced on each reassembly.







#### Maintenance Hazards

Never overtighten fasteners. This may cause leakage of system fluid and damage to product. Bolts should not be reused as re-torquing reduces bolt strength. After product maintenance or reassembly, use new fasteners and torque fasteners according to specifications in this Manual. If necessary, consult distributor or factory for torque specifications.


## GENERAL Information

-  For safe and satisfactory operation of product read all safety warnings, caution statements and this complete Manual before installation, startup, operation or maintenance.

### Must Read Before Installation

-  **DO NOT** exceed maximum pressure specified on product serial tag or label.
-  Turn pump off and remove all pressure from system prior to product installation.
-  Always wear safety glasses and other appropriate safety equipment when installing or repairing product.
-  **DO NOT** operate a product that is leaking, damaged, corroded or otherwise unable to contain internal fluid, air or gas pressure.
-  Temperature, pressure and chemicals affect the strength of plastic, elastomer and metal components.
-  Many plastics lose strength rapidly as temperature increases. Consult factory if in doubt.

## Maintenance

-  Remove all pressure from product AND pumping system before disassembly, removal or maintenance.

SENTINEL products require very little maintenance. Replacement parts are available from Blacoh. Consult distributor or factory for replacement part numbers.




### Diaphragms

Diaphragm replacement should be part of a preventive maintenance program. Diaphragms should be replaced at least every two years. Products used in conjunction with diaphragm pumps should have the diaphragms replaced at least every second time the diaphragms in the pump are replaced. As with any pumping system, wear is dependent on many factors including material, temperature, chemicals, fluid abrasiveness and system design. This suggested maintenance program may need to be adjusted according to specific applications.



### Fasteners

Periodic inspection of fasteners should be conducted to visually check for signs of over-pressurization, fatigue, stress or corrosion. Fasteners must be replaced at first indication of deterioration.

Where products are used in corrosive environments, fasteners should be regularly inspected and replaced with fasteners of equal grade/strength value if corrosion is observed. Failure to conduct such regular inspections and replacement will void the product warranty given by the manufacturer and the manufacturer will have no liability whatsoever for any product failure or malfunction.

-  **IMPORTANT!** After maintenance or reassembly, torque fasteners according to specifications in this Manual. If necessary, consult distributor or factory for specifications.
-  **DO NOT** use product if the fasteners are corroded. Check for fastener corrosion frequently, especially in atmospheres containing salt or corrosive chemicals, or if product leakage has occurred.
-  **DO NOT** over-tighten fasteners. This may cause leakage of system fluid, fastener failure or damage to product housings.

## Temperature Limits

-  Operating temperatures are based on the maximum temperature of the wetted valve components only. Non-wetted components may have a lower temperature limit. Temperature and certain chemicals may reduce the maximum pressure of the product.
-  **CAUTION!** Plastic (non-metallic) body materials lose strength as temperature increases, which reduces the maximum pressure sustainable by the material. All plastic materials must have an appropriate derating factor applied when working at elevated temperatures above 73.4°F (23°C) to determine maximum pressure.

Elastomer Materials	Temperature Limits		Applications
Buna-N	+10°F to +180°F	(-12°C to +82°C)	Good flex life; use with petroleum, solvents and oil-based fluids.
EPDM	-60°F to +280°F	(-51°C to +138°C)	Use in extreme cold; good chemical resistance with ketones, caustics.
PTFE	+40°F to +220°F	(+4°C to +104°C)	Use with highly aggressive fluids.
Viton	-10°F to +350°F	(-23°C to +177°C)	Use with hot and aggressive fluids; good with aromatics, solvents, acids and oils.

Non-Metallic Body Materials	Temperature Limits		Applications
CPVC	+32°F to +180°F	(0°C to +82°C)	Chlorinated PVC (CPVC): Good general chemical resistance; loses strength as temperature rises.
Polypropylene	+32°F to +175°F	(0°C to +79°C)	Good general purpose plastic; broad chemical compatibility at medium temperatures.
PTFE	+40°F to +220°F	(+4°C to +104°C)	Use with highly aggressive fluids, high temperatures.
PVC	+32°F to +140°F	(0°C to +60°C)	Good general chemical resistance; loses strength as temperature rises.
PVDF	+10°F to +200°F	(-12°C to +93°C)	Excellent resistance to most acids and bases; high temperatures.

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# Installation & Operation Instructions

- ❖ Turn pump off and remove all pressure from system prior to valve installation.
- ❖ Remove all pressure from pumping system and loosen valve adjustment screw until flush with top of spring housing to eliminate spring compression before disassembly, removal or maintenance.
- ❖ Loosen valve adjustment screw until flush with top of spring housing to eliminate spring compression before disassembly, removal or maintenance.
- ❖ **DO NOT exceed maximum pressure specified on valve serial tag or label.** If missing, consult distributor or factory for specifications.
- ❖ Always wear safety glasses and other appropriate safety equipment when installing or repairing valve.
- ❖ Read and observe all safety warnings and instructions in this Manual before installation, operation or repair.
- ❖ **IMPORTANT!** After maintenance or reassembly, torque fasteners according to specifications in this Manual. If necessary, consult distributor or factory for specifications.
- ❖ **DO NOT** over-tighten adjustment screw. This could fully compress the spring, resulting in loss of valve performance.
- ❖ **DO NOT** over-tighten fasteners. This may cause leakage of system fluid, fastener failure or damage to valve body.

## Back Pressure Valve Installation

Generally, back pressure valves can be installed anywhere in the discharge line, provided there is some downstream pressure at the dosage point. If there is no downstream pressure, back pressure valves should be installed at the dosage point to prevent siphoning and drainage of the chemical line. Back pressure valves should be installed downstream of any pulsation dampener.

- 2 port (180° ports) back pressure valves must be installed with the flow arrow pointed in the direction of fluid flow. Flow arrows are on valve serial tag or label, and marked on valve bottom.
- The inlet port on 2 port (90° ports) back pressure valves is on the side of the valve; the outlet port is on the bottom of the valve.

## Pressure Relief Valve Installation

Pressure relief valves should be installed as close to the pump discharge as possible, and downstream of any pulsation dampener.

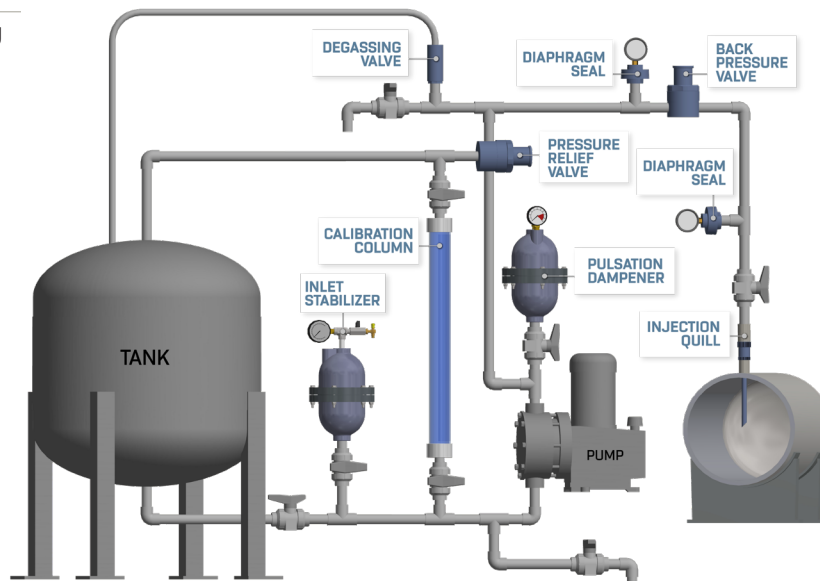
- Direction of flow for 3 port pressure relief valves is across the valve; the relief port is on the bottom of the valve. The side of fluid entry for 3 port valves is not important.
- 2 port (180° ports) pressure relief valves must be installed with the flow arrow pointed in the direction of fluid flow. Flow arrows are on valve serial tag or label, and marked on valve bottom.
- The inlet port on 2 port (90° ports) pressure relief valves is on the side of the valve; the relief port is on the bottom of the valve.
- The optimum installation for the pressure relief valve is to vent the relief port back to the chemical tank, or directly to a containment area. If this is not possible, the relief port can be piped back into the suction side of the pump; however, this will apply suction head to the relief port.

## Installation Notes

- △ It is preferable to install valve with the spring housing pointing up to minimize solids entrapment and for ease of maintenance; however, valve can be installed in any orientation.
- △ Valve performance is enhanced with the installation of a pulsation dampener to smooth the discharge pulses of the pump. Pulsation dampeners will also reduce the pressure drop across the valve by reducing peak flows.
- △ All valves can be factory set to a pressure specified when ordering. Field adjustment is possible using the adjustment screw.

## Typical Installation

Sample diagram showing installation in a metering pump application.



## Set Pressure Adjustment

All valves come from the factory at a preset pressure as listed on the valve serial tag or label. Valves are designed to be field-adjusted as follows:

1. Check valve serial tag or label to confirm factory setting and pressure range.
2. Remove spring housing cover from valve top to expose slotted adjustment screw or hex head adjustment screw.
3. Using a large flat head screwdriver (or hex socket as appropriate), turn adjustment screw to vary set pressure: turn **CLOCKWISE** to **INCREASE** pressure setting or, **COUNTERCLOCKWISE** to **DECREASE** pressure setting.
4. If a pressure gauge is installed in the system, the set pressure adjustment can be made with the valve inline and the process pump running. Refer to the gauge reading to confirm your adjustment.
5. If a gauge is not available, an approximate adjustment can be made by counting full 360 degree rotations of the adjustment screw. The approximate pressure change per rotation is shown in the charts below.
6. Reinstall spring housing cover once adjustment is complete.

Valve Size	Pressure Range	Set pressure Change per Rotation
1/4 - 1/2" Mini	5-50 psi	5 psi
	5-150 psi	24 psi
	5-250 psi	36 psi
	50-350 psi	70 psi

Valve Size	Pressure Range	Set pressure Change per Rotation
1/2 - 1"	5-50 psi	8 psi
	5-150 psi	21 psi
	5-250 psi	27 psi
	50-350 psi	42 psi

## Maintenance and Repair

Refer to Assembly & Maintenance Drawings following this section for exploded view and parts listing.



Remove all pressure from pumping system and loosen valve adjustment screw until flush with top of spring housing to eliminate spring compression before disassembly, removal or maintenance.



**IMPORTANT!** Before disassembling plastic valves, use a permanent marker to draw alignment marks across threaded ring and body where threads meet. This will ensure proper tightening upon reassembly.



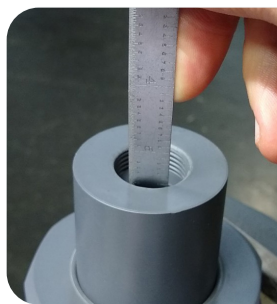
Alignment Marks

## Disassembly



**1**

Place assembly in a vise facing up across flats and clamp with soft jaws or wooden blocks. Remove spring housing cover ⑩ to expose adjustment screw ⑪.



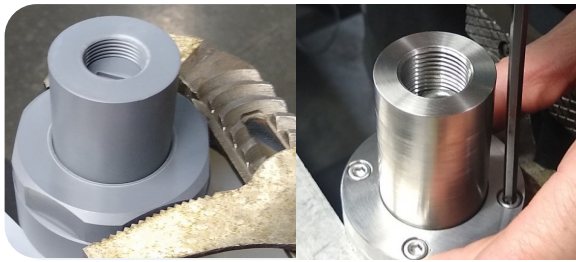
**2**

Use a ruler or calipers to measure distance between top of adjustment screw ⑪ and top of spring housing ⑨ to aid in adjusting set pressure during reassembly; or, when removing adjustment screw (Step 3) count the number of full counterclockwise rotations until face of adjustment screw is flush with top of spring housing.



**3**

Using a large flat head screwdriver, turn adjustment screw ⑪ counterclockwise to remove from spring housing ⑨. Inspect adjustment screw and spring housing for signs of chemical attack, wear or damage. Inspect threads on spring housing and adjustment screw for signs of galling or other damage. Replace parts as needed.



4

For plastic valve bodies, use a spanner wrench or large adjustable pliers to loosen threaded ring ④. For metal valve bodies, use an Allen wrench to loosen fasteners on bolt ring ④.



5

Remove spring housing ⑨ from valve body ① by carefully lifting straight up, leaving internal components in place.



6

Remove diaphragm O-ring ⑩ located in spring housing ⑨ groove. It is recommended that O-rings be replaced on each reassembly. Rebuild kits include new O-ring.



7

Inspect spring ⑦, spring seat pivot ⑥ and spring seat ③ for signs of chemical attack, wear or compression-set and replace as needed.



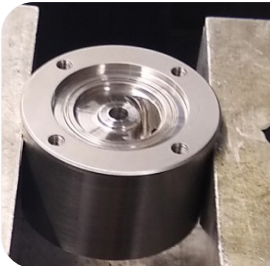
8

Remove diaphragm ② from valve body ①. Inspect diaphragm and body for signs of chemical attack, wear or damage and replace as needed.

## Assembly



Make certain all parts are clean and undamaged. Order replacement parts as needed. Replacement parts and rebuild kits are available from Blacoh. Consult distributor or factory for replacement part numbers.



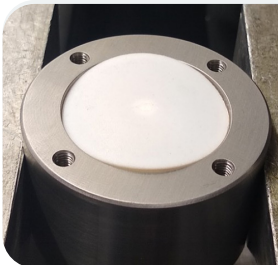
1

Place valve body ① facing up across flats and clamp with soft jaws or wooden blocks.



2

Place diaphragm ② in recess on valve body. For back pressure valves, diaphragm button must be facing down. Pressure relief valve diaphragms do not have button and can be installed in any orientation.



3

Run your fingers around diaphragm outer edge to ensure it is fully seated in recess.



4

Place spring seat ③ on top of diaphragm with locating nub facing up.

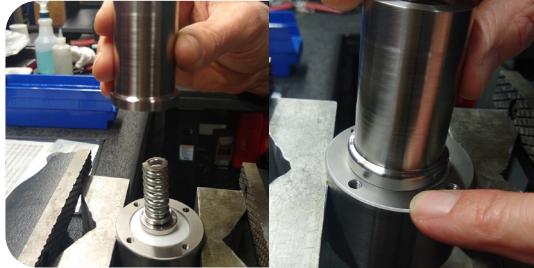


5

Insert spring seat pivot ⑥ into end of spring ⑦ and place on top of spring seat.

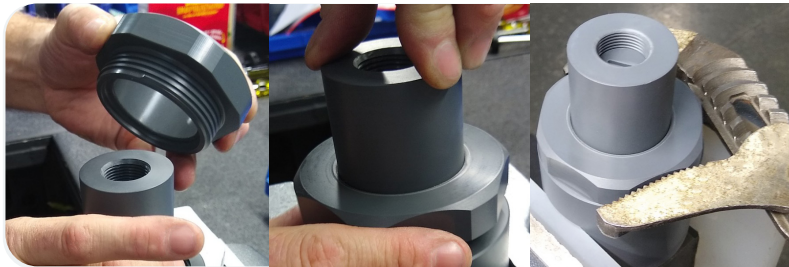


**6**  
 Insert new diaphragm O-ring ⑥ into groove in spring housing ③. Press O-ring into groove to ensure it is fully seated.



