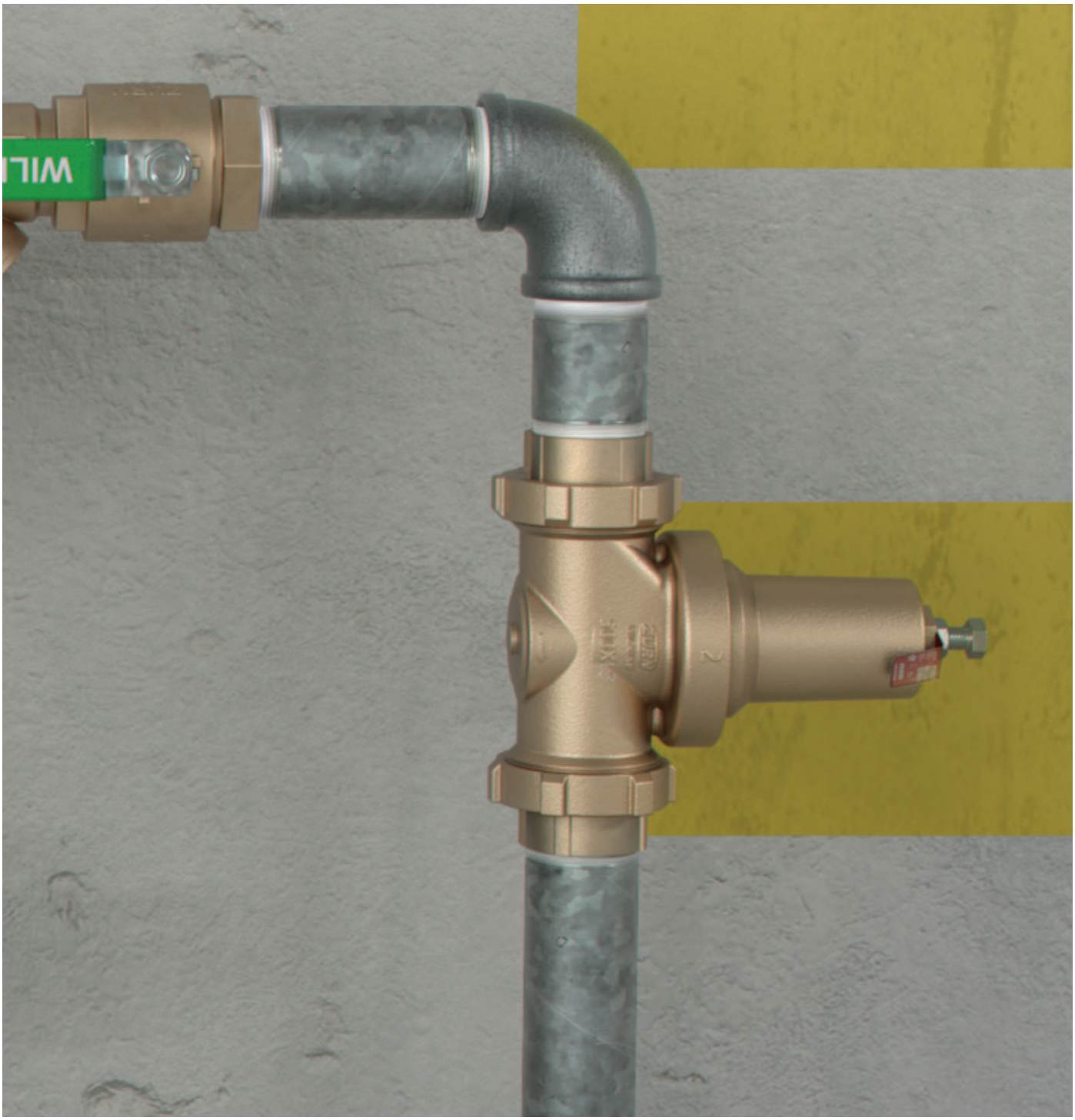
PRV Design Disruption: Delivering Enhanced Performance in a Smaller Package



Demands on commercial and industrial water systems are shifting, but pressure reducing valve design hasn't changed, until now. A patented innovation is modernizing the way PRVs are specified, installed and expected to perform. This white paper explains the concept and benefits of a groundbreaking PRV with the flattest flow curve of any direct-acting PRV on the market. Also included is a guide to proper PRV sizing, configuration and settings based on this PRV innovation.

