Streamline

Power Plant Maintenance *and* Enhance System Performance

with Small Bore Tubing Up to 2 Inches OD

If you need to service your steam turbine throttling valves, you want to get in and out of the system quickly.

Or, to take another example, suppose you need to change out pilot solenoid valves in your electrohydraulic controls (EHC). Again, you want to get in and out of the system quickly. Downtime is lost revenue.

Unfortunately, cutting, welding, and threading hard pipe is not a quick process. It's slow and labor intensive. A better alternative may be stainless steel tubing.

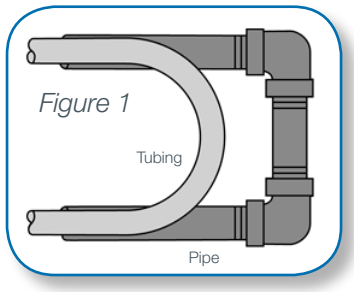
Most control systems in a power plant depend on fluid delivery of one kind or another – steam, condensate, hydraulic fluid, chemicals, pressurized air, etc. And these fluids are delivered through piping systems, many of which are 2 inches in diameter or less. For these fluid systems, stainless steel tubing, instead of hard pipe, can greatly simplify installation and plant maintenance.

If you were to compare two teams of technicians building any typical configuration involving 90-degree turns and other complexities – one working with stainless steel tubing and the other with hard pipe – you will probably find that the stainless steel tubing team would finish many minutes, even hours, ahead of the piping team.

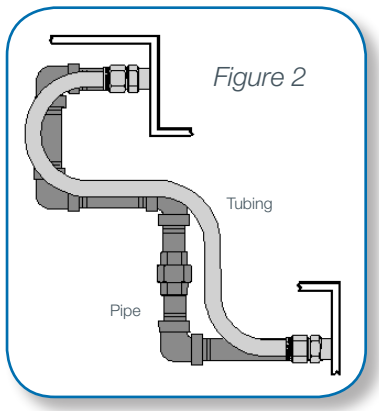
Further, with stainless steel tubing, no special contractors or welding teams are required on the plant floor. Your own technicians can be trained to manage the bending and assembly.

Let's take another look at your EHC, but this time from the standpoint of fluid power efficiency. A pump drives hydraulic fluid to a set of electronically controlled valves. In turn, these electronic valves send precise signals to the actuator of the steam turbine throttling valves. So, the whole system is dependent on the efficient transfer of fluid power from one location to the next. The EHC must be quick and responsive. If your power demand is up, you need greater steam volume at the turbine, and you need it fast.

And yet, hard piping systems are inefficient by their very nature. They contain hard 90-degree turns (elbows), which create pressure drop. They also contain threaded pipe fittings, which are likely to leak, especially if your system generates vibration or thermal expansion and contraction *(Figure 1).* These leaks can starve your system of pressure.



By contrast, stainless steel tubing is bendable to precise radiuses. Therefore, rather than 90-degree elbows, you can create gradual sweeps, which minimize pressure drop *(Figure 2).* And through a combination of tube bending and automated orbital welding, you can greatly reduce the number of potential leak points or mechanical connections. Where mechanical connections are necessary, Swagelok tube fittings will not back off with thermal cycling or high vibration, unlike hard pipe threaded connections. As a result, stainless steel tubing systems can pay for themselves many times over.



Swagelok®

Stainless Steel Tubing Systems Are Assembled and Disassembled More Quickly and Easily

Let's take a closer look at why stainless steel tubing is the preferred solution for piping systems two inches in diameter or less, particularly from the standpoint of installation and plant maintenance, as well as reliable performance.

Stainless steel tubing is usually employed for instrumentation in diameters of a ½ inch or less. If you have ever worked with stainless steel tubing in these smaller sizes, you will find that it is no different in the larger sizes. For example, tube cutting and preparation are all the same. And you can bend stainless steel tubing up to 2 inches to any desired radius, with allowances for springback, using manual or electronic tube benders.

Tube fittings up to 2 inches fully tighten and seal with one-and-a-quarter turns, just like the smaller fittings, but because they are proportionally larger, we recommend that you use a hydraulic swaging unit to prepare the stainless steel tubing.

For permanent connections, the Swagelok orbital welding system will produce precise, repeatable welds and full documentation of the weld quality. Orbital welds are just as strong as tube fitting connections. The Swagelok orbital welding system and other equipment for larger-sized stainless steel tubing, including tube benders and swaging units, are available for sale or rental through your authorized Swagelok sales and service center.