**7**  
 Slide spring housing ③ over spring onto valve body ①. Ensure spring housing is centered in diaphragm recess on body.

**PLASTIC VALVE BODY**



**8**  
 Slide threaded ring ④ over spring housing ③. Hand tighten threaded ring onto valve body until snug. Use a spanner wrench or large adjustable pliers to tighten until lines marked before disassembly line up.

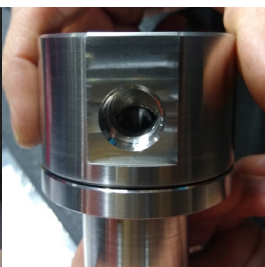
**METAL VALVE BODY**



**9**  
 Prior to installation, apply Moly Dee lube or equivalent to metal fasteners to prevent galling. Slide bolt ring ④ over spring housing ③ and align bolt holes in ring with threaded holds in valve body. Insert lubed fasteners in bolt ring ④.



**10**  
 Hold bolt ring ④ firmly in place and hand tighten fasteners using a criss-cross pattern. Use an Allen wrench to tighten fasteners in quarter-turn intervals using a criss-cross pattern until snug.



**11**  
 Use a torque wrench to torque fasteners using a criss-cross pattern according to the torque specifications shown. Ensure that the gap between valve body and bolt ring is even and consistent after fasteners have been torqued.

- Torque Specs**
- 1/4 - 1/2" Mini Valves:  
**30 in-lb (3.4 Nm)**
  - 1/2 - 1 1/2" Valves:  
**75 in-lb (8.5 Nm)**
  - 2" Valves:  
**155 in-lb (17.5 Nm)**

## METAL SPRING HOUSING



**12**

Prior to installation, apply Moly Dee lube or equivalent to adjustment screw ⑩ to prevent galling.



**13**

Insert adjustment screw ⑩ into threaded bore of spring housing ⑨. Using a large flat head screwdriver, turn adjustment screw until flush with spring housing. Continue turning adjustment screw until proper spring compression is achieved (depth measured or number of complete rotations counted during disassembly).



**14**

Replace spring housing cover ⑪.

## Troubleshooting

### Insufficient Flow Through Valve

- Improperly sized valve (too small for application).
- Debris in flow path restricting flow.

### Valve Not Operating

- Spring set pressure adjusted too high. Fluid pressure is not able to overcome the force provided by the spring, which prevents the valve from opening.
- Debris in flow path restricting flow.

### Valve Not Closing

- Spring set pressure is adjusted too low, which does not provide enough spring force for the diaphragm to create a proper seal.
- Crystallized media or debris around valve seat preventing diaphragm from completely seating.
- Damaged valve seat or diaphragm preventing proper seal.

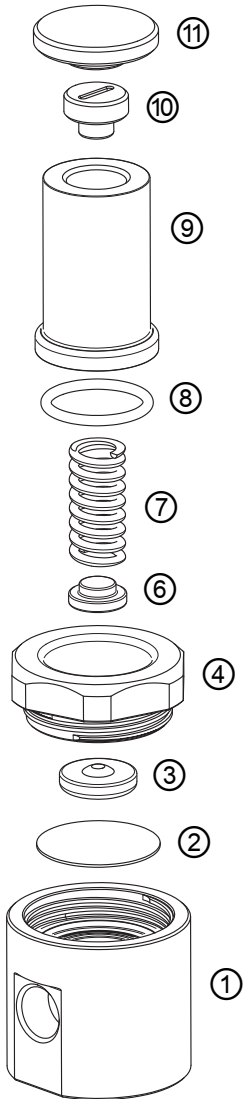
### Valve Leaking at Spring Housing

- Fasteners not tightened properly. Under-tightened fasteners can provide insufficient force for diaphragm seal. Over-tightened fasteners can warp or damage components causing a leak.
- Damaged diaphragm or sealing O-ring.

### Erratic Operation

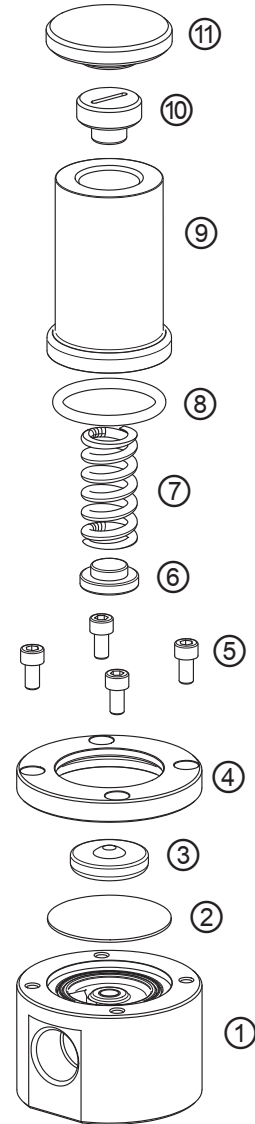
- Discharge piping not properly sized (oversized for small pump, undersized for larger pump).
- No line pressure or vacuum downstream of back pressure valve.
- Excessive air in discharge line.

## Plastic Valve



- ① Valve Body
- ② Diaphragm
- ③ Spring Seat
- ④ Bolt/Threaded Ring
- ⑤ Fasteners
- ⑥ Spring Seat Pivot
- ⑦ Spring
- ⑧ Diaphragm O-Ring
- ⑨ Spring Housing
- ⑩ Adjustment Screw
- ⑪ Cover

## Metal Valve



## Manufacturer's Limited Warranty & Return Policy

Detailed information regarding warranty terms and conditions, warranty claims and new product returns available at [Blacoh.com](http://Blacoh.com).

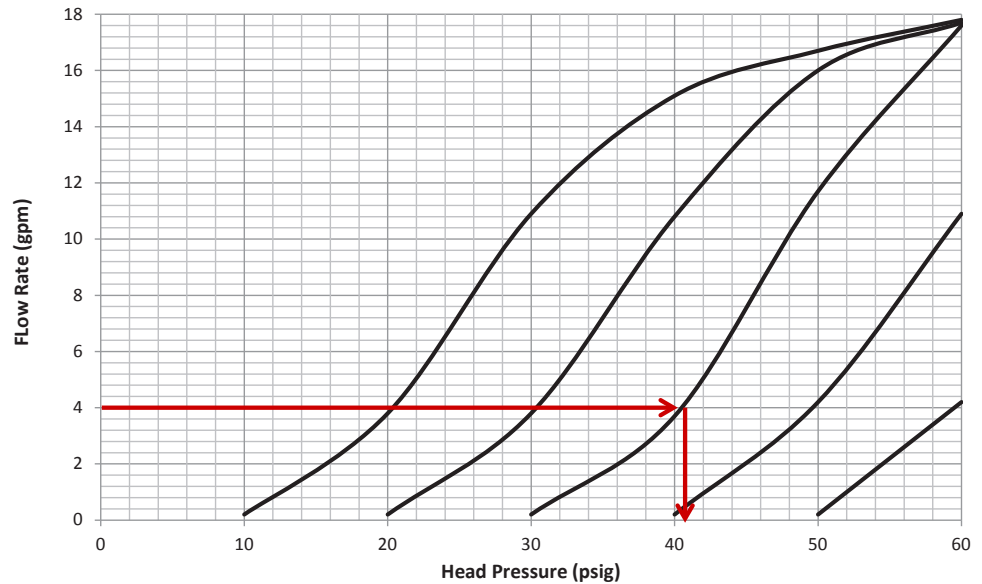
## Valve Performance Charts

Performance charts can be used to properly size and estimate the performance of Blacoh back pressure and pressure relief valves. Each curve on the chart represents a valve set pressure. The set pressure, which is measured in pounds per square inch, is the pressure at which the valve opens and allows fluid to flow through it.

The sample chart below shows set pressure curves for 10 to 60 psig. The horizontal axis on the chart indicates the head pressure drop across the valve. The vertical axis indicates the flow through the valve. As the flow through the valve increases so does the pressure drop across the valve.

To determine the pressure drop across a valve at a specific flow rate, follow the flow rate line horizontally until it intersects the set pressure curve for the valve. The pressure drop across the valve is found by dropping straight down to the horizontal head pressure axis.

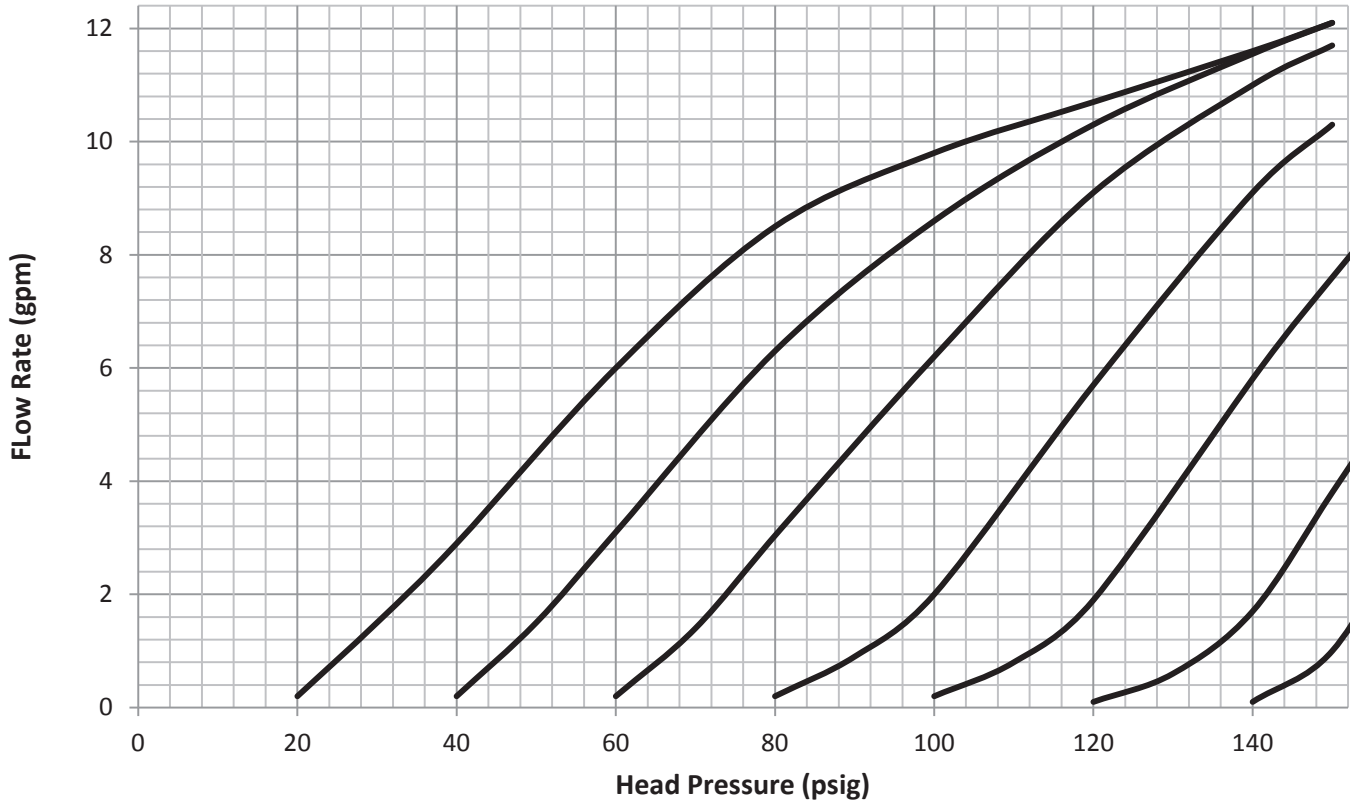
*In this sample chart, if the flow rate of a metering pump is 4 gpm and the set pressure for the valve in the system is 30 psig, the pressure drop across the valve when the pump is running will be 41 psig.*



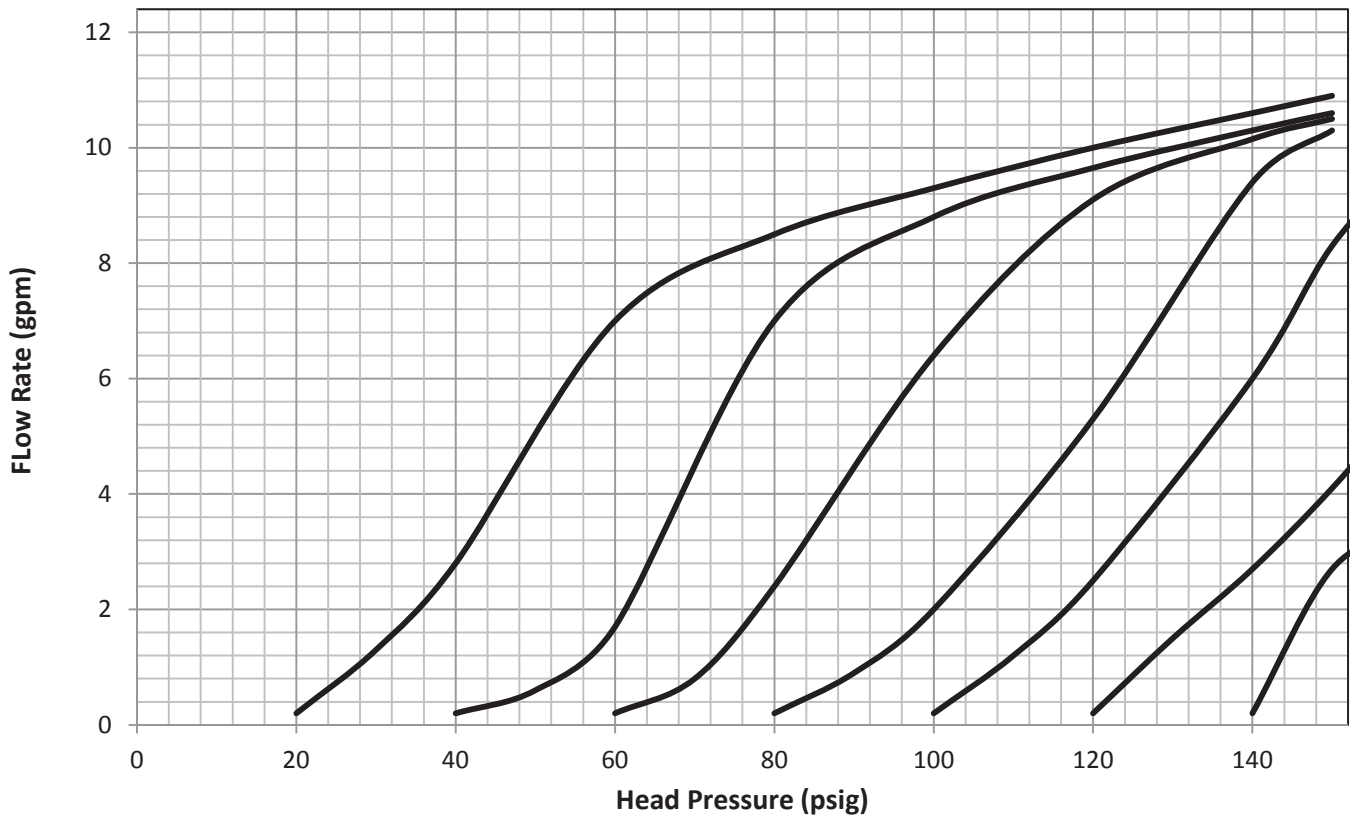
The set pressure can be adjusted by removing the spring housing cover and turning the adjustment screw. Turning the adjustment screw clockwise increases the set pressure. Turning the adjustment screw counterclockwise reduces the set pressure. Refer to the Installation & Operation Manual for detailed instructions.

