Pressure Regulators
Who needs them?

a Senninger Irrigation article

What is a pressure regulator?
By name and definition, a pressure regulator is a device designed to automatically regulate water pressure in pipes or tubing downstream of its placement in order to maintain downstream pressure at a predetermined set point. Irrigation system designers use pressure regulators to control and customize a system's hydraulics to meet specific design objectives. A pressure regulator maintains downstream pressure by automatically modulating the area of opening through the device. By changing the area of opening as upstream pressures vary, pressure loss through the valve changes proportionally to maintain the downstream pressure very close to a predetermined point.

There are various models of pressure regulators available to meet specific flow and pressure requirements. To ensure proper regulator function, the designer should always observe the operating parameters stated by the pressure regulator manufacturer. The manufacturer's parameters usually include a maximum upstream pressure, the downstream pressure to be maintained, and an acceptable flow range. Understanding that all pressure regulators are designed to reduce system pressure, it is important to always design for an upstream pressure into the device that is greater than the nominal outlet pressure of the regulator.

Why regulate pressure?

Distribution uniformity
A standard design objective is to take a predetermined amount of water and apply it uniformly over a predetermined area. Uncontrolled pressure fluctuations into applicators or emitters result in unwanted flow deviations. Consequently, it is important to keep system pressures constant in order to deliver uniform water distribution coverage throughout the entire irrigated area. System pressures will vary throughout a system due to friction loss through pipe and fittings and also pipeline elevation changes. Once the system is installed, pipe diameters are constant and topography does not change. The predictability of these pressure variations make it possible for a designer to select the pump, pipe sizes, sprinklers, and

pressure regulation consistent within the limits of the specific design. However, mechanical move systems have the potential to experience radical elevation and associated pressure changes as they move across the irrigated area. Pressure changes of this magnitude can easily cause flow fluctuations in excess of 10% *(plus or minus 5%)*, in which case, pressure regulators are recommended.

Solid set systems can experience significant pressure and therefore significant flow variation due to system flow demand changes that occur as system zones cycle on and off. The system designer must be able to forecast these changes in order to maintain the integrity of the system. Using pressure regulators greatly enhances the veracity of the design and the ability of the system to effectively operate. The same demand changes occur in mechanical move systems. For example, when a center pivot system's end gun or corner arm actuates, significant fluctuations in pressure and flow occur in the un-pressure regulated system. Proper placement of pressure regulators prevents or minimizes system pressure variation and the related flow variation from affecting the uniformity of water distribution. The designer need only provide adequate pressure up to the point of regulation.

System component performance

Some system components may fail or exhibit unacceptable performance characteristics or reduced operating life if the system pressure exceeds a specific point. For example, most low-volume tubing or tape products have a maximum pressure rating to prevent product damage or failure. Pressure compensating sprinklers and emitters have a pressure range which, if exceeded, can cause failure or poor performance. Use of pressure regulators ensures that the proper operating pressure is delivered throughout the system.

Pressure regulators are used to even out system pressure and flow if the pumping pressure is too high or if the system's irrigation zones are not sized correctly. Some systems have irrigation zones which are different in size and therefore the inherent frictional losses and the flow they require vary, however, the pump must deliver equal distribution regardless of the size of the zone. In this type of solid set system, pressure regulation is essential. Controlling pressure equalizes the flow to each zone as dictated by the specific design. Mechanical move system components have a range of pressures that provide optimal performance. For example, many devices are designed to operate at 10 to 15-PSI or even lower. When pressures are greater, these devices will produce water droplets that are very susceptible to evaporation and wind drift. This can dramatically lower a system's efficiency and increase operating costs. Use of pressure regulators reduces these losses and increases efficiency while improving product longevity and returns to the grower.

Energy and water conservation

An increasing awareness of energy savings and pumping costs

are resulting in efforts to conserve energy through improved irrigation system design. This objective can be achieved by lowering the operating pressure of a system. However, the lower a system's design pressure, the more critical it is to changes in pressure. If a system designed for 60-PSI experiences a 5-PSI drop, the result is a 4% reduction in delivered flow. If the same system was designed at 20-PSI the same 5-PSI pressure drop would result in a reduction in delivered flow of a little over 12%, three times greater. With current water availability and quality concerns, placing ever-increasing demand for greater efficiencies in irrigation systems, the use of pressure regulation is critical. Good distribution uniformity is dependent on proper system design. Proper system design hinges on a designer's ability to control the hydraulics of the system through pressure regulation.

The Pressure vs. Flow relationship

The formula to calculate the change in flow resulting from a change in pressure is:

New Flow Rate = Old Flow Rate x the square root of (New Pressure divided by Old Pressure)

A good rule of thumb to use is flow will vary by approximately ½ the variation in pressure. For example if pressure varies by 10%, flow will vary by 5%. A common design practice is to regulate any system with any combination of variables resulting in a flow fluctuation of plus or minus 5% or a 10% maximum pressure variation throughout the entire system. ■

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يُستعمل منظّم الضغط لضبط ضغط المياه في الأنابيب والمحافظة على ضغطها باتجاه منبعها. يستخدم مصمّمو أنظمة الري أجهزة تنظيم الضغط للتحكّم بالمزايا الهيدروليّة للأنظمة وبرمجتها بحسب الحاجة. يتواجد العديد من نماذج منظّمات الضغط لملاقاة المتطلبات المختلفة من حيث التدفّق والضغط، وعلى مُصمّم الجهاز أن يأخذ دائماً بعين الإعتبار أحوال وقياسات التشغيل التي يحدّدها مُصنّع الجهاز وذلك لتأمين تشغيل صحيح لمنظّم الضغط. يُعتبر الهدف الأساسي لمنظّمات الضغط أن تُخفّض الضغط في نظام ري ما، وذلك يساهم بالمساعدة على زيادة الوعي في مجال الحفاظ على الطاقة وتخفيض تكاليف الضغط من خلال تحسين تصميم نظام الري. غير أن ذلك يتسبّب أحياناً بمشاكل إذ تتناقص متانة النظام تجاه التغيّرات المفاجئة في الضغط مع تخفيض ضغط نظام الري بشكل إجمالي.

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