Senninger®

PRESSURE REGULATOR GUIDE

AGRICULTURAL IRRIGATION | *A HUNTER INDUSTRIES COMPANY*

Low Pressure - High Performance™

WHAT IS A PRESSURE REGULATOR?

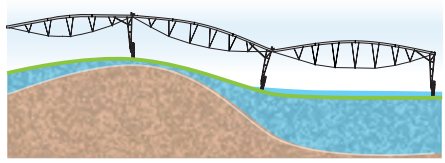
The primary function of a pressure regulator is to maintain an irrigation system's desired performance by controlling excessive and varying inlet pressures to constant outlet pressure.

Proper use of pressure regulators helps maintain the overall efficiency of an irrigation system. Pressure regulators assure good sprinkler performance and can help lower energy costs and save water.

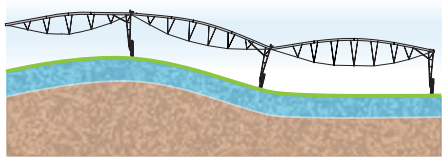
Manufacturers offer several models of pressure regulators to meet various irrigation needs: flow ranges, operating pressure rating, maximum inlet pressure, inlet and outlet connection size, and connection type - NPT, BSPT, and hose connection threads.

WHY DO I NEED A PRESSURE REGULATOR?

Every irrigation system will experience some pressure fluctuation, which also causes unwanted flow deviations. Regulators ensure the sprinklers operate within a specific range of flows and pressures to deliver the intended distribution pattern and application rate. Without regulators, the radius of throw is altered, application rates are not consistent, and uniformity numbers are drastically affected. It may also impact the application of fertilizers, chemicals, and nutrients through the irrigation system.



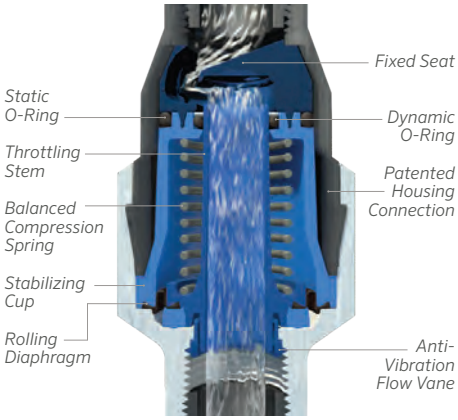
*Water Application **Without** Pressure Regulators*



*Water Application **With** Pressure Regulators*

Pressure is related to gravity. More pressure is needed to move water uphill. When water moves downhill, more pressure is available.

Every 2.31 ft (0.7 m) of elevation change will result in 1 psi (0.07 bar) pressure change.



Cutaway of a pressure regulator.

WHAT CAUSES PRESSURE FLUCTUATIONS?