## Back Pressure Valves 1/4" – 1/2" Mini

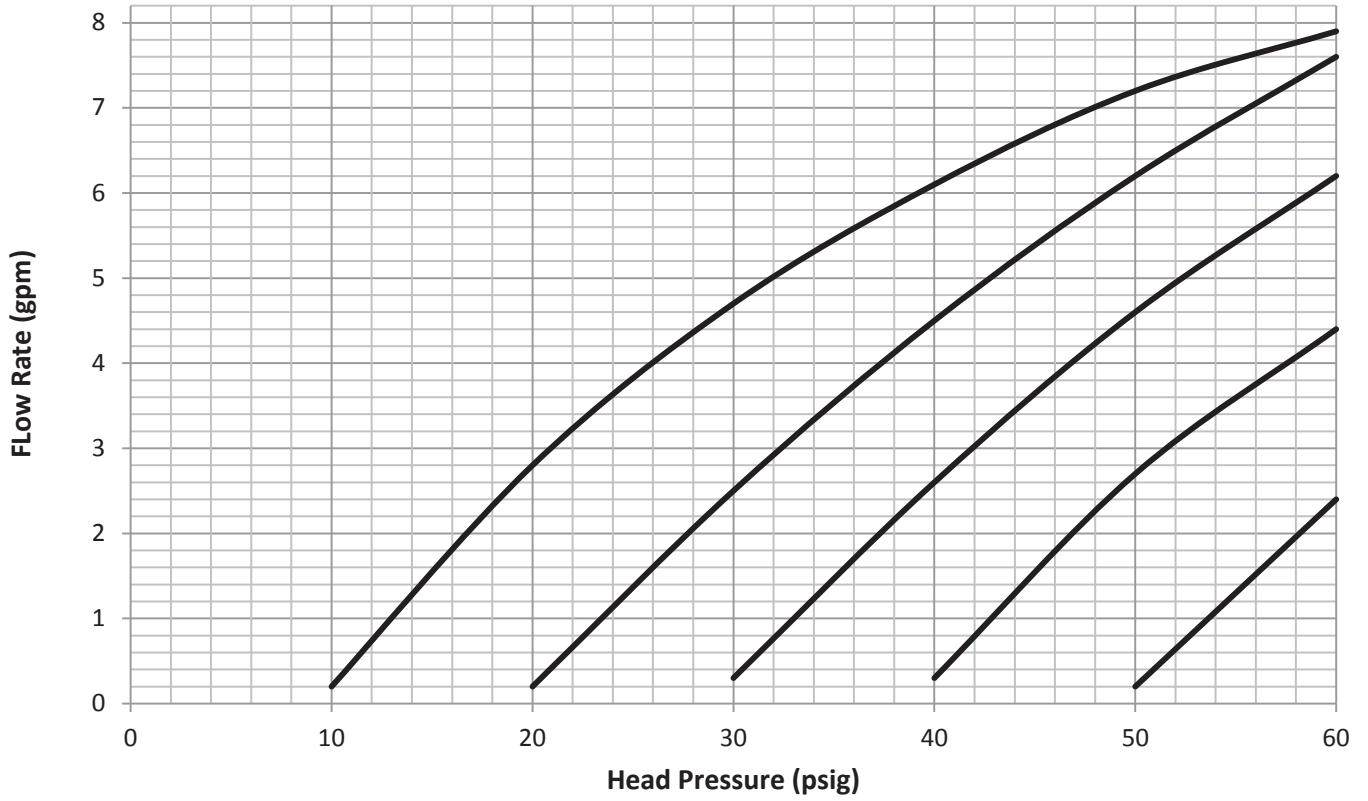
1/4" – 1/2" Back Pressure Valve, 5-150 PSI Spring, PTFE Diaphragm



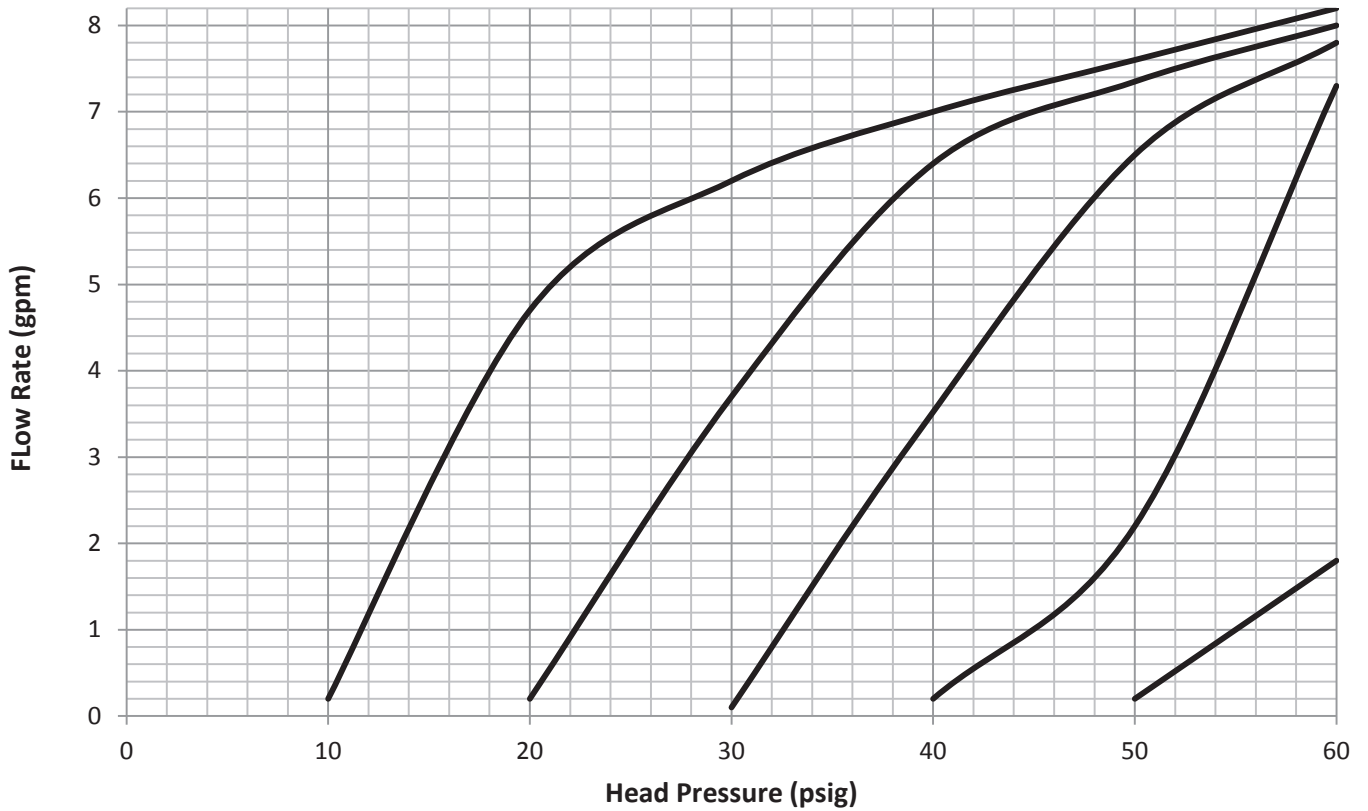
1/4" – 1/2" Back Pressure Valve, 5-150 PSI Spring, Elastomer Diaphragm