INTRODUCTION

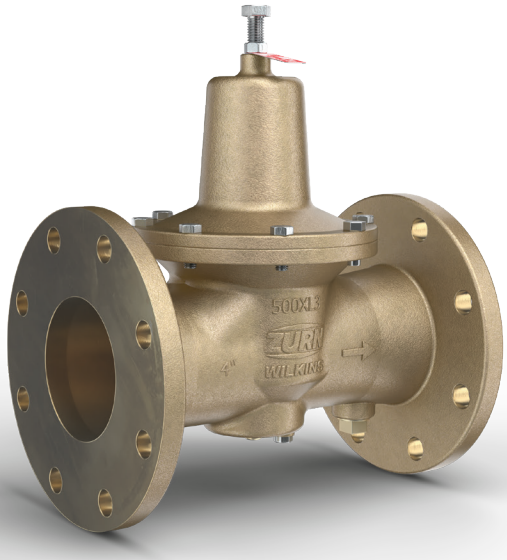
Pressure reducing valves (PRV) have changed very little in the last 100 years. However, today water is a more limited and costly resource, and because PRVs help to reduce water consumption and wastewater volume, it's time for innovation.

Engineers and specifiers designing industrial water lines and commercial systems have had several PRV product types and multiple configuration options to work with, each with its own set of pros and cons. Pilot-operated pressure reducing valves (also called automatic control valves or ACVs) can handle high volume flows but are large and expensive. They can be complex to install and repair and are prone to damage and vandalism. In contrast, direct-acting PRVs have a simple design and are simple to use relative to more complicated pilot-operated valves, but they tend to have greater than desired fall-off pressure. The Zurn Wilkins 500XL3 integrates the simplicity of direct-acting PRVs with the comparable flow performance of pilot-operated valves, offering a fall-off rate that is so low it changes the way PRVs should be specified.

Determining proper PRV sizing and configuration to create the optimal balance of performance and cost for a specific build or renovation is complex and time-consuming. With the Zurn Wilkins 500LX3, pressure fall-off (a drop in set pressure as flow increases) is so low that it is not necessary to increase the valve outlet set pressure to account for pressure loss at high-flow rates. Because this innovation changes the way fall-off should be approached, guidance on proper sizing and configuration with the Zurn Wilkins 500XL3 is provided at the end of this white paper.

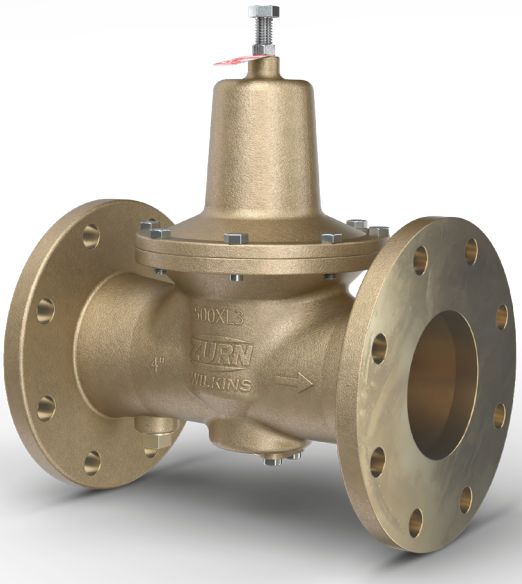
DISRUPTION IN PRV DESIGN

The Zurn Wilkins 500XL3's innovative design delivers best in class performance in a small package. The key is a patented venturi that reduces the sensed pressure during operation to allow the valve to open without a drop in outlet pressure. The 500XL3 nearly matches the performance of an ACV, providing consistent results with high-flow capacity in a smaller, direct acting PRV that is easier to maintain. It represents the next evolution in PRV design.



"The patented venturi design enables increased flow performance, limiting fall-off, to provide more stable outlet set pressure than any other direct acting PRV today."
– Matthew Sires, Product Manager, Zurn Elkay Water Solutions

The venturi design increases plunger travel, which greatly reduces chatter and other fluctuations that are typically associated with other PRVs or PRVs handling excessive load reduction. In addition, the 500XL3's ability to handle high flow rates without much pressure fall-off significantly reduces the risk of downstream pressure dropping, which may create user disturbances or improper system equipment function.



ADVANTAGES OF THE NEW DESIGN

For Plumbing Design Engineers

With the 500XL3's flat flow curve, proper valve sizing is easier than ever. The 500XL3 ensures stable outlet pressure even with higher flow rates, allowing for its specification in a wide variety of applications. Design configurations can be simplified and the number of PRVs needed reduced. (See Guide to Proper P RV Sizing, Configuration and Settings section at the end for more information). In addition, the 500XL3 is compact in size and features the shortest lay length in its class to allow for installation versatility.

For Building Owners

The 500XL3's stable outlet pressure drives savings for building owners in terms of reduced water consumption, energy use, and wastewater disposal. The PRV is built for lasting durability and lower lifecycle costs. The stainless-steel stem and composite cartridge internals resist corrosion to extend its lifespan. The stainless-steel fasteners withstand heavy wear and harsh environments, and the all-bronze body and bell provide enduring strength.