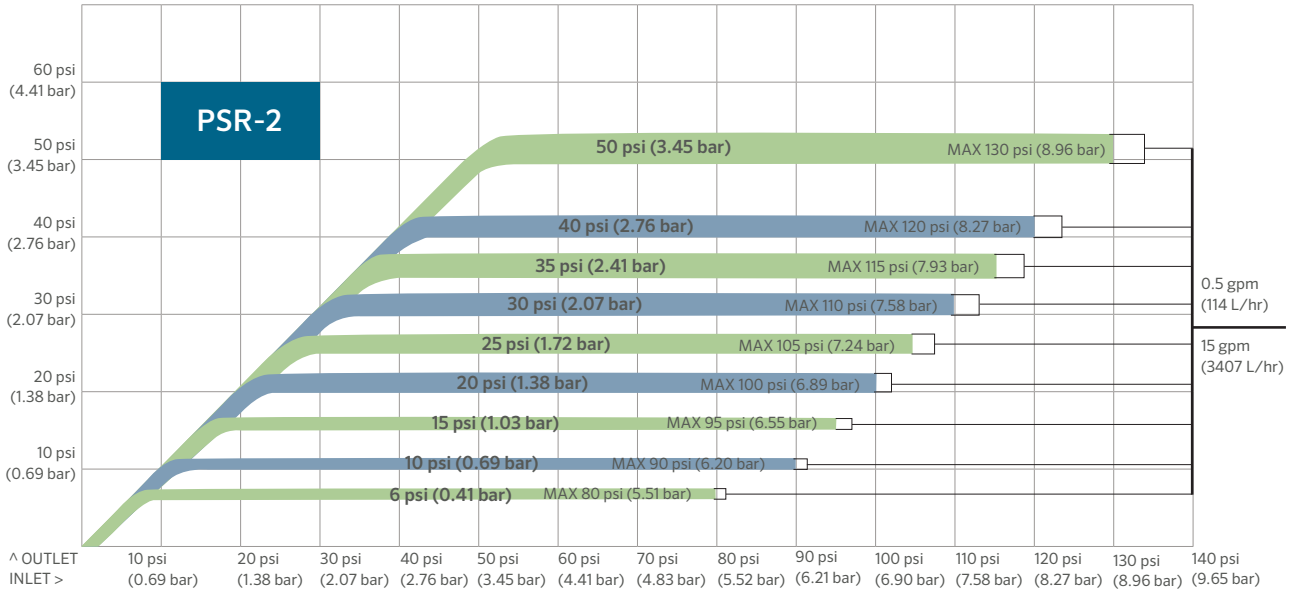
Some causes include elevation changes within the irrigated area; pressure loss through pipes and fittings; fluctuations when zones cycle on or off; system demand change on large projects with multiple wells providing water; and activation of end guns and corner arms on mechanized systems.

HOW DO PRESSURE REGULATORS WORK?

Water travels through the inlet of the regulator across a fixed seat into the critical flow area. Water then enters a hollow cylinder or throttling stem attached to a diaphragm. Increasing inlet pressure causes valve to close. Decreasing inlet pressure allows valve to open. The regulated outlet pressure is determined by the spring's compressive strength.

WHAT IS A PERFORMANCE CURVE?

Every pressure regulator is designed to operate at a minimum and maximum inlet pressure and a predetermined flow range. A regulator performance curve illustrates how the pressure regulator will perform within the model's range of inlet pressures and flows. The Y-axis shows outlet pressure, and the X-axis shows inlet pressure.



In the chart above, the blue band for the 30 psi (2.07 bar) model shows the performance at various flows. At the lowest flow (0.5 gpm or 113 L/hr), the regulator will maintain an actual outlet pressure slightly higher than 30 psi (2.07 bar). At the highest flow (15 gpm or 3407 L/hr), the actual outlet pressure is slightly lower than 30 psi (2.07 bar).

(Rogers, Shaw, Pragada, & Alam, 2010)

HOW TO SELECT A PRESSURE REGULATOR?

When selecting the proper pressure regulator for an irrigation system, there are several factors to consider. These include the range of fluctuations in inlet pressure, the required outlet pressure, and the allowable variation.

Other factors are:

- The maximum flow rate required and expected variation
- Any size and inlet/outlet connection constraints
- Any specific application needs such as those in wastewater or mining installations.

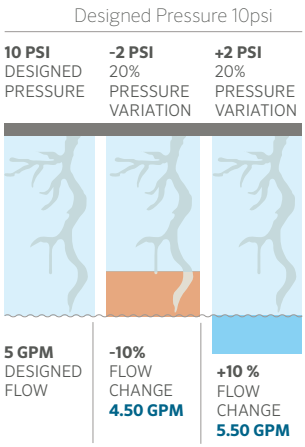
Note that in many instances, irrigation design software such as the Senninger SennPAQ or WinSIPP programs will automatically let you know what type of pressure regulator you need.

HOW DOES PRESSURE AFFECT FLOW?

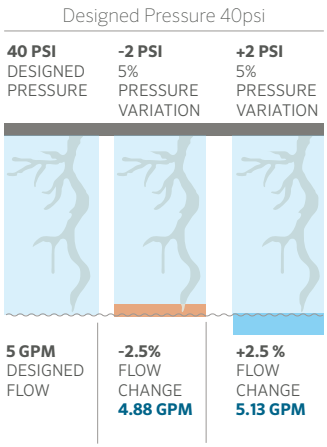
The operating pressure of an irrigation system always affects the flow rate – $Q = K\sqrt{P}$.