1/4" – 1/2" Back Pressure Valve, 5-50 PSI Spring, PTFE Diaphragm

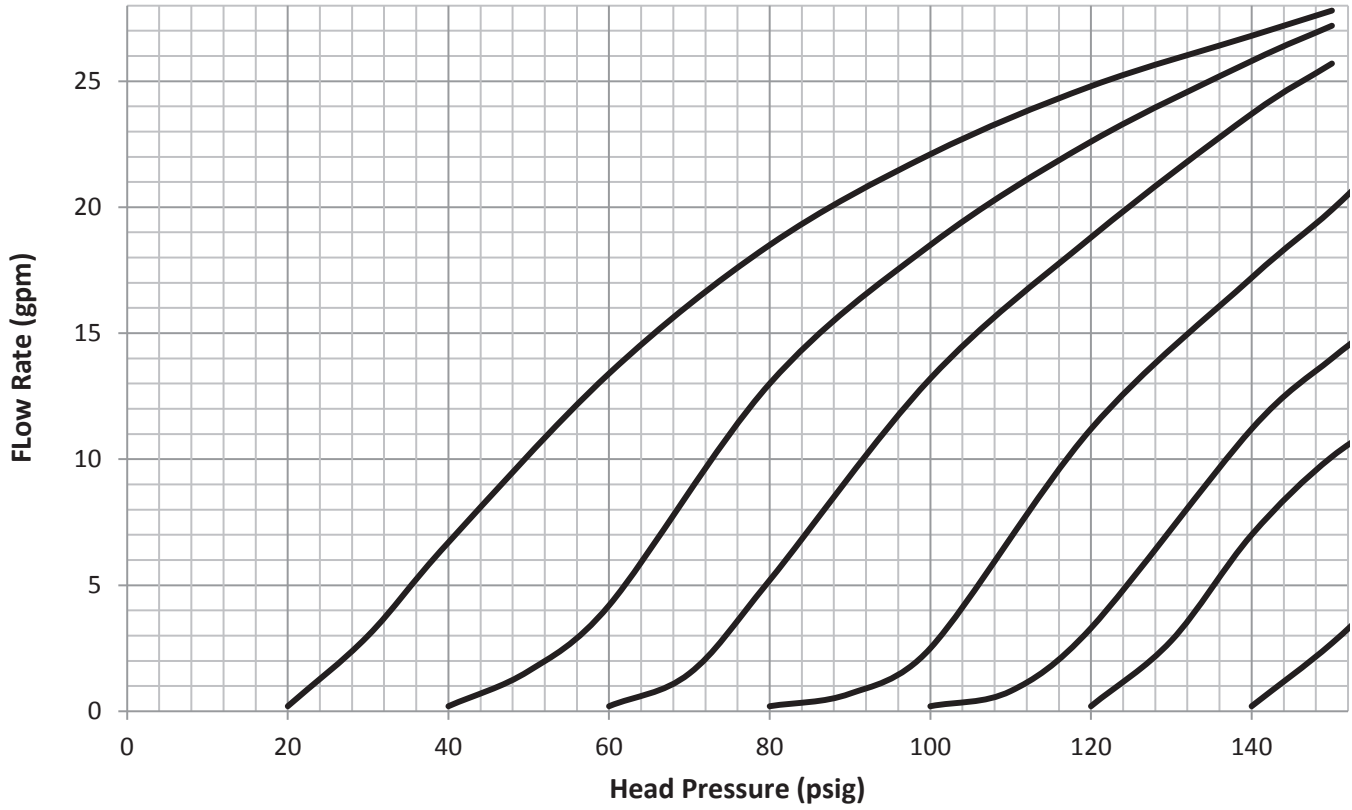


1/4" – 1/2" Back Pressure Valve, 5-50 PSI Spring, Elastomer Diaphragm

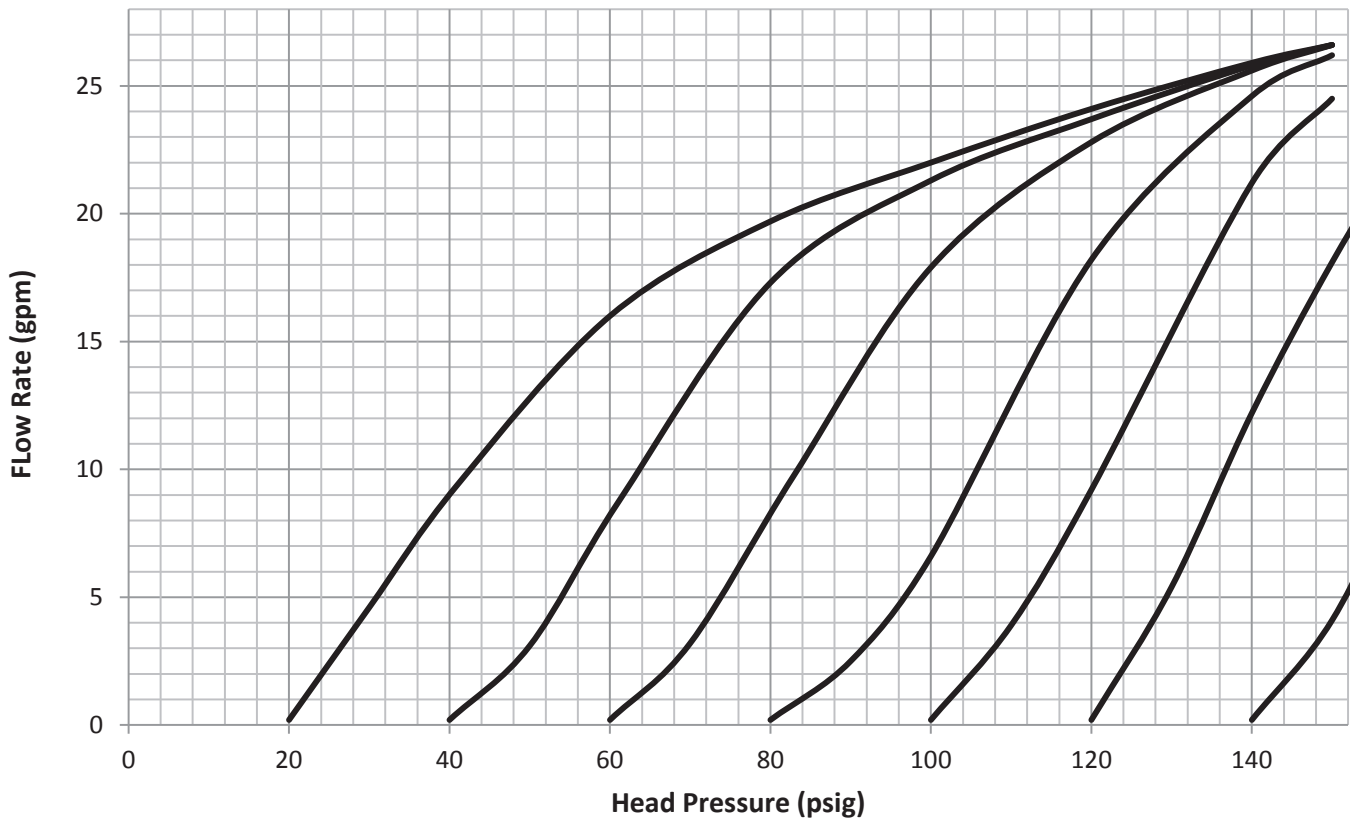


## Pressure Relief Valves 1/4" – 1/2" Mini

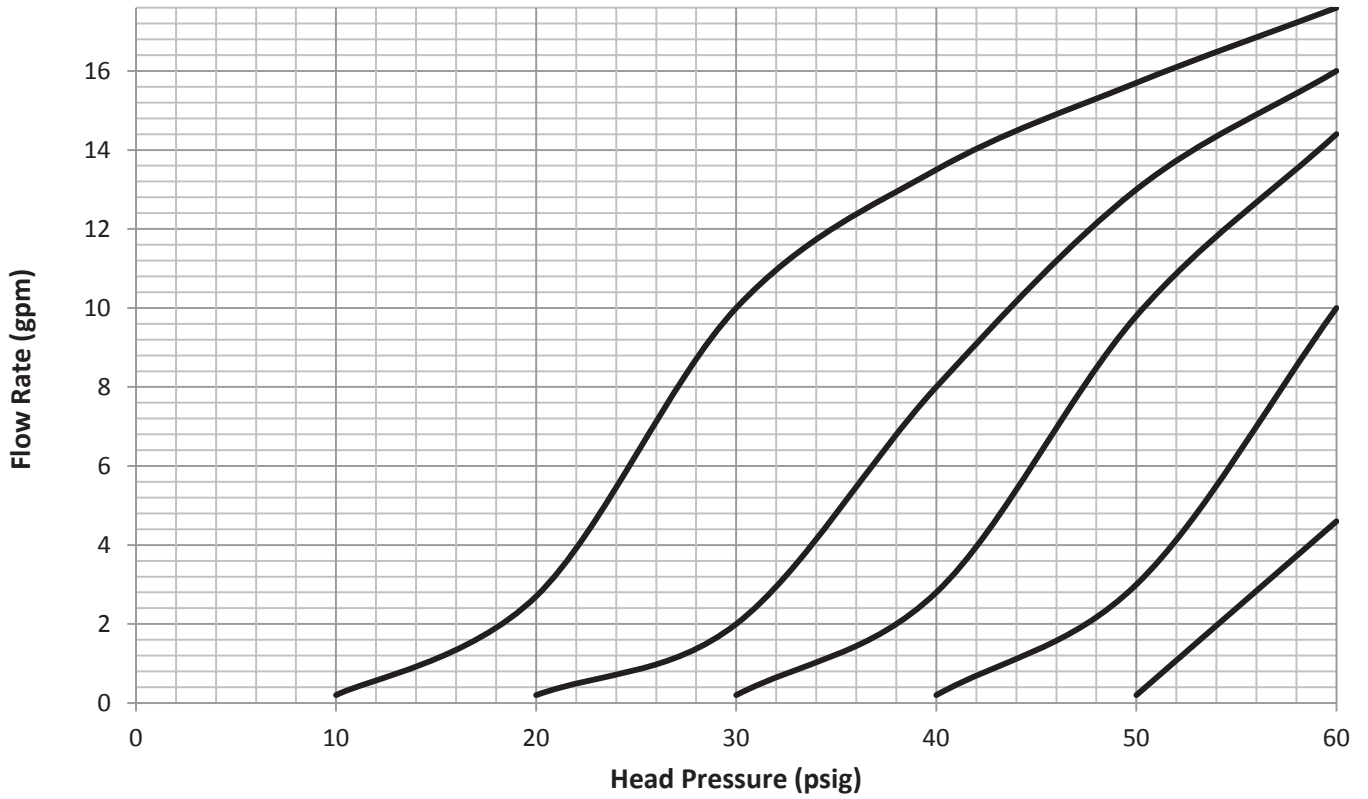
1/4" – 1/2" Pressure Relief Valve, 5-150 PSI Spring, PTFE Diaphragm



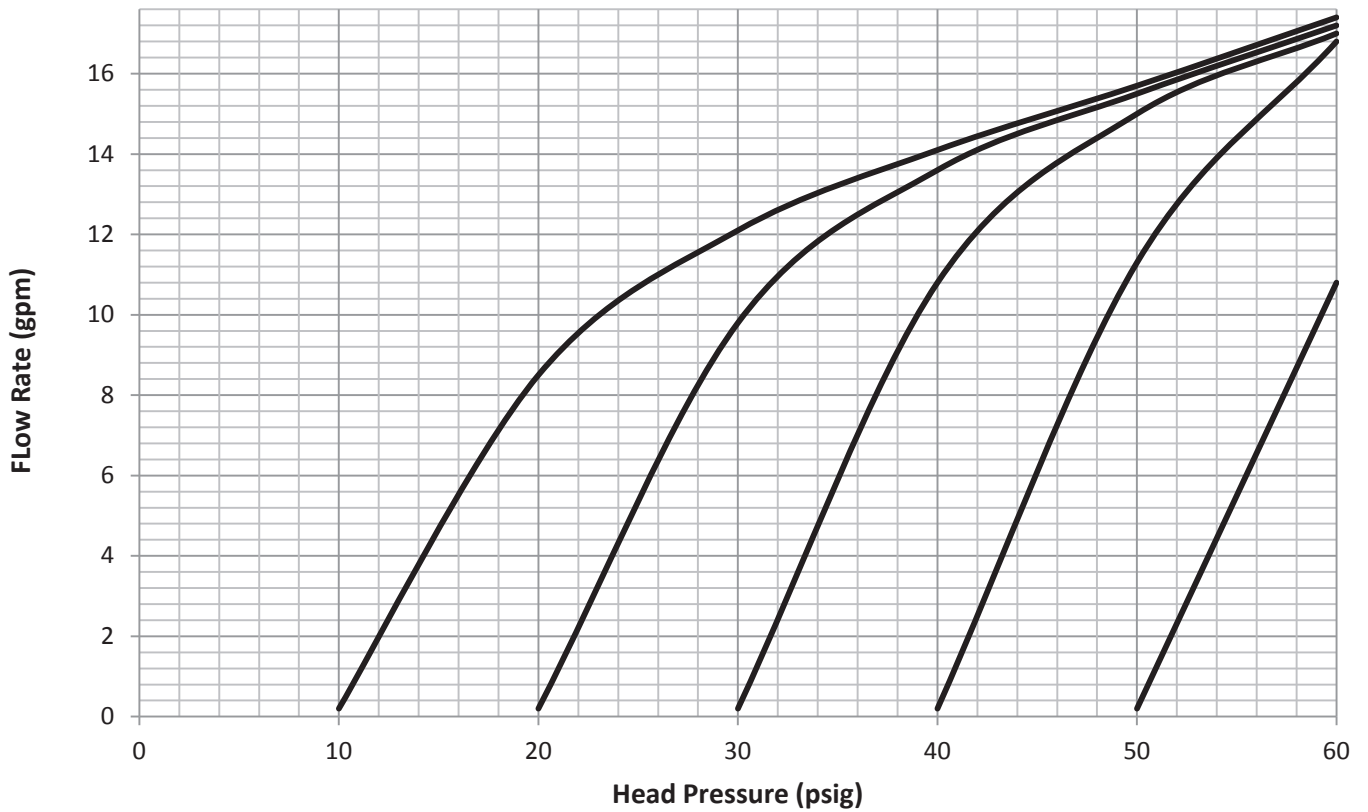
1/4" – 1/2" Pressure Relief Valve, 5-150 PSI Spring, Rubber Diaphragm