For Contractors and Installers

The 500XL3 is designed for faster, simple installation featuring compact size and short lay length. Horizontal or vertical installation options provide flexibility on new construction and retrofit jobsites. Every 500XL3 model comes tapped and plugged, ready for a gauge or a connected pressure monitor to be installed. In addition, the easy access to internals reduces time required for maintenance.

HIGHLIGHTS OF THE ZURN WILKINS 500XL3

The 500XL3's next-level design allows for reduction in the number of PRVs needed, less installation time, and fewer potential leak/failure points by using fewer high-low PRVs in place of multiple smaller PRVs. The 500XL3 can be installed in single union, double union or less union connections in 1", 1-1/4", 1-1/2" and 2" sizes. In sizes 2-1/2" and 3", it is available in flanged and less union connections. The 4" size is available flanged.

In addition, a bypass kit, connected options and wye strainer options are available with the Zurn Wilkins 500XL3.

Best in class for direct-acting pressure reducing valves

Leading Performance:

- **Breakthrough performance** allows for value-engineered system design, optimizing flow and pressure to create substantial savings in material costs
- **Patented venturi** delivers consistent results for high flow rate and low falloff applications
- **Cost-effective repair kits** significantly reduce lifecycle costs

Drop-In Install:

- **Shortest lay length** fits within tight spaces
- **Horizontal or vertical installation options** offer complete jobsite flexibility
- **Flanged version** matches previous 500XL lay length for drop-in replacements

Lasting Durability:

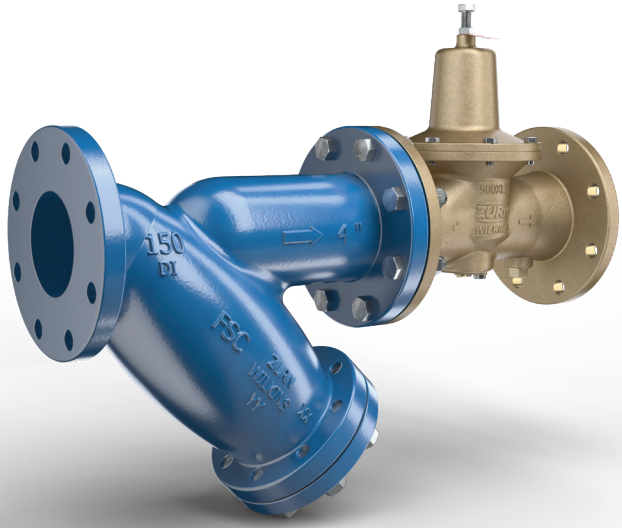
- **Stainless steel stem and composite cartridge internals** resist corrosion to extend lifespan
- **Stainless steel fasteners** withstand heavy wear and harsh environments
- **All-bronze body and bell** provide enduring strength

Changing How Specifiers Select PRVs

Innovation in Zurn Wilkins 500XL3 design drives higher value, fewer valves and a smaller footprint, allowing for value engineered design optimization. The 500XL3's highly durable, all-bronze body resists corrosion and provides easy access to cartridge internals. It's proven to deliver the flattest flow curve in the direct-acting pressure reducing valve market as well as has industry leading durability. Isn't it time to rethink pressure reduction specification?

GUIDE TO PROPER PRV SIZING, CONFIGURATION AND SETTINGS WITH THE ZURN WILKINS 500XL3

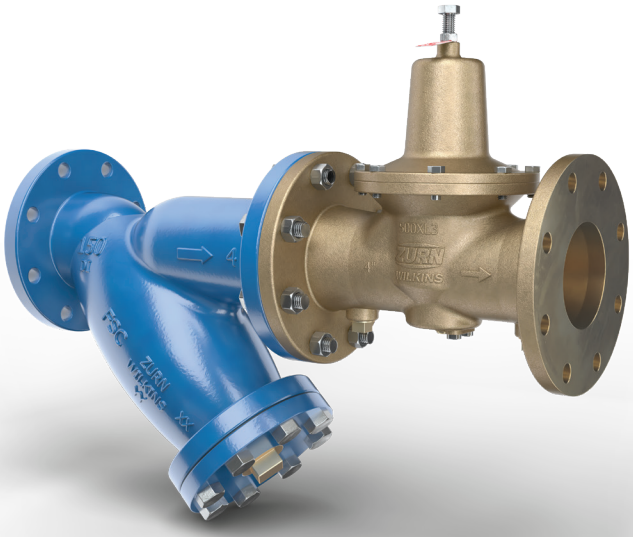
Historically, in high-flow/low-flow parallel PRV applications it was very common for the smallest (low-flow) valve to be approximately half the size of the largest (high-flow) valve. This guide details proper PRV sizing configuration and settings considering the innovation of the 500XL3.