Pressure regulation is particularly important in low-pressure systems, where a slight pressure variation can have a significant impact on the application rate.

Keep in mind that all it takes is a ~20% pressure change to create a ~10% flow variation. The lower a sprinkler's design pressure is, the more critical it is to control pressure to maintain its design flow rate.



Above left: A pressure variation of 2 psi (0.14 bar) on a sprinkler designed to operate at 10 psi (0.69 bar) is equivalent to a 20% pressure variation. This alters the flow by 10%. Likewise, a sprinkler designed to operate at 5 gpm (1136 L/hr) will have 0.5 gpm (113 L/hr) variation; delivering 4.5 gpm (1022 L/hr) if the pressure decreases and 5.5 gpm (1249 L/hr) if the pressure increases.



Above right: On a sprinkler designed to operate at 40 psi (2.76 bar), the same 2 psi (0.14 bar) variation will only result in a 5% pressure variation. In this case, the fluctuation in flow will be equivalent to a 2.5% change, which is less than a tenth of a gallon per minute. Thus, the flow will oscillate between 4.88 (1108 L/hr) and 5.13 gpm (1165 L/hr).

KEY: **Under**watering
Overwatering

PRESSURE CHANGE	DESIGN PRESSURE						
	6 psi (0.41 bar)	10 psi (0.69 bar)	15 psi (1.03 bar)	20 psi (1.38 bar)	30 psi (2.07 bar)	40 psi (2.76 bar)	50 psi (3.45 bar)
1 psi (0.069 bar)	16.7	10.0	6.7	5.0	3.3	2.5	2.0
2 psi (0.138 bar)	33.3	20.0	13.3	10.0	6.7	5.0	4.0
3 psi (0.207 bar)	50.0	30.0	20.0	15.0	10.0	7.5	6.0
4 psi (0.276 bar)	66.7	40.0	26.7	20.0	13.3	10.0	8.0
5 psi (0.345 bar)	83.3	50.0	33.3	25.0	16.7	12.5	10.0
6 psi (0.414 bar)	100.0	60.0	40.0	30.0	20.0	15.0	12.0
7 psi (0.483 bar)	N/A	70.0	46.7	35.0	23.3	17.5	14.0
8 psi (0.552 bar)	N/A	80.0	53.3	40.0	26.7	20.0	16.0
	Percentage of Pressure Variation (%)						

Pressure regulators are recommended if there is a 20% pressure and/or a 10% flow variation. The lower a system's design pressure, the more critical it is to accurately control its pressure.

HOW TO INSTALL A PRESSURE REGULATOR

Pressure regulators must always be installed downstream from all shut-off valves in the proper direction.
Each model has a directional arrow on the side that shows the direction of the flow. This arrow should point downstream, toward the sprinklers and emitters.

Hydraulic friction loss is what makes a pressure regulator work. To compensate for friction inside the device, the recommendation is to assure inlet pressure is 5 psi (0.34 bar) higher than the regulator preset psi rating.
Each pressure regulator is designed with a maximum pressure rating, typically 80 psi (5.51 bar) above the designed pressure rating for that model. Operating outside these recommendations will affect the regulator's performance and could cause premature failure.

PRESET OPERATING PRESSURE	MAXIMUM INLET PRESSURE
6 psi (0.41 bar)	80 psi (5.51 bar)
10 psi (0.69 bar)	90 psi (6.20 bar)
12 psi (0.83 bar)	90 psi (6.20 bar)
15 psi (1.03 bar)	95 psi (6.55 bar)
20 psi (1.38 bar)	100 psi (6.89 bar)
25 psi (1.72 bar)	105 psi (7.24 bar)
30 psi (2.07 bar)	110 psi (7.58 bar)
35 psi (2.41 bar)	115 psi (7.93 bar)
40 psi (2.76 bar)	120 psi (8.27 bar)
50 psi (3.45 bar)	130 psi (8.96 bar)

Mechanized systems –

- Pressure regulators are usually installed immediately preceding the sprinkler.
- Some prefer to install the pressure regulator on the outlet or inlet side of the gooseneck. Increased pressure or head between the regulator and the sprinkler should be a design consideration.