1/4" – 1/2" Pressure Relief Valve, 5-50 PSI Spring, PTFE Diaphragm

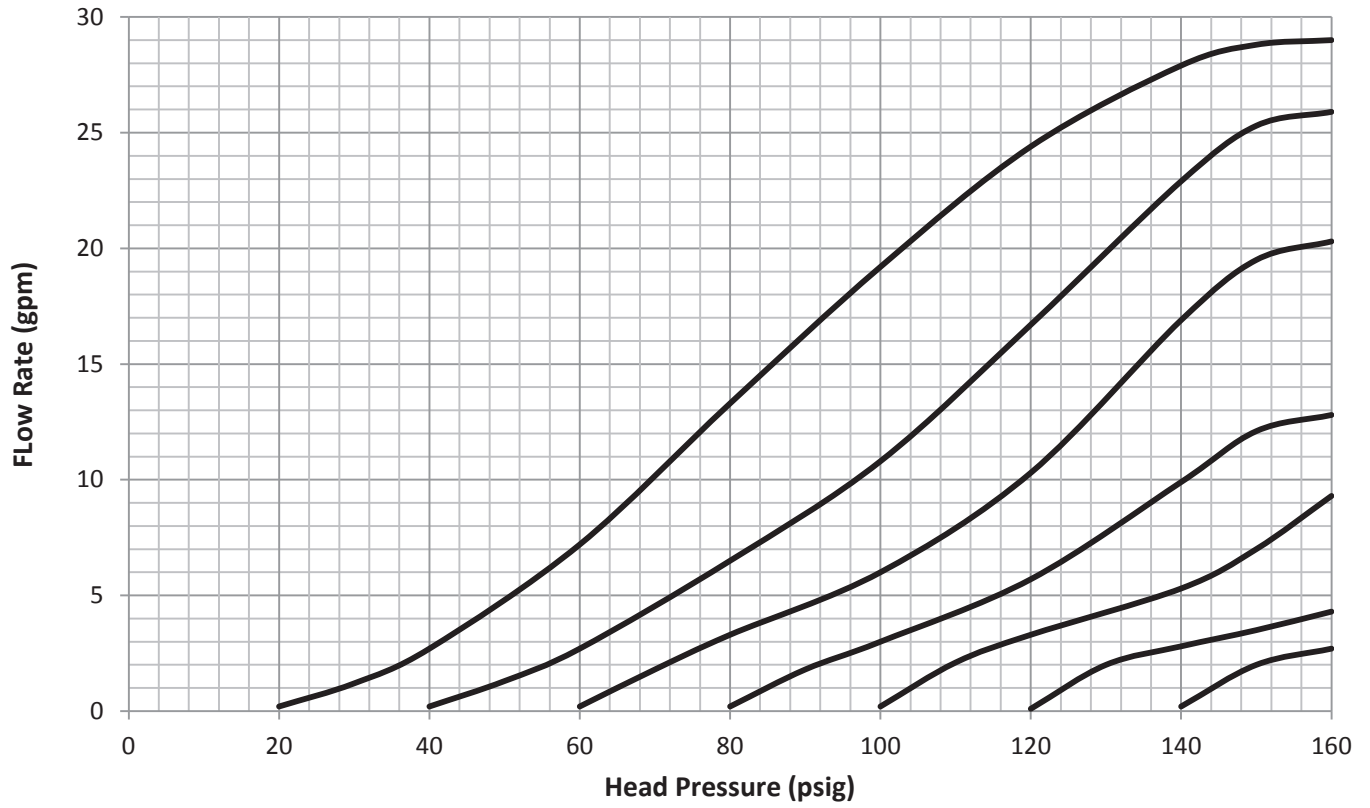


1/4" – 1/2" Pressure Relief Valve, 5-50 PSI Spring, Elastomer Diaphragm

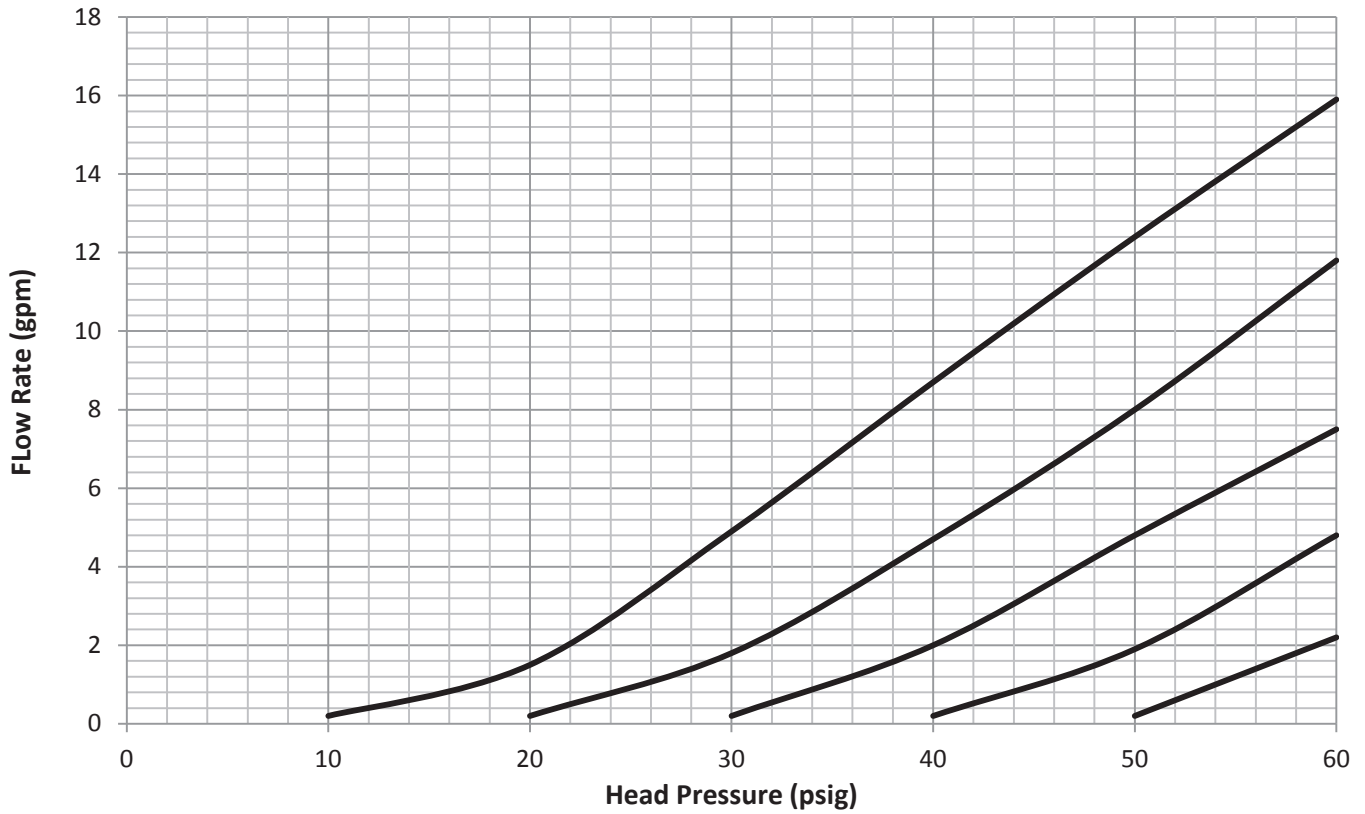


# Back Pressure Valves 1"

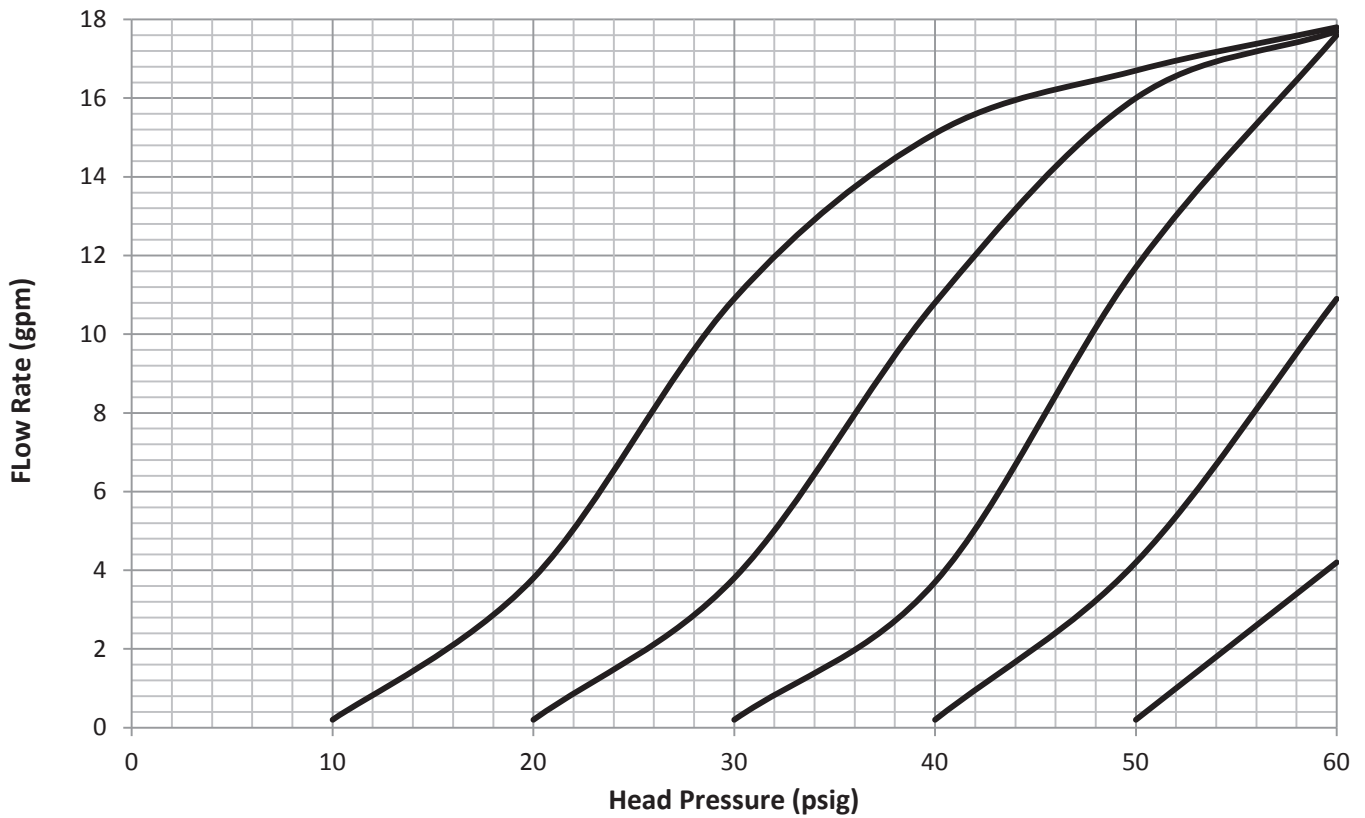
1" Back Pressure Valve, 5-150 PSI Spring, PTFE Diaphragm



1" Back Pressure Valve, 5-50 PSI Spring, PTFE Diaphragm

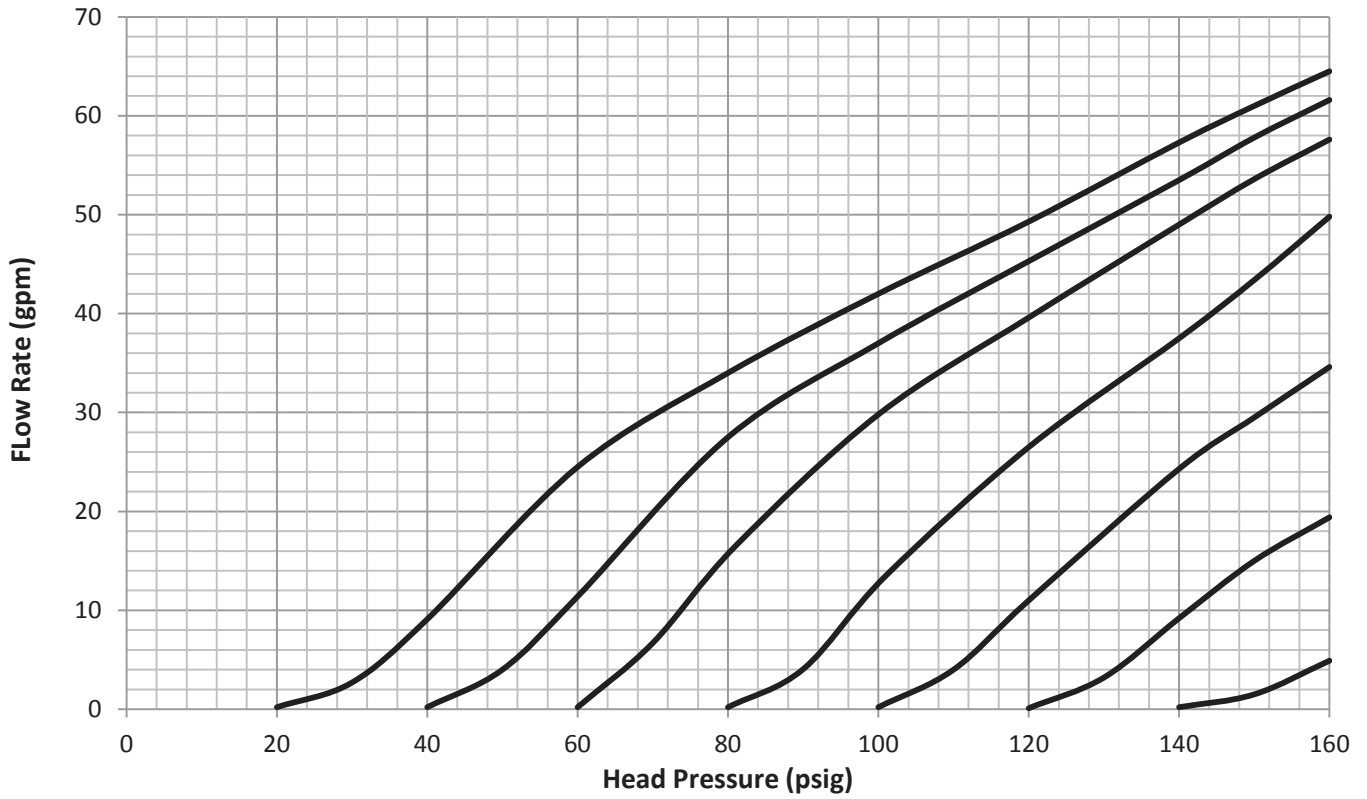


1" Back Pressure Valve, 5-50 PSI Spring, Rubber Diaphragm

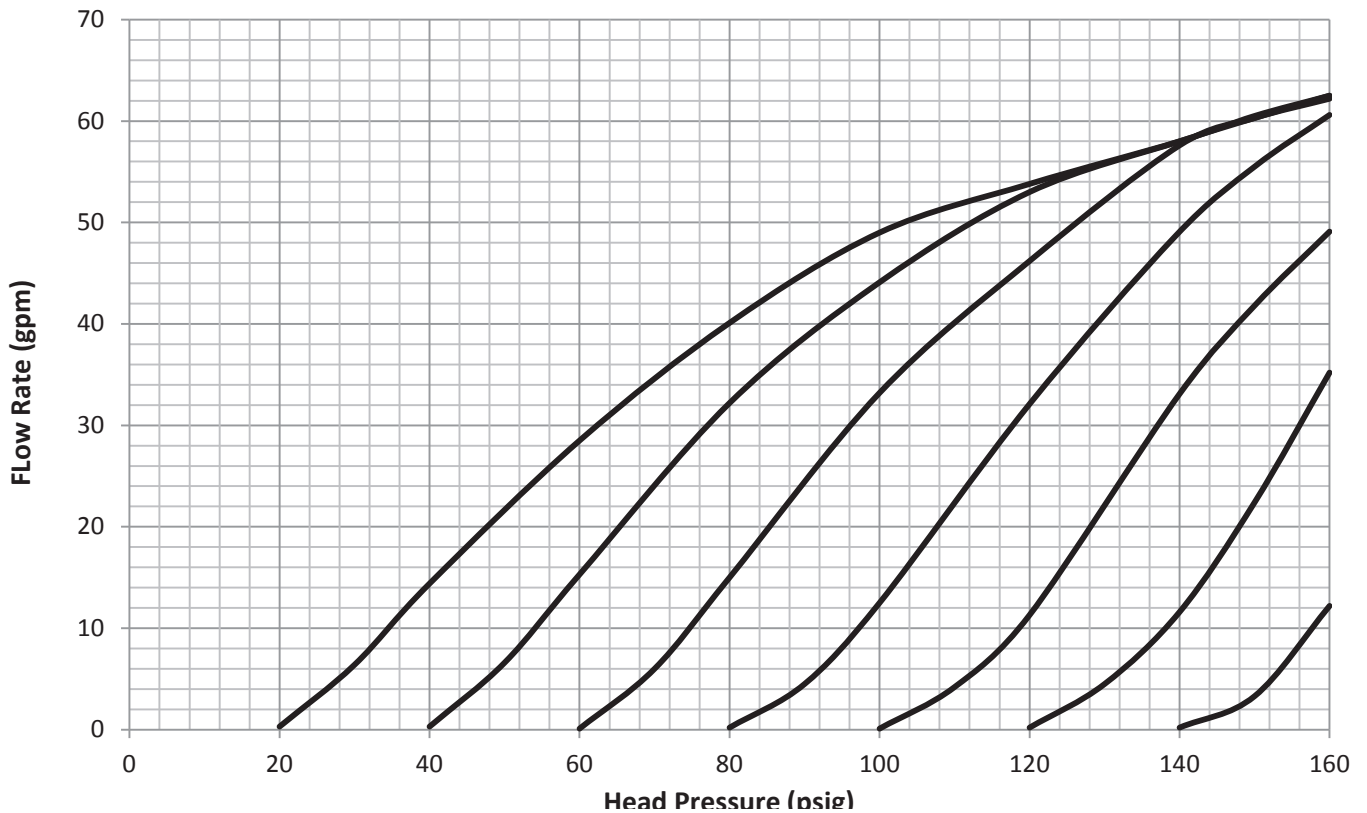


# Pressure Relief Valves 1"

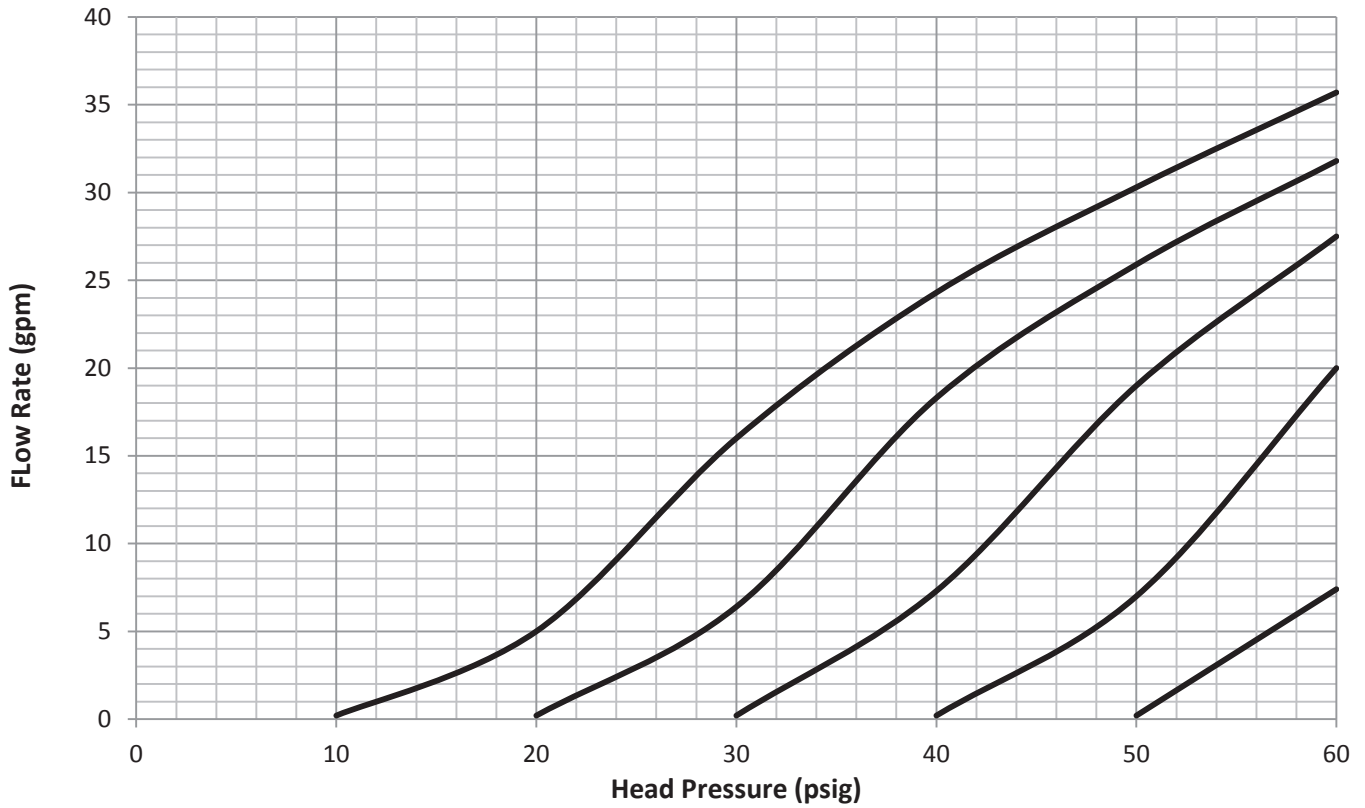
1" Pressure Relief Valve, 5-150 PSI Spring, PTFE Diaphragm