Proper Regulation of High Pressures

The 500XL3 should be used in applications with a pressure reduction ratio below 3:1, such as 150psi inlet to 50psi outlet. In applications utilizing high supply pressures in excess of 150psi, or inlet pressure reduction by a ratio of 3:1 or greater, use multiple PRVs in series to step the pressure down in stages. This reduces wear on the valve, eliminates cavitation, and extends the lifespan of the PRV.*

*High velocities (near 8 ft/sec) may be useful to achieve adequate flushing of pipes during peak demand, to limit MIC (Microbial Induced Corrosion) and microbial growth.



Terms Used in the Guide

Static pressure: Downstream pressure at no flow once the valve is drip-tight. Static pressure will be 5-10 psi higher than the initial flowing pressure on direct acting valves to be drip tight.

Set pressure: Downstream pressure when valve bolt is adjusted with a small amount of water flowing.

Flowing pressure: Downstream pressure at calculated flow rate found by subtracting fall-off from set pressure.

1. Determine the valve inlet pressure, desired outlet pressure, minimum and maximum flow rates.
2. Select valve size. Determine valve sizes to meet flow demands. In some installations, water velocity is limited by code to 8 ft/sec. The 500XL3 can handle flows up to 16 ft/sec or higher for surge demand, but like most valves, product life is extended by using the valves at lower flow rates.

Size	8 ft/sec	16 ft/sec
1″	22 gpm	43 gpm
1-1/4″	37 gpm	75 gpm
1-1/2″	51 gpm	102 gpm
2″	84 gpm	167 gpm
2-1/2″	119 gpm	239 gpm
3″	184 gpm	369 gpm
4″	317 gpm	635 gpm

3. Select the size that can handle the maximum flow rate. Single valves can be used but you can also use parallel valves to meet the maximum flow rate. See section 5 for recommended bypass and parallel installations. Note that valves in parallel should be set to slightly different pressures to avoid both opening simultaneously at low-flow rates. Two valves of the same size should not be set more than 5 psi apart since the 500XL3 valves flow so well.

   Examples:

   The system demand is 0 to 160 gpm. A 3” valve may be selected or two 2” valves if a parallel system is desired to accommodate flow during maintenance of one valve.

   The system demand is 50 to 360 gpm. A 4” and 1-1/2” valve may be used together, or for a single valve, a pilot-operated control valve, model ZW209 maybe selected instead of the 500XL3.

4. Determine step down ratio for high pressure reduction. Divide inlet pressure by the outlet pressure to determine the step-down ratio. If this number is higher than 3, then the pressure will have to be stepped down by multiple valves in series to reduce noise and cavitation damage to the valves. For a ratio of 3 to 9, two valves will be used. If the ratio is higher than 9, then three valves in series will be needed.

   Examples:

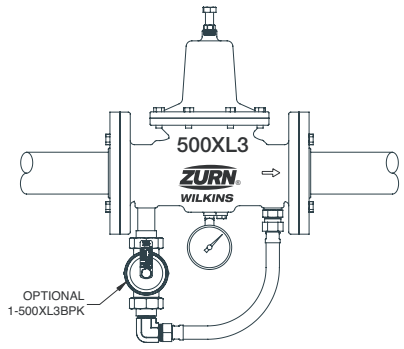
   140 psi to 50 psi, ratio 140/50 = 2.8, a single valve is used to drop the pressure

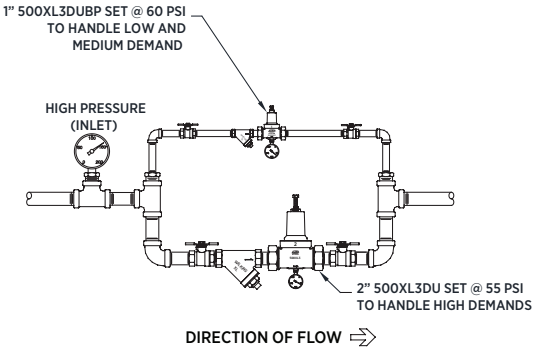
   220 psi to 50 psi, ratio 220/50 = 4.4, two valves in series, first valve (high range option) set to 105 psi, second to 50 psi. (220/105 = 2.1 ratio, 105/50 = 2.1 ratio, each valve ratio must be below 3 and being close to equal reduces noise equally.)

   280 psi to 25 psi, ratio 280/25 = 11.2, three valves in series. First valve (high range option) set to 125 psi, second set to 55 psi, third set to 25 psi. (280/125 = 2.2, 125/55=2.3, 55/25 = 2.2)

5. Using parallel valves for low flow. Large valves trying to go to very low flows operate with the plunger very close to the seat. Large pressure reductions require the valve to open small amounts. When these two conditions combine, the result may be "low-flow chatter," where the plunger opens a small amount, then closes quickly against the seat if flow rises too rapidly. This may be characterized by banging pipes, downstream pressure swinging wildly on a pressure gauge, or loud noises coming from the pressure reducing valve.

