Steam Pressure-Reducing Valve Station Installation Guidelines

The steam pressure-reducing valve station is an indispensable part of a steam system. It plays a critical role by providing the correct steam pressure to the process application in the process plant.

A steam pressure-reducing valve station often employs a pneumatic control valve or a regulating valve (sometimes called a pressure-reducing valve) as the controlling device. However, pneumatic control valves make up a higher percentage of these controlling devices used in pressure-reducing applications.

Thanks to current available technology and better materials, all steam pressure-reducing valve station components should have an operational life of at least six years. Proper design, component selection, and installation of the steam pressure-reducing valve stations will greatly prolong the life of all the steam components as shown in Figure 1.

Let’s review the station components and what action needs to be taken.

1. Match the valve to the Application
To select the correct valve for a given application one must know the maximum and minimum steam flow rates, and understand the pneumatic control valve and/or regulating valve turndown capabilities. When sizing a pressure-reducing valve, always size on the maximum steam flow rate, but know that the minimum flow rate will be a frequent and important control point. That’s because maximum steam flow rates are seldom or never reached in the operation of the steam pressure-reducing valve station, while minimum flow rates will always be part of the operation in most every steam pressure-reduction application. To summarize: the steam pressure-reducing valve must be able to operate successfully at the minimum steam flow rates as well as the maximum flow rates.

Figure 1: Two-Stage Steam Pressure-Reducing Station
Typical Turndown Ratio for Valves:

a. 20 to 1  
   Regulator
b. 30 to 1  
   Globe valve
c. 40 to 1  
   Cage valve

In addition to meeting the given application, all valves (control and isolation) need to meet a designated internal permissible leak rate standard: FCI/ANSI. There are six permissible leak rates or classes numbered I through VI. The higher the leak rate number, the lower the permissible internal leak rate. Therefore, a Class I valve will have the highest internal leak rate and usually the lowest cost, while a Class VI valve will have the lowest permissible internal leak rate and usually the highest cost.

2. Specify 85 dBA or Lower

Pressure-reducing valves that have high dBA levels will also have high outlet velocities and reduced operational life. A pressure-reducing valve with low dBA levels or lower velocities will have a much longer reliable operational life. There are many ways to lower the dBA level in a pressure-reducing valve application, including increasing the valve outlet pipe size, muffling the orifice, or adding special trim.

- The valve manufacturer will provide the appropriate pipe size required after the pressure-reducing valve.
- Muffling orifice plates can be used to reduce a high-pressure drop across the steam valve and reduce velocities.

3. Include Steam Line Drip Pocket

All steam pressure-reducing valves must have a condensate removal drip pocket piped upstream of the pressure-reducing valve. The drip pocket removes condensate from the steam line, preventing condensate from passing through the valve. This is essential because condensate that enters the steam valve will cause erosion and shorten the life of the valve. Even during those times when the steam pressure-reducing valve shuts off during low or non-production periods, the condensate drip pocket will continue to remove accumulating condensate from the inlet of the steam pressure-reducing valve.

4. Include Strainer with Blow-Off Valve

All steam pressure-reducing valves must have a strainer ahead of the valve. Steam lines frequently contain residual solid materials from corrosion and other impurities. The strainer will filter the steam stream and prevent this material from lodging in the valve internals, which would cause premature failure. The strainer should be rated for 0.020 perforated stainless steel mesh. Never mount the strainer with the strainer segment in a down position; instead, install the strainer segment in a horizontal position (see Figure 2). This will prevent condensate from accumulating in the strainer pocket and passing through the pressure-reducing valve, thereby reducing the likelihood of internal erosion and premature valve failure.

Finally, install a blow-off valve on the strainer to allow plant personnel to periodically clean out the strainer. Be sure to choose the proper thread type: straight thread or NPT thread.

5. Locate the Pressure-Reducing Valve

The distance after the steam pressure-reducing valve should be at least 10 pipe diameters before any change in steam flow direction or before the steam line takes offline. The regulating valve could require at least 20 pipe diameters.

6. Position the Pressure-Reducing Valve

The pressure-reducing valve should always be installed on a horizontal steam line, never vertically. A pressure-reducing valve in a vertical installation has no ability to eliminate the build-up of condensate prior to the inlet of the pressure-reducing valve. Condensate passing through a steam pressure-reducing valve always negatively affects that valve’s life.
7. Use Bypass Valves, Warm-Up Valves

Bypass valves and warm-up valves should be used in all pressure-reducing valve installations. The warm-up valve is used to warm the steam line within recommended time frames for the steam line. The warm-up is modulated and controlled during the start-up procedure. A steam pressure-reducing valve should not be used for warming up a steam distribution line.

The bypass valve must have a lower CV than the pressure-reducing valve. When using the same diameter bypass valve as the pressure-reducing valve, the safety valve will have to be sized for the bypass valve, which always will have a higher CV. Sizing the safety valve for the bypass valve will usually require the safety valve to be extremely large in size and capacity.

8. Need a Safety Valve?

If any steam component or the steam line downstream of the steam pressure-reducing valve is not rated for the maximum inlet steam pressure to the steam pressure-reducing valve station, then a safety valve has to be installed to protect the system. The safety valve has to be sized for the maximum steam flow with the highest steam pressure that could be provided to the pressure-reducing valve. In addition,
to ensure the proper size, perform the calculations with the largest CV trim available for the pressure-reducing valve.

Safety valve discharge should be piped to a location where the steam discharge will not pose a safety risk for plant personnel.

See Best Practice on Safety Valve Installation.

9. When Two or More Valves Are Required
More than one pressure-reducing valve arrangement is used when the steam flow varies greatly and one valve does not have the required turndown capabilities. The safety valve has to be sized for all valves failed in the open position with the largest trim available from the manufacturer.

Note: The piping from the pressure-reducing valve to the downstream isolation valve has to be designed and installed to meet the highest steam pressure at the inlet to the pressure-reducing valve. The downstream isolation valve is located before the safety valve protecting the system, so if the isolation valve is closed and the pressure-reducing valve goes into the open position, then the piping could experience the inlet steam pressure.

10. Before and After Pressure Gauges
It is always good practice to install pressure gauges before and after the
steam pressure-reducing valve as diagnostic tools. Be sure to include a siphon pipe and isolation valve for maintenance purposes. In systems with high vibration levels, use liquid-filled gauges to extend the life of the pressure gauge.

11. Standard Operating Procedures (SOPs)
Every pressure-reducing valve station requires a SOP to ensure the plant personnel are starting, operating, and shutting down the valve station correctly and safely. The valve manufacturers should provide the SOP as part of the documentation with the equipment.

![Typical Pressure-Reducing Valve Station](image-url)