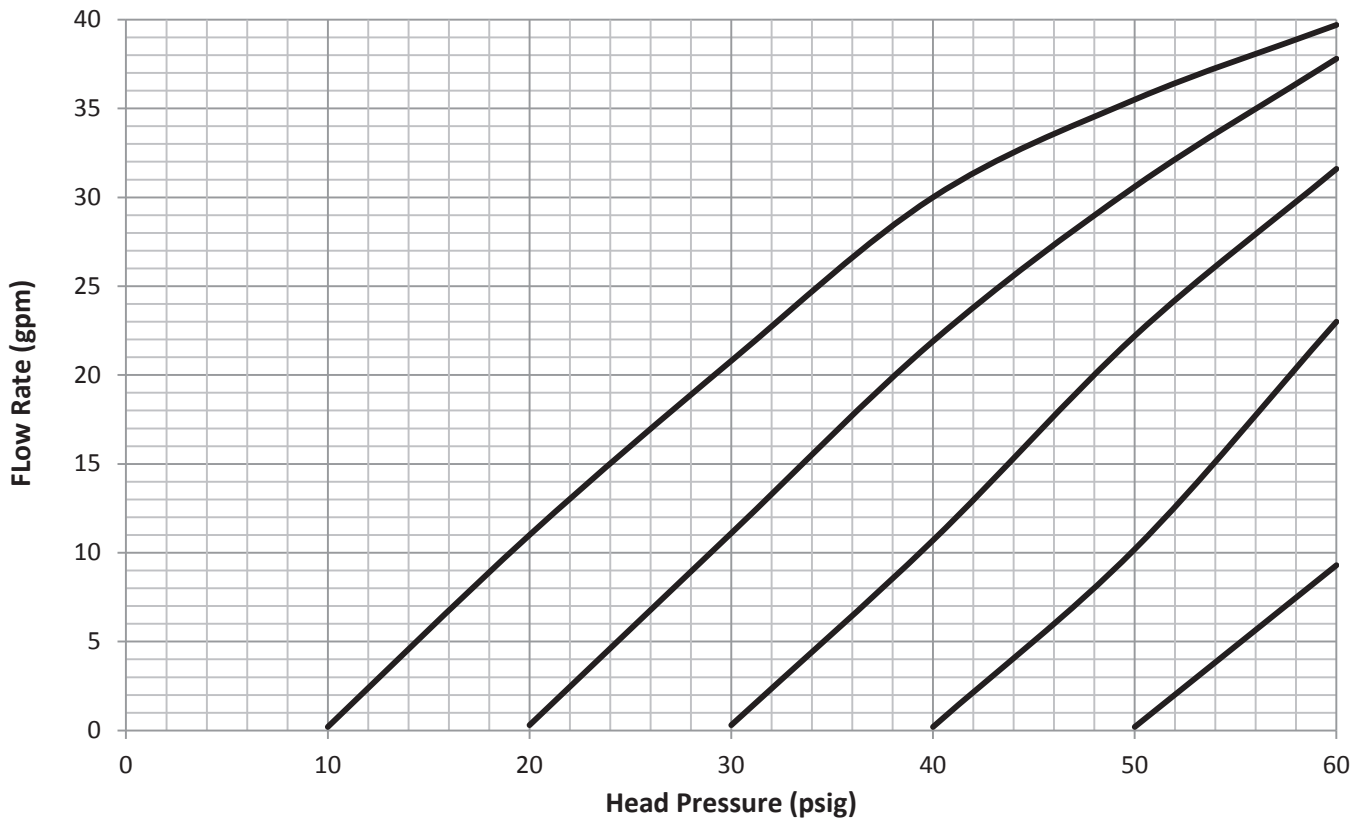
1" Pressure Relief Valve, 5-150 PSI Spring, Elastomer Diaphragm