   To solve this a smaller valve can be placed in parallel as a low-flow bypass. This small valve is set 5-10 psi higher than the large valve so that it opens first. Once the small valve's downstream flowing pressure falls off the 5-10 psi difference, then the large valve starts opening to handle higher flow rates. A low-flow bypass is not needed for 2" and smaller 500XL3 but may be needed on larger valves when making large pressure drops at low-flow rates. If the pressure drop ratio is less than 2 to 1 or flow never drops below 2 ft/sec, a low flow bypass may not be required. Each system has different harmonics and performance, so there is no absolute rule when it may be required. The flanged valves in 2-1/2" to 4" sizes are pre-tapped for a low-flow bypass kit, so if one is required when using these models, a low-flow bypass can easily be added later.





Main PRV	2-1/2" 500XL3FBP	3" 500XL3FBP	4" 500XL3FBP	3" ZW209	4" ZW209	6" ZW209
Suggested By-Pass PRV	1" 500XL3DUBPK (Integral Kit)	1" 500XL3DUBPK (Integral Kit)	1" 500XL3DUBPK (Integral Kit)	1" 500XL3DUBP* (Plumbed Separate)	1-1/2" 500XL3DUBP* (Plumbed Separate)	2" 500XL3DUBP* (Plumbed Separate)
Suggested Setpoint Differential	5 psi	5 psi	5 psi	10 psi	5-10 psi	10 psi

*These bypass units are plumbed separately in parallel with the primary valve. Fittings are not included.

Example:

System demand is 0 to 160 gpm. A 3" valve size was selected previously. Pressure is being reduced from 145 to 70 psi. Reduction ratio is 145/70 = 2.1. The 3-500XLF flanged valve is selected with a 1" low flow bypass kit, 1-500XL3BPK to handle flows down to 0 gpm.

System demand is 50-360 gpm. A 4" and 1-1/2" valve were selected previously. Pressure is being reduced from 220 to 50 psi, requiring two valves in series. This requires pressure being dropped in two steps for each of the parallel lines. Flow is never below 50 gpm, so no low flow bypass is needed. Combining these means a 4" high range valve set to 105 psi then a 4" valve set

to 45 psi in series is needed. Then a parallel line will have a 1-1/2" high range valve set to 105 psi then a 1-1/2" valve set to 50 psi. With the 1-1/2" valve set 5 psi higher, flow will start with the smaller valves first. When the valve outlet pressure falls off 5 psi (at approximately 50 gpm based on flow curves) then the 4" valve will start to open and add flow to the system.

6. Calculating flow in parallel systems. It can be very confusing to determine how much flow is going through two different valves in parallel. It's a common misconception that a large valve with a low-flow bypass half the size may separate the total flow into one third in the small line and two thirds in the large line. The actual flow in each line is determined by the setpoint of each valve, the downstream pressure during flow, and the fall-off curves on the spec sheet. Many parallel setups may actually have only one tenth the total flow in the small line since the fall-off curve is steep.

In the example above with a 1-1/2" and 4" in parallel and with the valves together flowing at 40 psi to the system the flow in each line can be calculated. A 1-1/2" valve set at 50 psi flowing at 40 psi is 10 psi fall-off. Looking at the flow curve, 10 psi-fall off occurs at 85 gpm. The 4" valve is set at 45 psi and flowing at 40 psi which is 5 psi fall off. On the curve this occurs at 150 gpm, so combined flow is 235 gpm. Since the 500XL3 valves flow so well with very little fall-off, too much flow is going through

Size	5 psi Setpoint Differential	10 psi Setpoint Differential
1" 500XL3DUBP	20 GPM	30 GPM
1-1/2" 500XL3DUBP	45 GPM	60 GPM
2" 500XL3	70 GPM	95 GPM

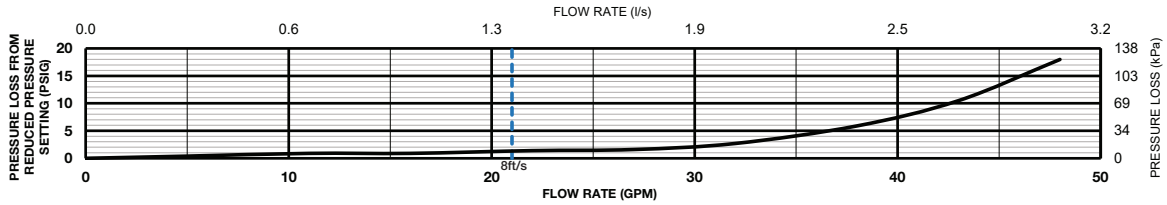
the smaller valve than is desired. To correct this situation, the 1", 1-1/2", and 2" come in a model 500XL3DUBP for use as parallel bypass valves. These valves include special tailpieces to limit the flow in the smaller line. Flow through these bypass valves is shown in the table below based on how far they are set above the larger valve setting.