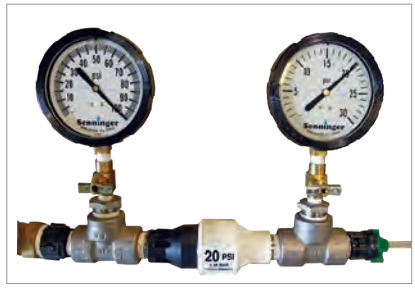
Solid Set field installations –

- Regulators are usually installed at the beginning of the lateral.
- Although, based on the design, one regulator can be used to manage pressure for several laterals.
- Certain installations may require a pressure regulator for each sprinkler.
- In high flow scenarios, a high flow model should be used.
  Although, multiple regulators in manifold can be used to handle the specific flow requirements.
- Timer-control installations employ regulators after the control valve, whether for multiple units or inside a valve box.

HOW TO TEST PRESSURE REGULATORS

All users should check their pressure regulators at least once every three years. You can test pressure regulators by installing a high-quality pressure gauge on each side of the regulator.

The gauge on the inlet side assures there is enough pressure for the regulator to operate. Remember that inlet pressure should be at least 5 psi (0.34 bar) above the pressure regulator rating for the regulator to function. The gauge on the outlet side (after the regulator) should match the preset pressure printed on the device, allowing for slight variation due to flow.



If your irrigation dealer has a regulating testing device, you can also check the readings on a new pressure regulator that matches the model you are testing.

WHAT IS A FILTER REGULATOR

The Senninger all-in-one Filter Regulator helps prevent clogging of the small nozzles on the first few spans of a center pivot. This solution integrates filtration and pressure regulation in one product to provide economy, convenience and help ensure optimal system performance. It combines the reliability of the Senninger black and white pressure regulators with the choice of screen models based on nozzle size to help keep your irrigation system operating efficiently. Three pressure models 6, 10, and 15 psi cover the pressure range for most low-pressure sprinklers.

Growers can easily access the filter screens with just a twist of the bonnet. They do not need tools, nor do they need to dismantle the drop components. Replacement stainless-steel mesh screens come with color-coded rubber seals to readily identify mesh size.

REPLACEMENT MESH SCREENS

Part Numbers	Description	
FPSR220SCREEN	Filter PSR2, 20 mesh screen, **black rings**	#13 - 23
FPSR230SCREEN	Filter PSR2, 30 mesh screen, **green rings**	#6 - 12.5
FPSR240SCREEN	Filter PSR2, 40 mesh screen, **grey rings**	#2 - 5.5

HOW LONG DO PRESSURE REGULATORS LAST?

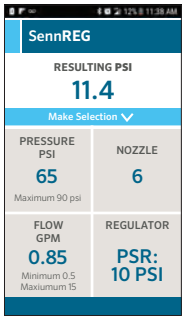
Though regulators can last for years, the degree of regulation will change over time as internal parts begin to wear. The conditions under which pressure regulators operate influence their lifespan. Various factors contribute to pressure regulator wear, including poor water quality, unflushed chemicals in the system, abrasive materials in the water, and extended operating hours. Plan to do a yearly check or 2,000 hours, whichever comes first. Any significant variance will mean a loss of efficiency and revenue in the long run. At 10,000 hours, you should review the original design parameters of the system, do random checks on two or more sprinklers per span, and see if you have any variance to the original specifications.

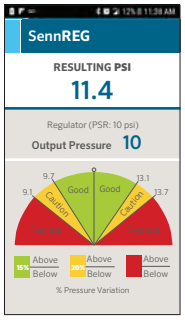
WHAT ARE THE MAIN SIGNS OF WEAR?

Malfunctioning pressure regulators can be difficult to identify visually. However, some emit water through the sides of the regulator when they fail structurally, which often happens because the regulator was installed before a shut-off valve. Sometimes they also produce a high-pitched squealing.