1" Pressure Relief Valve, 5-50 PSI Spring, PTFE Diaphragm

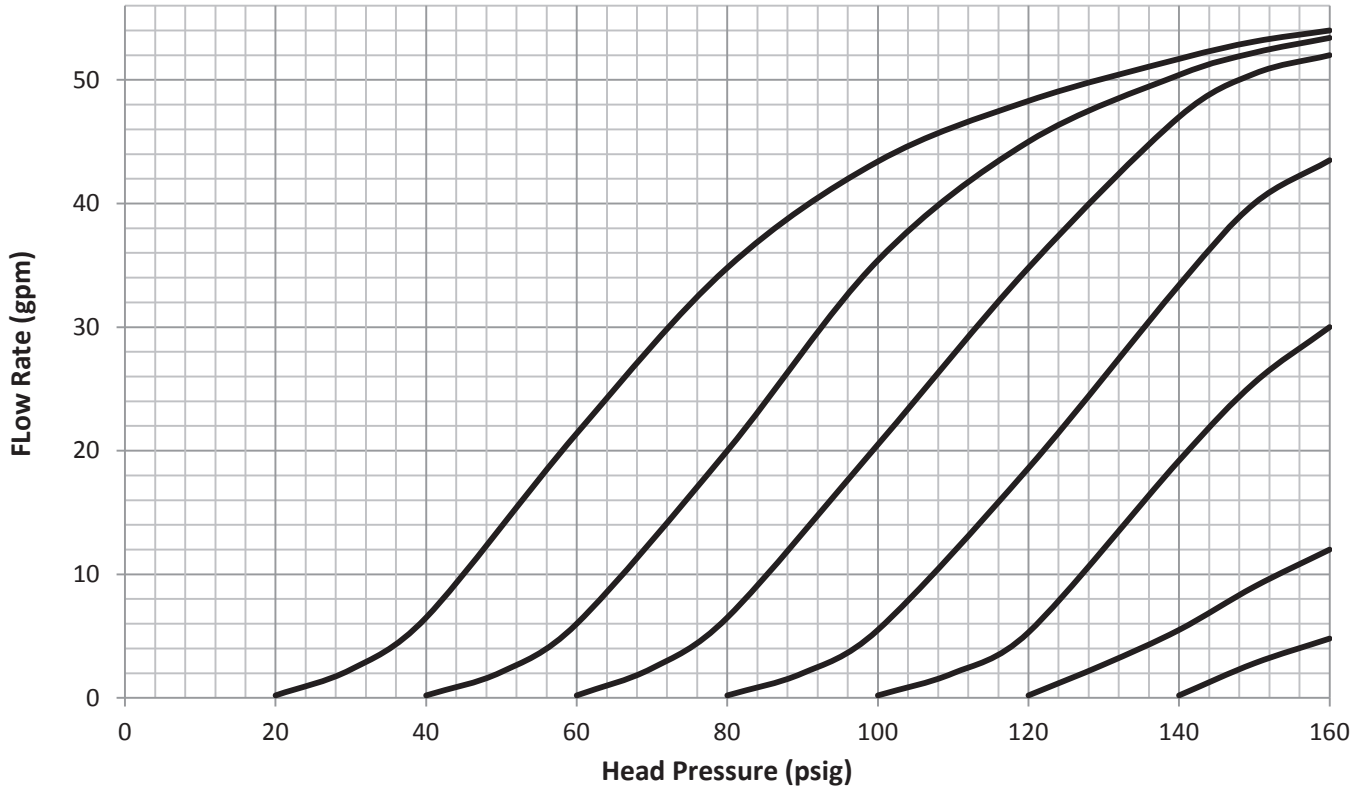


1" Pressure Relief Valve, 5-50 PSI Spring, Rubber Diaphragm

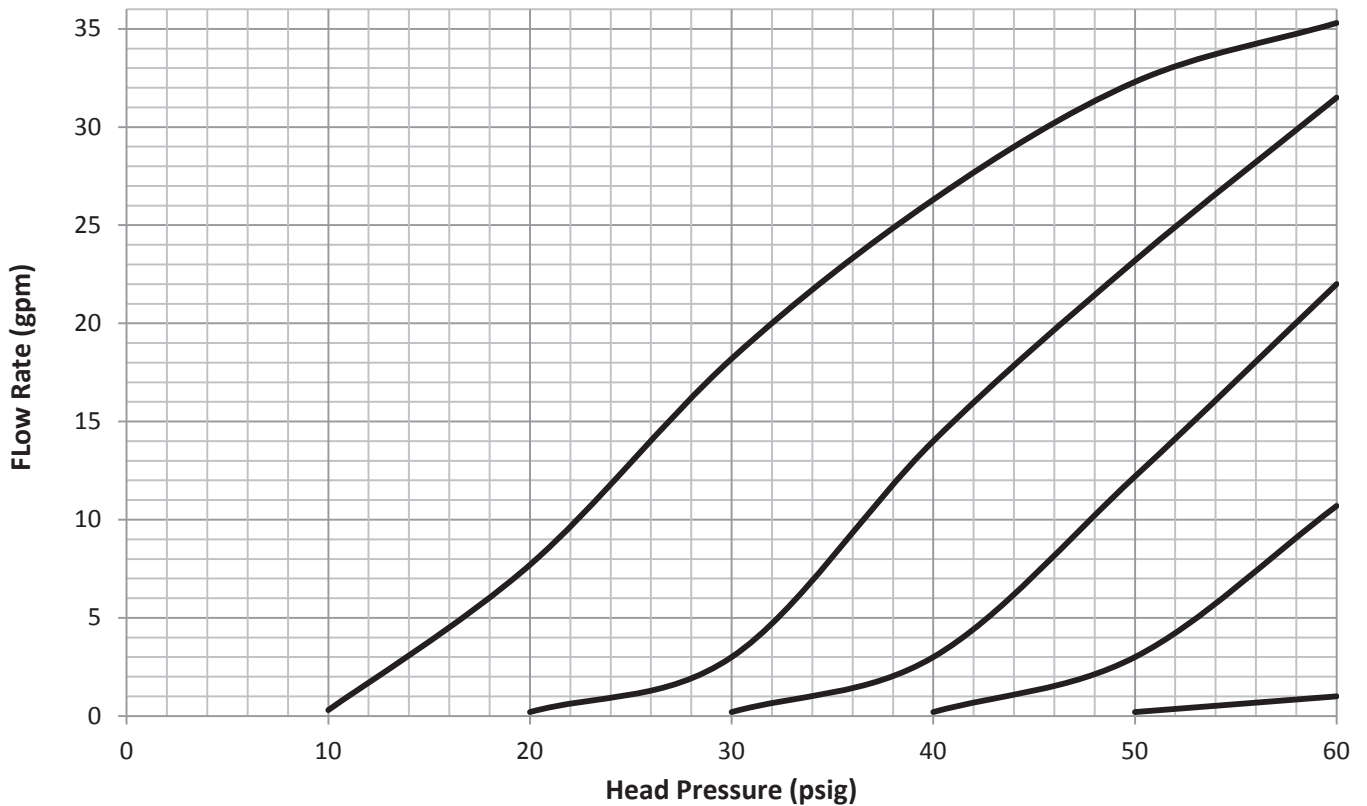


## Back Pressure Valves 1-1/2"

1-1/2" Back Pressure Valve, 5-150 PSI Spring, PTFE Diaphragm

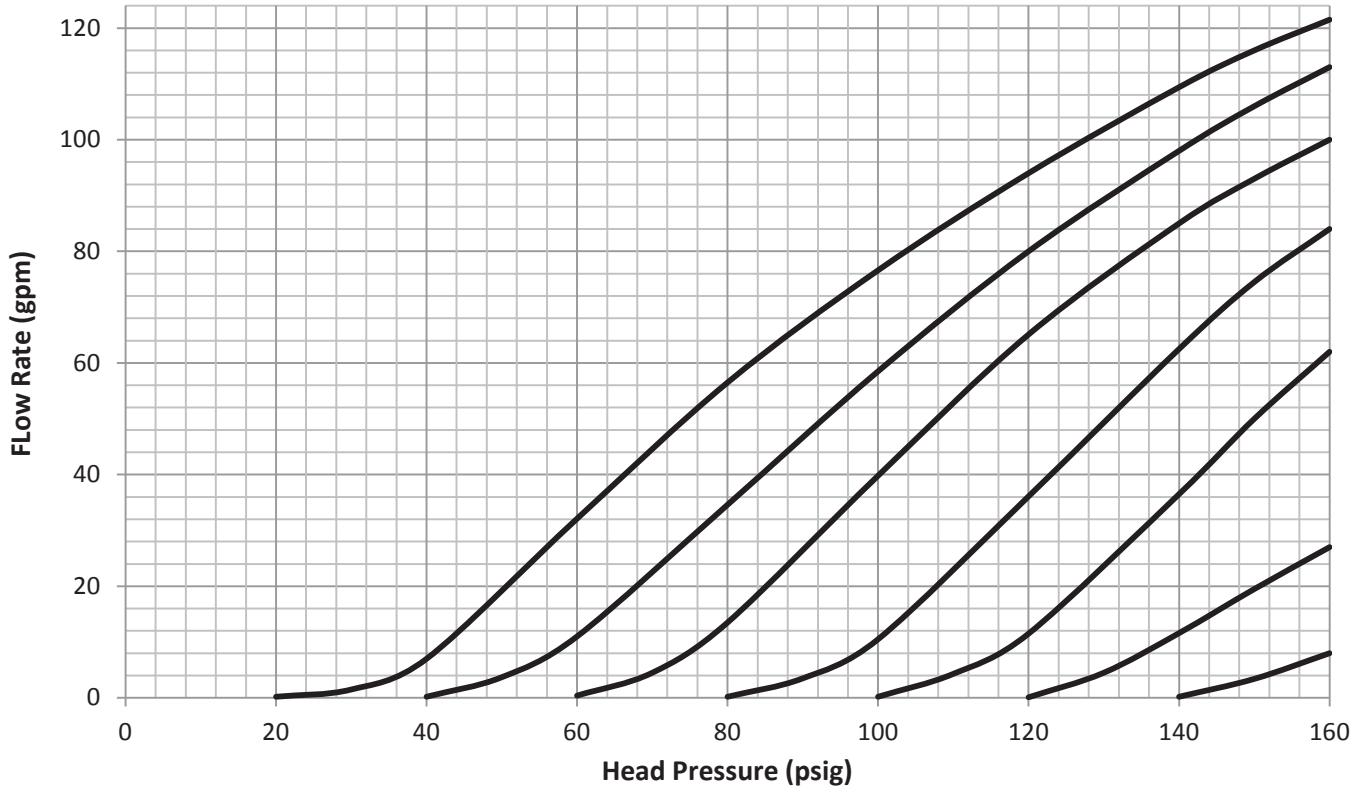


1-1/2" Back Pressure Valve, 5-50 PSI Spring, PTFE Diaphragm

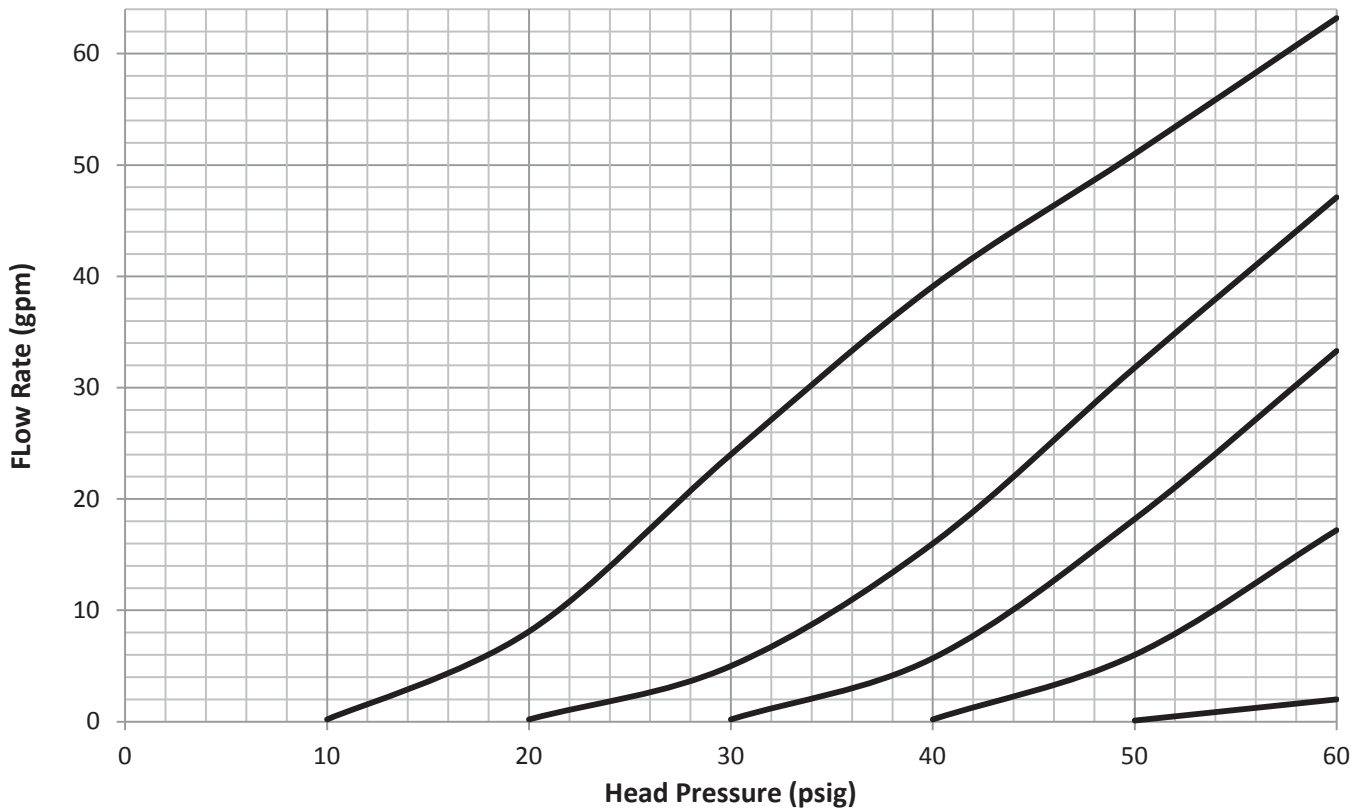


## Pressure Relief Valves 1-1/2"

1-1/2" Pressure Relief Valve, 5-150 PSI Spring, PTFE Diaphragm

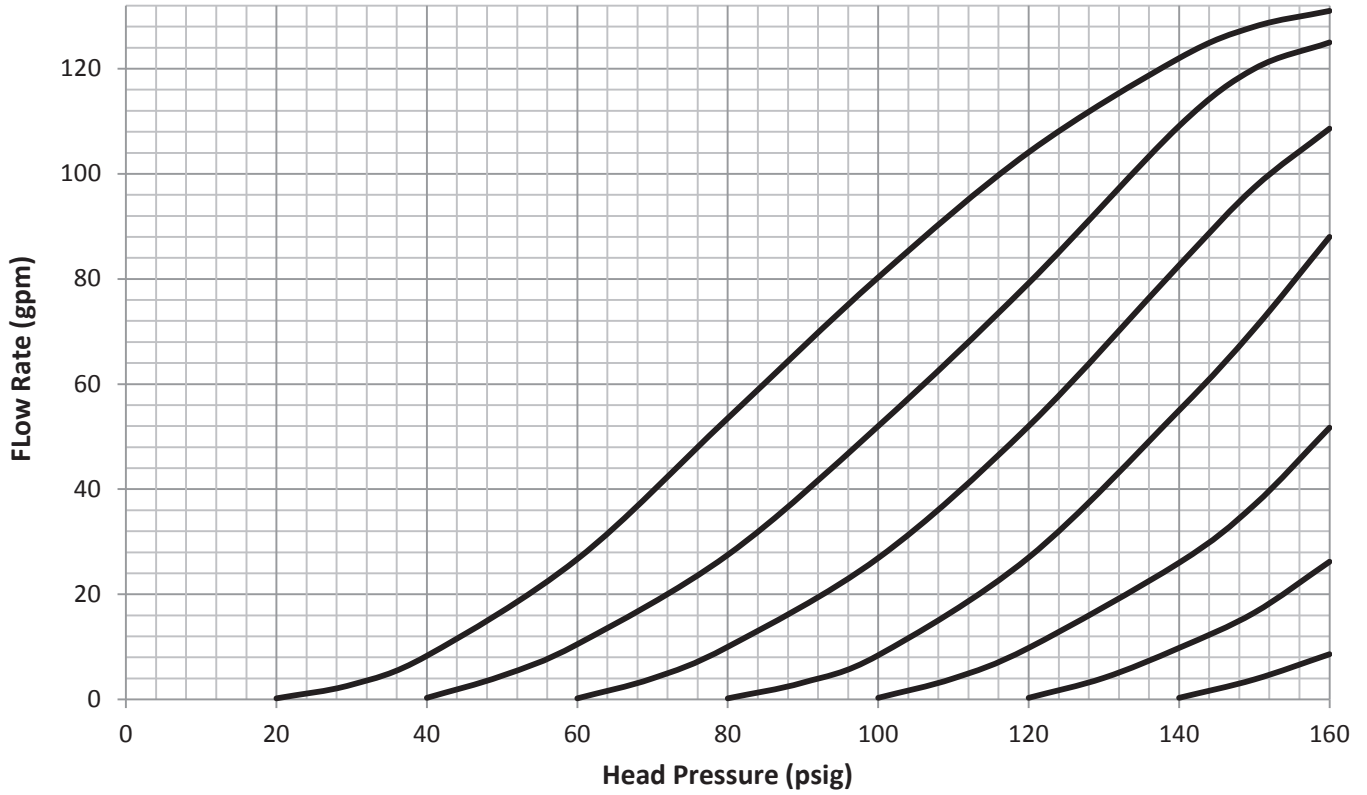


1-1/2" Pressure Relief Valve, 5-50 PSI Spring, PTFE Diaphragm

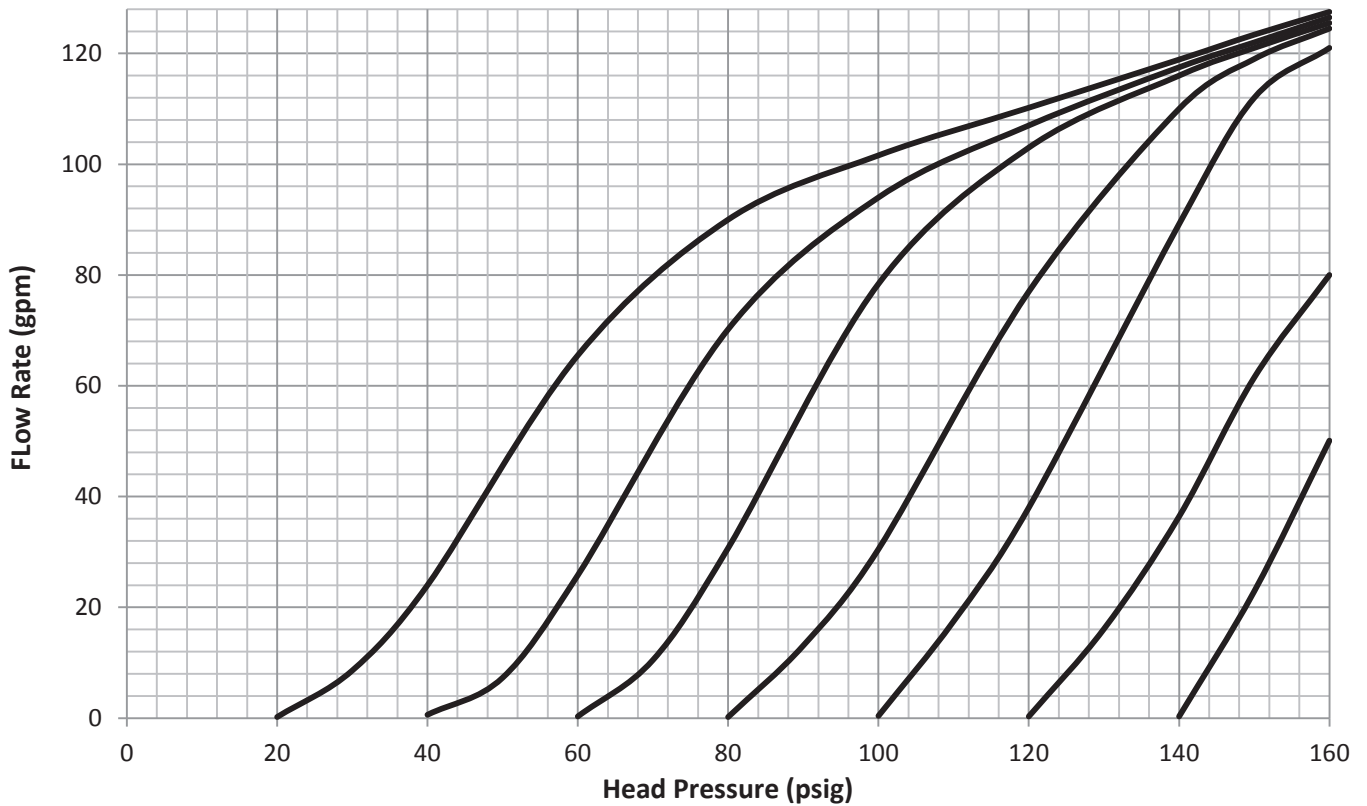


## Back Pressure Valves 2"

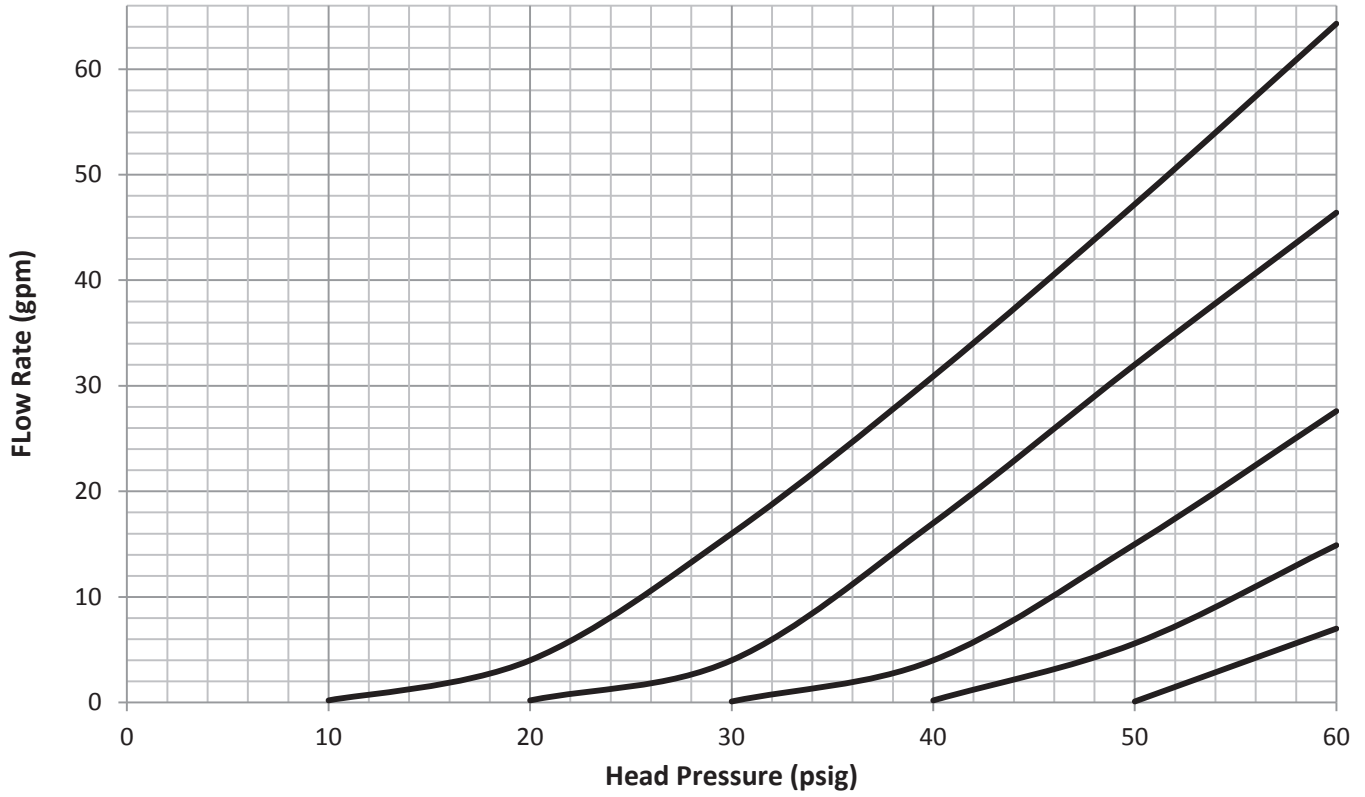
2" Back Pressure Valve, 5-150 PSI Spring, PTFE Diaphragm



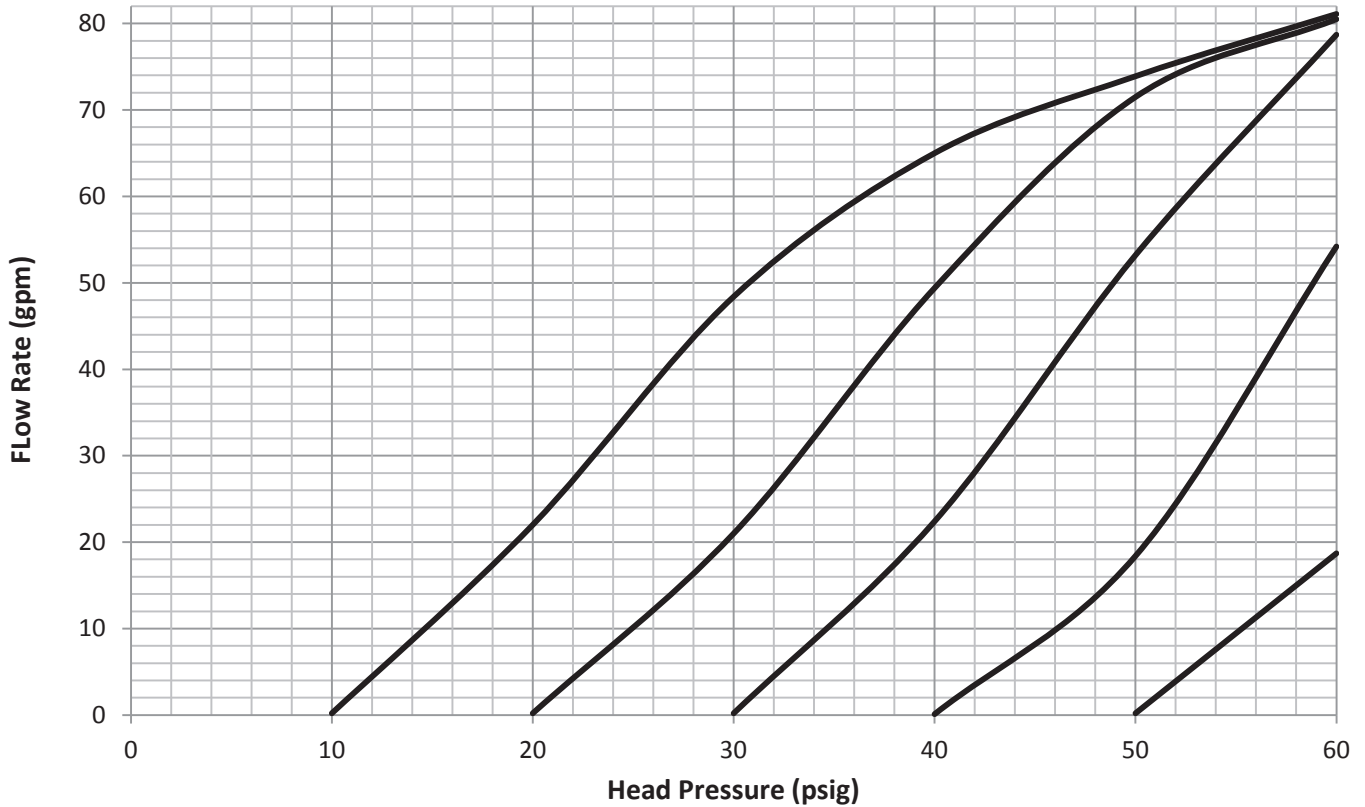
2" Back Pressure Valve, 5-150 PSI Spring, Rubber Diaphragm