Now checking flow rates, the 1-1/2" valve set 5 psi higher will be limited to about 45 gpm. With system demand of 360 gpm, 315 gpm is needed to go through the 4" valve. This occurs at 10 psi fall off. If the 4" valve was set to 45 psi, then the system will be at 35 psi at 360 gpm. To get the system pressure to be at 45 psi at the maximum flow rate, the second 1-1/2" and second 4" valve settings would be increased 10 psi to 60 and 55.

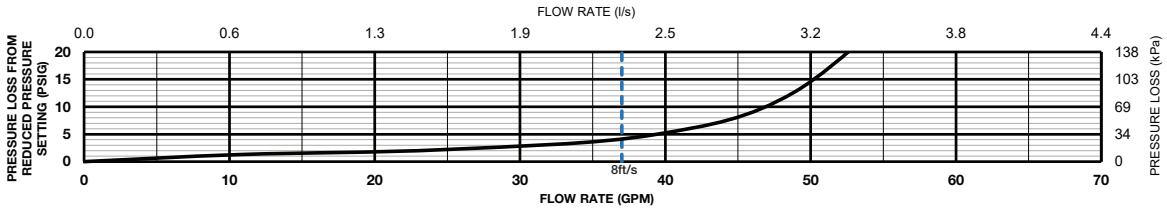
Flow Characteristics

Flow curves are based on a 50 psi pressure reduction. Pressure loss will be less with higher pressure reduction.

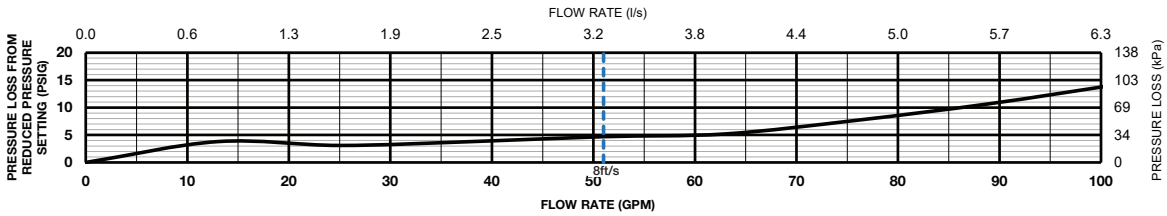
1" MODEL 500XL3 (STANDARD AND METRIC)



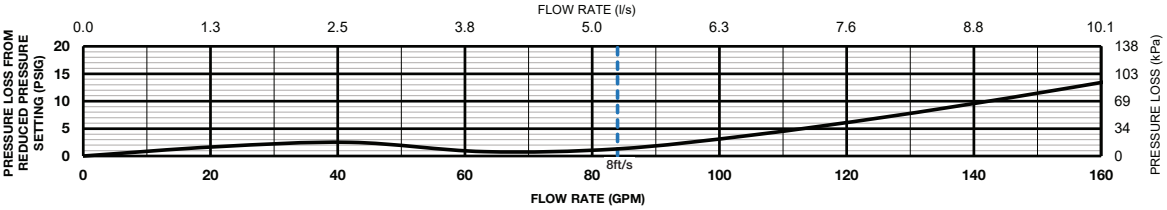
1-1/4" MODEL 500XL3 (STANDARD AND METRIC)



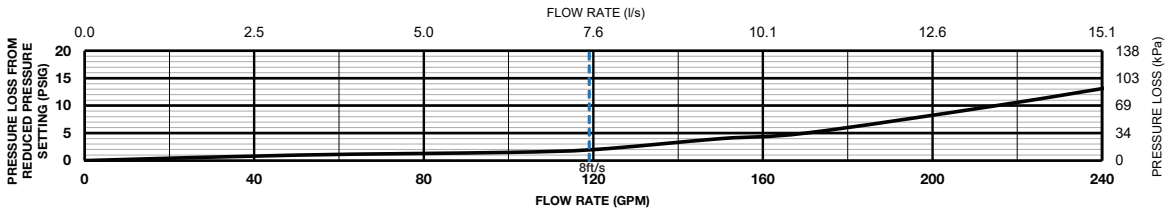
1-1/2" MODEL 500XL3 (STANDARD AND METRIC)