A malfunctioning regulator can result in a sprinkler pressure that will be too high. A sprinkler emitting a finer spray or exhibiting a faster rotation speed relative to adjacent sprinklers may indicate a regulator is operating above its nominal rating. If operating below its nominal rating, sprinklers will produce larger droplets and slower rotation speed, as well as reduced wetted diameter.

Inlet and outlet of worn pressure regulators.





*Download the app for **Apple or Android devices** from the app store.*

SennREG APP

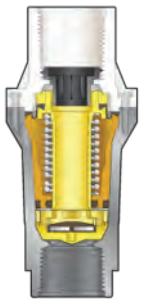
The SennREG app is a handy tool to bring into the field when checking your pressure regulator's performance. It shows the relationship pressure has on flow in either Imperial or Metric units. With just a few clicks, you'll know exactly what to expect out of your pressure regulator – from what your output pressure should be to when you should start thinking about replacements.

- Select your Senninger pressure regulator model and desired outlet pressure. Be sure you have at least 5 psi (0,34 bar) above the regulated pressure available for the regulator selected.
- Select the UP3 nozzle number currently installed in your sprinkler.
- Enter your expected flow numerically.
- Enter your overall system pressure.

Test your pressure regulator to see the outlet pressure. In the **SennREG** app, replace the outlet pressure with your actual pressure and review the results on the chart. If the line falls within the green area, the pressure regulator operates as intended. If it falls within the yellow area, use caution and monitor system performance. If it falls within the red area, it is time to replace your pressure regulators.

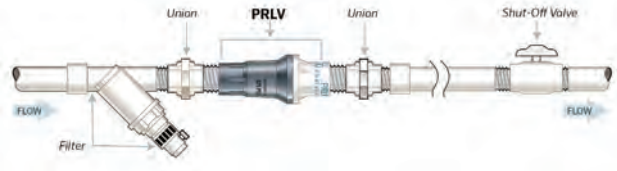
WHAT IS A PRESSURE REGULATING LIMIT VALVE?

Pressure regulating limit valves are used where there is a shut-off valve downstream. Often these are used to limit the pressure going to multiple zones downstream that each include their own shut-off valve. When this shut-off valve is closed, the limit valve's (throttling) stem flow-passage closes and seals to limit the outlet pressure to only 10 to 15 psi (0.69 to 1.03 bar) above its normal regulating pressure. This helps protect downstream components from potential damage due to high static upstream water pressure.



Standard pressure regulators should not be used where there is a shut-off valve downstream. With these non-LV regulators, when the downstream shut-off valve is closed, the (throttling) stem is unable to seal completely against the harder seat. The high inlet pressure eventually equalizes across the regulator and up to the valve. Upon opening the shut-off valve, a high-pressure surge could damage downstream meters, sprinklers, or other plumbing components.

Pressure regulating limit valves are designed to control pressure when there is NO water flow through the device. In contrast, a standard pressure regulator will not regulate without flow. Unlike a standard pressure regulator, a pressure regulating limit valve can be installed BEFORE (upstream) shut-off valves.



WHY SENNINGER PRESSURE REGULATORS?

Recognizing the importance of maintaining correct system pressure, Senninger introduced the first in-line pressure regulators to the industry in 1966. The Senninger black and white pressure regulators are known worldwide for their accuracy and reliable performance.

The design and materials used to manufacture pressure regulators greatly impact their accuracy. Senninger pressure regulators are designed and built to rigorous quality standards. They are 100% pressure tested to ensure quality and performance before they are packaged and shipped. Senninger pressure regulators are backed with a two-year warranty on materials, workmanship, and performance. Several models have been developed throughout the years to meet a variety of installation needs including mechanized systems, nurseries, greenhouses, and open fields.

