"Establishing Pressure/Flow Control For Sample Systems"

Flow control of liquid sample is important to help assure the quality of the samples and repeatability of the analytical results. Constant flow in the sample line minimizes the chance of modifying the chemistry of the samples of high purity water through entrapment and/or release of soluble species from deposits in the system. Analyzer repeatability is enhanced when the flow rate through the sensor remains constant.

The best way to establish constant flow is to establish a zone of constant pressure within the sampling system so that changes in sample supply or demand do not alter sample flow characteristics to the analyzers. To accomplish this zone of constant pressure, a pressure reducing device (generally a needle valve or Sentry VREL valve) is combined with a back pressure regulating valve, (Fore pressure valves that do both pressure reduction and regulation should not be confused with back pressure regulator valves. They do not keep the total sample flow constant if the analyzer flow demand varies. Also, in higher pressure applications, there is usually erosion on the seat causing lack of pressure control) assuring constant flow to the analyzers even if the source pressure varies. The back pressure valve works by regulating the pressure above it. Once the pressure is regulated, the desired constant flow requirement will be achieved. Should the source pressure remain constant, as is the case in most power plants, the total flow in the sample line will also remain constant. Using the regulator outlet flow for the grab sample is a good way to keep the system simple.

Note: Using a Sentry VREL or needle valve with a fore pressure regulator negate the ability to control total flow because the fore pressure regulator counteracts any change in position of the VREL/needle valve trying to maintain constant pressure.

Let`s look at the various pressure reduction devices and back pressure regulating valve alternatives.

Pressure Reduction

A fixed or variable orifice can provide the pressure reduction in a sample line. Fixed orifices can be capillary tubes or fixed rod-in-tube devices. Variable orifices can be needle valves, variable rod-in-tube devices (Sentry VREL) or multi-disc pressure

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reduction valves. Sometimes orifices plug from bursts of crud that release from plant piping during start-up or operational changes. When a capillary, fixed rod-in-tube, or multi-disc valve plugs, the sample line must be shut down to disassemble the component for cleaning. This plugging often happens at start-up, a time when proper analysis is critical and downtime to clean the pressure reducer is a real problem. The VREL and needle valve have the advantage of being able to be opened while in operation allowing the crud to pass through.

Back Pressure Regulation

Back pressure regulating valves are highly reliable, especially since they operate in a low pressure region. They must be selected to have good sensitivity across a fairly wide flow range. Set pressures can vary from 10-50 psi, but Sentry has found that in most applications a fixed pressure back pressure regulating valve is much easier to operate and provides adequate pressure to all analyzers. The fixed pressure eliminates the need to tweak the valve after each adjustment of the VREL or needle valve, and eliminates the possibility of getting a setting that starves the analyzers downstream. Sentry has developed a device with a fixed pressure (23 psi, higher pressure available) that acts as a back pressure valve in combination with a relief valve. This device, denoted a BPR/RV, eliminates the need for a separate sample relief valve since the line cannot be shut off by inadvertently closing the back pressure regulating valve. It is designed to relieve sample over pressures caused by other component/system problems.

Design Tips - Welding Small Diameter Tubing

Welding of austenitic stainless sample tubing joints is normally done to increase the reliability for critical samples. These samples are frequently at high temperature and pressure. Most often, tubing joints are socket weld.

Tungsten-inert-gas, TIG, is the easiest process to employ for welding small diameter tubing. Purging the inside of the sample tube with inert gas will minimize excess penetration which would result in blockage of the tube ID. Use the minimum heat which will provide adequate joint penetration. Watch for undercuts which can significantly reduce the strength of thin wall tube. An undercut of only .020" will reduce the wall thickness of .042" tube by almost 50%. Insure that the tubes in socket weld joints have been pulled out 1/16" to prevent bottoming out in the socket.

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For operating temperatures below 1000°F it usually is advantageous to use tubing with a low or reduced carbon content. Sentry prefers to use welded tubing of SA249TP316. The tube manufacturer limits the carbon content so the corrosion resistance of the parent material during longitudinal seam welding is not reduced. Select the chemistry of the welding electrode to provide sufficient delta ferrite to prevent cracking.

Check that your welding procedure qualifications and welder performance tests qualify the diameter and material thickness.

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