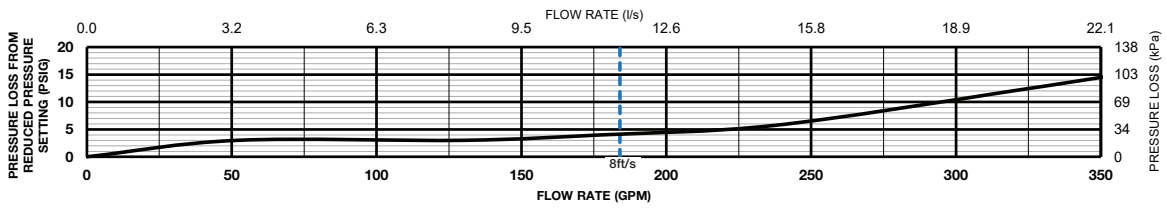
2" MODEL 500XL3 (STANDARD AND METRIC)



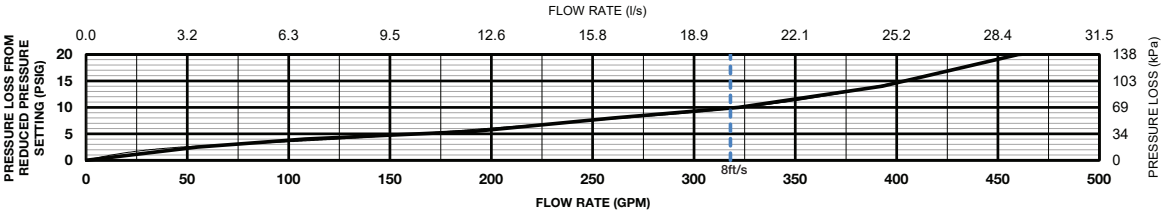
2-1/2" MODEL 500XL3 (STANDARD AND METRIC)



3" MODEL 500XL3 (STANDARD AND METRIC)



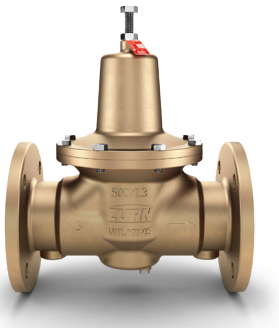
4" MODEL 500XL3 (STANDARD AND METRIC)



Zurn Wilkins 500XL3 Pressure Reducing Valve

Flat-Out Best In Flow

2-500XL3



3-500XL3F

The Zurn Wilkins 500XL3 leads in performance with the flattest flow curve on the market today. The patented venturi gives the series its edge. No other PRV handles high flow rates more efficiently for industrial lines and commercial systems.

Leading Performance:

- **Breakthrough performance** allows for value-engineered system design, optimizing flow and pressure to create substantial savings in material costs
- **Patented venturi** delivers consistent results for high flow rate and low falloff applications
- **Cost-effective repair kits** significantly reduce lifecycle costs

Drop-In Install:

- **Shortest lay length** fits within tight spaces
- **Horizontal or vertical installation options** offer complete jobsite flexibility
- **Flanged version** matches previous 500XL lay length for drop-in replacements

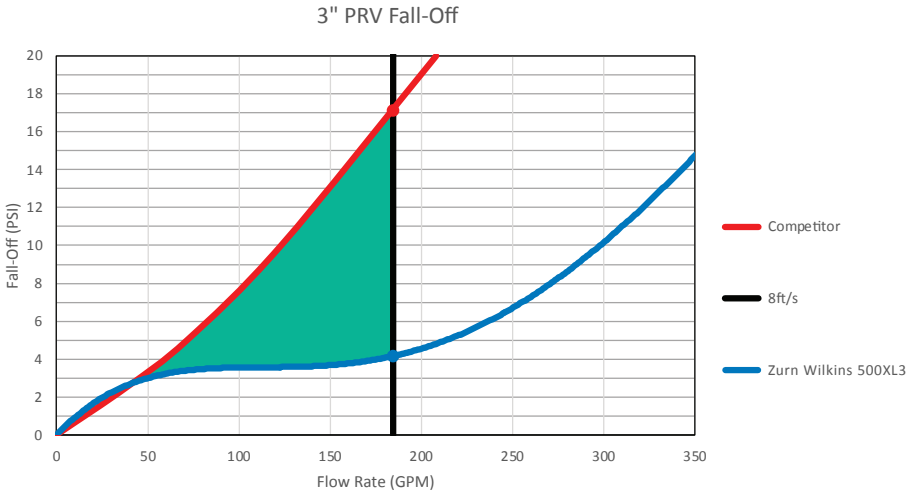
Lasting Durability:

- **Stainless steel stem and composite cartridge internals** resist corrosion to extend lifespan
- **Stainless steel fasteners** withstand heavy wear and harsh environments
- **All-bronze body and bell** provide enduring strength

Ahead of the (Flow) Curve

The Zurn Wilkins 500XL3 leads the competition in flow performance.

The 3” Zurn Wilkins 500XL3 has a 13 PSI pressure advantage when compared to the leading competitor at the typical plumbing design flow rate limit (8ft/s).