2" Back Pressure Valve, 5-50 PSI Spring, PTFE Diaphragm

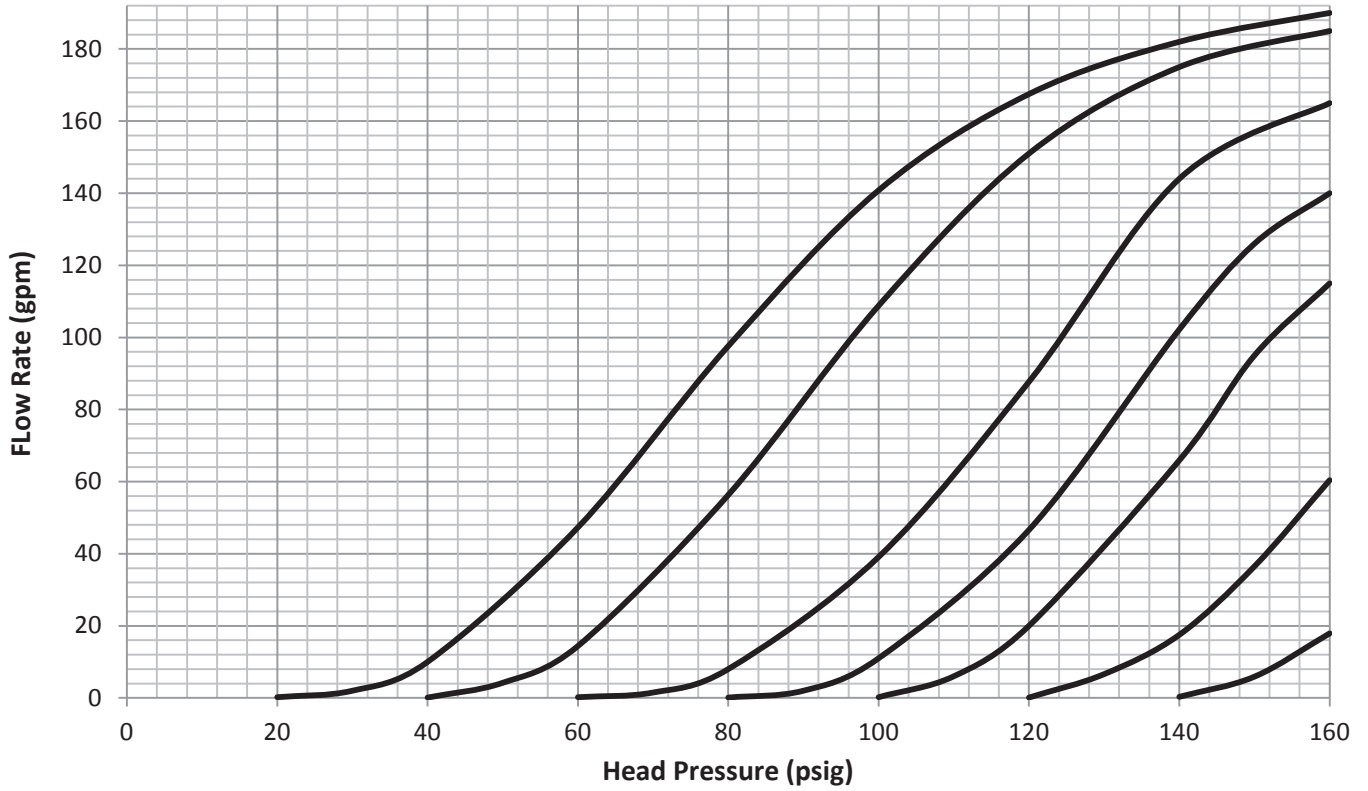


2" Back Pressure Valve, 5-50 PSI Spring, Rubber Diaphragm

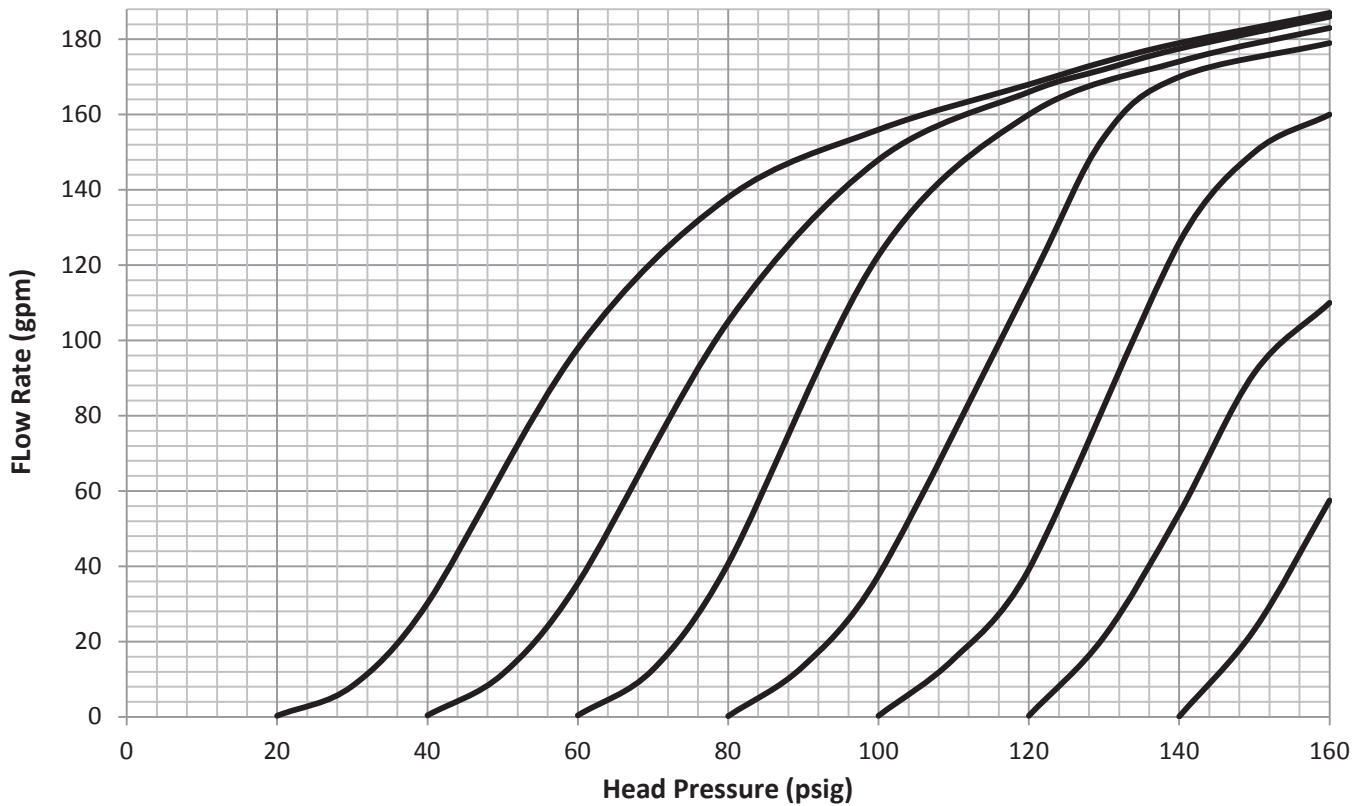


## Pressure Relief Valves 2"

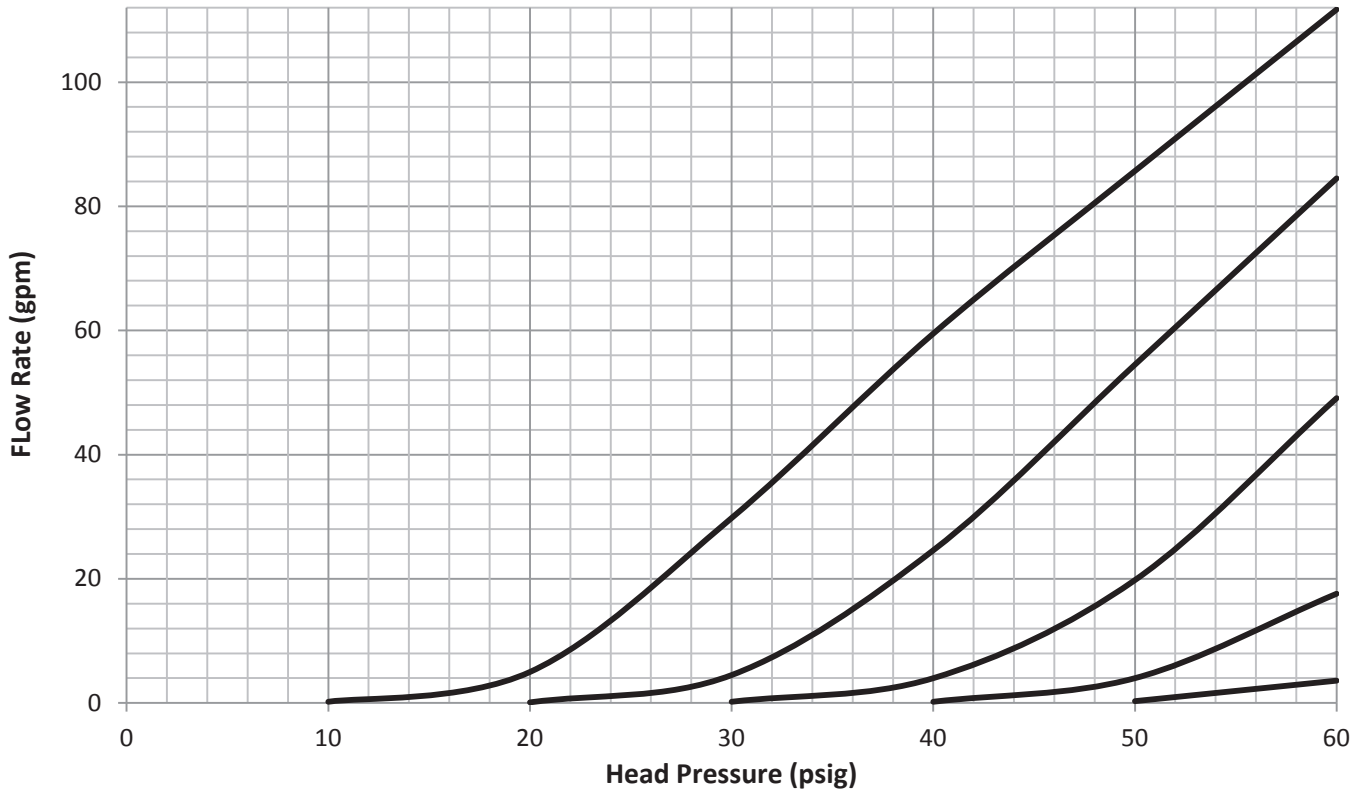
2" Pressure Relief Valve, 5-150 PSI Spring, PTFE Diaphragm



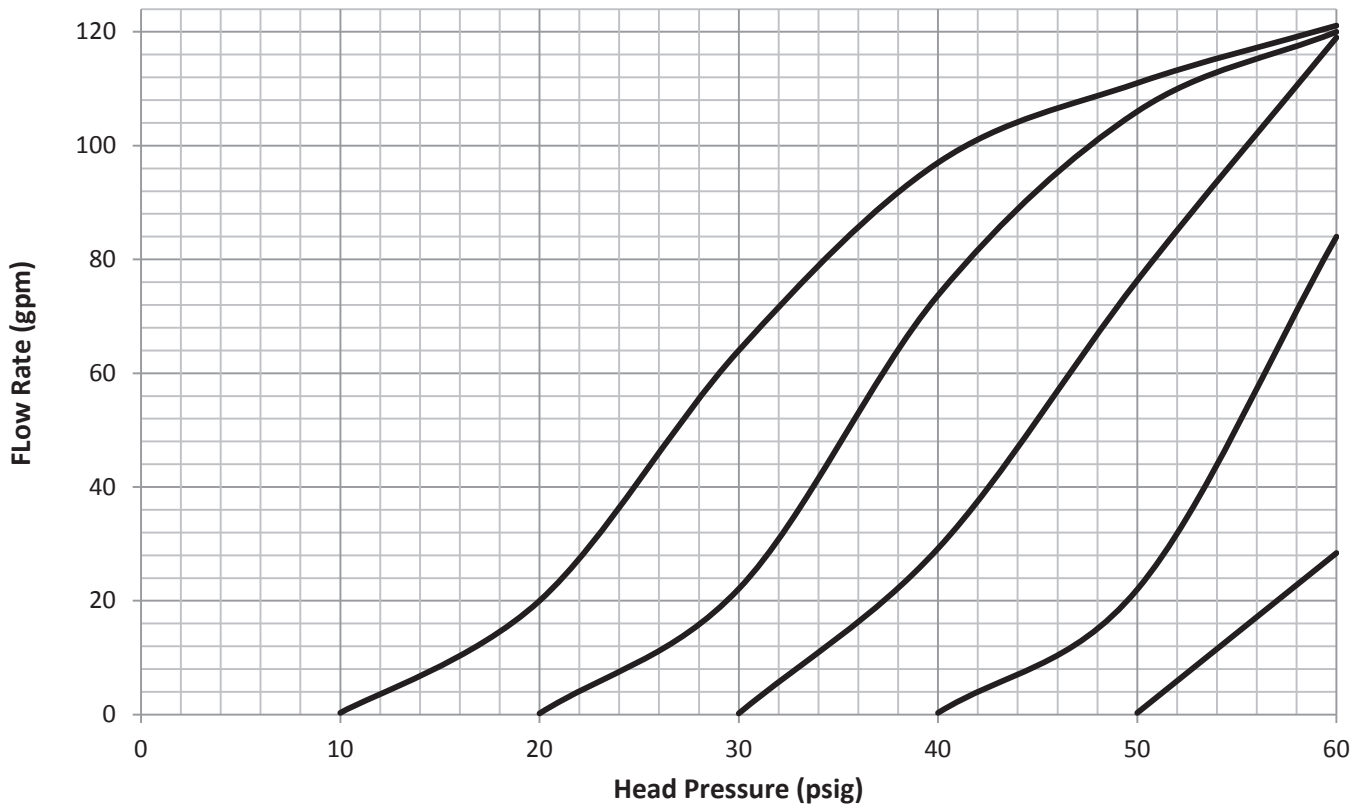
2" Pressure Relief Valve, 5-150 PSI Spring, Rubber Diaphragm



2" Pressure Relief Valve, 5-50 PSI Spring, PTFE Diaphragm



2" Pressure Relief Valve, 5-50 PSI Spring, Rubber Diaphragm



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I N D U S T R I E S



**SENTINEL™**

Diaphragm Seals & Gauge Guards  
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**Blacoh Headquarters – Offices Worldwide**

601 Columbia Ave, Bldg D, Riverside, CA 92507 USA

951.342.3100

[Sales@Blacoh.com](mailto:Sales@Blacoh.com)

[Blacoh.com](http://Blacoh.com)