LOW FLOW

PRLG

PRODUCT SPECS	
Flow Range	0.5 – 7 gpm (114 – 1590 L/hr)
Preset Operating Pressure	10 – 40 psi (0.69 – 2.76 bar)
Maximum Inlet Pressure*	90 - 120 psi (6.20 - 8.27 bar)
Inlet Sizes	¾" F hose, ¾" F NPT
Outlet Sizes	¾" M hose, ¾" M NPT

PRL

PRODUCT SPECS	
Flow Range	0.5 – 8 gpm (114 – 1817 L/hr)
Preset Operating Pressure	6 – 40 psi (0.41 – 2.76 bar)
Maximum Inlet Pressure*	80 - 120 psi (5.51 - 8.27 bar)
Inlet Sizes	¾" F NPT, ¾" F hose
Outlet Size	¾" F NPT

MEDIUM FLOW

PSR™2

PRODUCT SPECS	
Flow Range	0.5 – 15 gpm (114 – 3407 L/hr)
Preset Operating Pressure	6 – 50 psi (0.41 – 3.45 bar)
Maximum Inlet Pressure*	80 - 130 psi (5.51 - 8.96 bar)
Inlet Size	¾" F NPT
Outlet Size	¾" F NPT

PMR-MF

PRODUCT SPECS	
Flow Range	2 – 20 gpm (454 – 4542 L/hr)
Preset Operating Pressure	6 – 60 psi (0.41 – 4.14 bar)
Maximum Inlet Pressure*	80 -140 psi (5.51 - 9.65 bar)
Inlet Sizes	¾" F NPT, 1" F NPT, 1" F BSPT
Outlet Sizes	¾" F NPT, 1" F NPT, 1" F BSPT

FILTER REGULATOR

PRODUCT SPECS	
Flow Range	0.07 - 14.54 gpm (16 – 3302 L/hr)
Preset Operating Pressure	6 – 15 psi (0.41 – 1.03 bar)
Maximum Inlet Pressure*	80 -95 psi (5.51 - 6.55 bar)
Inlet Size	¾" M NPT
Outlet Size	¾" F NPT

HIGH FLOW

PRHF

PRODUCT SPECS	
Flow Range	10 – 32 gpm (2271 – 7268 L/hr)
Preset Operating Pressure	10 – 50 psi (0.69 – 3.45 bar)
Maximum Inlet Pressure*	90 - 130 psi (6.20 - 8.96 bar)
Inlet Sizes	1 ¼" F NPT, 1 ¼" F BSPT
Outlet Sizes	1" F NPT, 1 ¼" F NPT, 1" F BSPT, 1 ¼" F BSPT

PRU

PRODUCT SPECS	
Flow Range	20 -100 gpm (4543 - 22713 L/hr)
Preset Operating Pressure	10 – 60 psi (0.69 – 4.14 bar)
Maximum Inlet Pressure*	90 - 140 psi (6.20 - 9.65 bar)
Inlet Sizes	2" F NPT, 2" F BSPT
Outlet Sizes	2" F NPT, 2" F BSPT

Senninger pressure regulators are recommended for outdoor use only. Not NSF certified.
** Maximum recommended inlet pressure not to exceed 80 psi (5.52 bar) above nominal model pressure.*

LIMIT VALVE

PRLV

PRODUCT SPECS	
Flow Max	18 gpm (4088 L/hr)
Preset Operating Pressure	10 – 60 psi (0.69 – 4.14 bar)
Maximum Inlet Pressure	125 psi (8.62 bar)
Inlet Sizes	¾" F NPT, 1" F NPT
Outlet Sizes	¾" F NPT, 1" F NPT

PRXF-LV

PRODUCT SPECS	
Flow Max	75 gpm (17034 L/hr)
Preset Operating Pressure	20 – 60 psi (1.38 – 4.14 bar)
Maximum Inlet Pressure	125 psi (8.62 bar)
Inlet Size	3" F slip
Outlet Size	3" F slip

For more information about limit valve models,see page 9.

Senninger pressure regulators, PRLV, and PRXF-LV are recommended for outdoor use only. Not NSF certified.

Senninger®

The Senninger commitment to world-class products, local support and technical expertise ensure we provide the most efficient and reliable agricultural irrigation solutions available in the world today.

Steve Abernethy, President of Senninger Irrigation

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