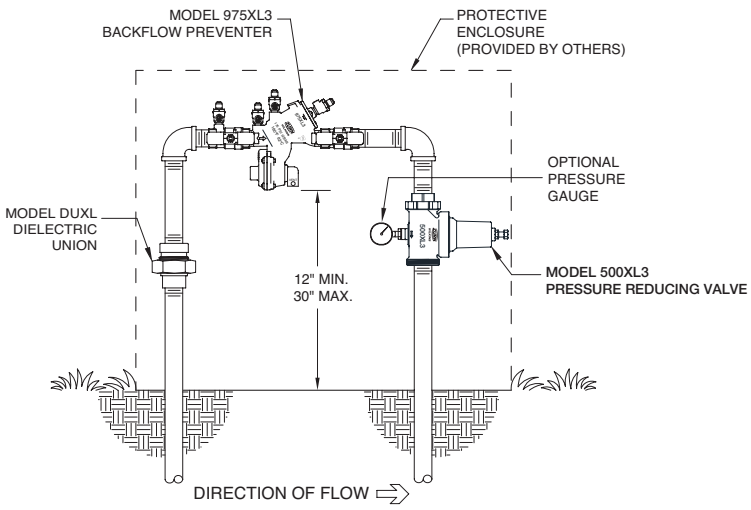


Zurn Wilkins 500XL3 Pressure Reducing Valve

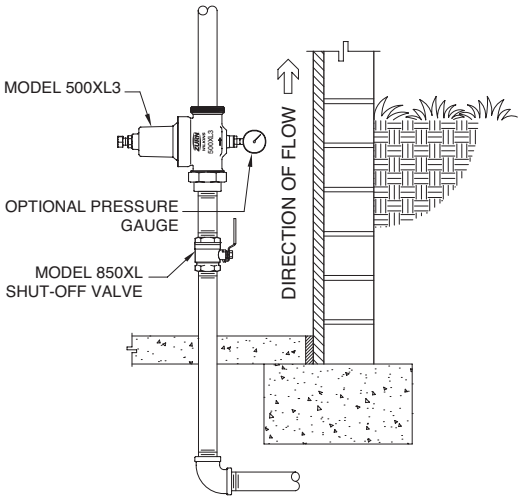
Find more information at:
zurn.com/products/water-control/pressure-reducing-valves/500xl3

Typical Installation

Horizontal Installation



Vertical Installation



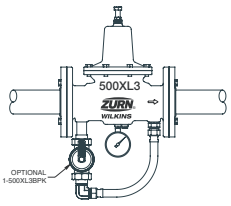
Features

- **Size:** 1", 1-1/4", 1-1/2", 2", 2-1/2", 3", 4"
- **Maximum working water pressure:** 400 psi
- **Maximum working water temperature:** 140°F (60°C)
- **Reduced pressure range:** 15 psi - 75 psi
- **Factory preset:** (field set 2-1/2" & 3") 50 psi
- **Threaded connections:** (FNPT) ANSI B1.20.1
- **Copper connections:** (Female) ANSI B 16.22

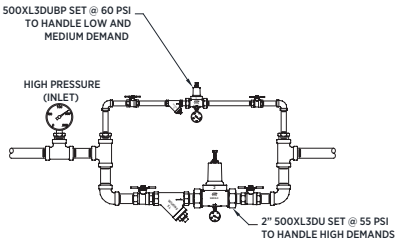
Standard Compliance

- ASSE Listed 1003
- cUPC® Listed
- CSA Certified
- Meets the requirements of NSF/ANSI/CAN61 & 372

500XL3BPK



500XL3DUBP



Options (suffixes can be combined)

Standard Outlet With single union FNPT inlet x FNPT (1" thru 2") or less union (2-1/2" & 3")

DU Double union FNPT x FNPT (1"-2")

DUC Double union copper sweat x sweat (1"-2")

C Single union copper sweat x FNPT (1"-2")

F Flanged class 150 (2-1/2"-4")

HR High range, outlet adjust from 60 psi to 125 psi

Y With lead-free bronze "Y" strainer on inlet

FY With ductile iron "Y" type flanged strainer, fusion epoxy coated, inside & out (2-1/2"-4")

G Tapped and plugged with gauge

Accessories

PART NUMBER	DESCRIPTION	USE WITH
1-500XL3BPK	1" Low Flow Bypass	Flanged
1-500XL3HRBPK	1" Low Flow Bypass, 60 - 125 psi setting	Flanged
1-500XL3DUBP	Double Union 1" Low Flow Bypass*	2-1/2"-3"
1-500XL3DUHRBP	Double Union 1" Low Flow Bypass, 60 - 125 psi setting*	2-1/2"-3"
SXL	Cast Bronze Wye Type Strainer	1"-3"
FSC	Ductile Iron Wye Type Strainer	Flanged

**Installed in parallel, fittings not included*