With stainless steel tubing systems, a best practice is to assemble permanent, welded connections in the instrument and control shop. Then, move the assembly to the plant floor and connect it with tube fittings. If the tube fitting connections are strategically located, then the system becomes modular. All Swagelok tube fittings can be made and remade without compromise to the quality of the connection. When a particular valve or panel needs to be serviced, the tubing assembly is simply detached at the tube fittings and set aside. Then, when service is complete, the assembly is reattached with one-and-a-quarter turns of the tube fitting nuts.

The speed and ease with which Swagelok tube fittings can be disconnected and reconnected are unmatched by hard pipe threaded fittings. Further, almost as soon as the last tube fitting is assembled, a tubing system is ready for service. There is no need to flush the system because assembly does not produce filings and chips like a hard pipe system does. These filings and chips from hard pipe can potentially clog the transducers on the pilot solenoid valves or otherwise undermine the performance of valves.

Reliable Performance Even with High Vibration and Temperature Swings

Unlike threaded connections, Swagelok tube fittings are highly reliable under a range of conditions, including high vibration and changes in temperature.

Threaded pipe fittings are prone to failure under these conditions. Threaded pipe fittings employ an "interference fit" – a series of mating wedges that are forced into a competing space. The fit may be tight at one temperature but become loose with changes in temperature. Vibration can also shake a threaded connection loose, especially if temperature changes come into play.

A Swagelok tube fitting resists vibration because it is anchored to the stainless steel tubing with two ferrules, which are permanently affixed to the tubing during makeup. The front ferrule performs the sealing function, while the back ferrule grips or holds the tube over a wide area, enabling the tube fitting to resist vibration *(Figure 3).* The two ferrules do not in any way compromise the

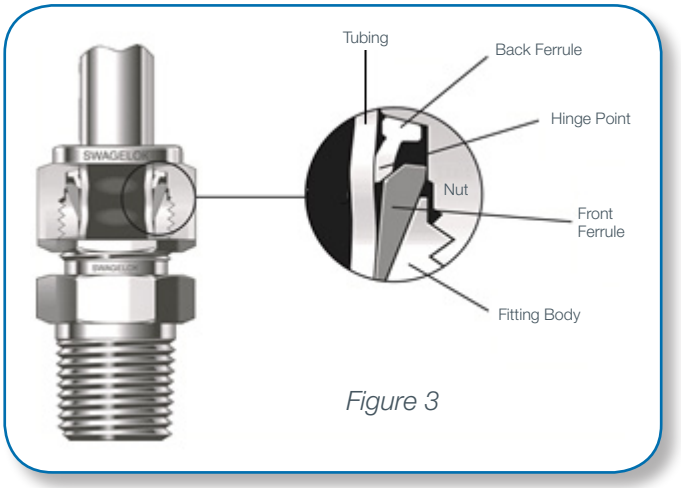


Figure 3

strength of the tubing wall, unlike some competitive two-ferrule fittings that may bite into the surface of the tubing wall, creating a “stress riser” or a condition that invites failure during vibration.

Swagelok’s tube fitting product test report (PTR-1308) documents a rotary vibration test derived from SAE-ARP-1185. At least 48 Swagelok tube fittings were assembled with a piece of stainless steel tubing and pressurized with hydraulic oil at the tubing’s working pressure. Vibration was created at the alternating stress of 2,800 lbs/in2, a strain level that frequently results in failure, according to ASME Pressure and Vessel and Piping (PVP) 62. None of the Swagelok tube fittings in the test failed to reach 10 million cycles, a mark that is usually equated with infinite life, according to ASME PVP-62.

In some power plant applications, vibration may be so severe as to cause stress fractures in the stainless steel tubing itself. In this case, there are a couple of possible solutions. You can bend the tubing into a hairpin or pigtail configuration, which can help to absorb the vibration *(Figure 4).* These solutions also work well in places where there is substantial thermal expansion and contraction. Many technicians may not realize that hose is another option. Also available up to 2 inches in diameter, hose can manage most pressure and temperature requirements. A common location for hose in a power plant is between systems or different platforms, racks, or foundations, where vibration is at its worst. Make your choice among hose options with care so you can minimize your cost of ownership. Depending on your pressure and temperature specifications, there are material options for the hose core, reinforcement layers, covers, and end connections. There are also options for the interior wall surface, which will affect the hose’s flexibility and drainability.

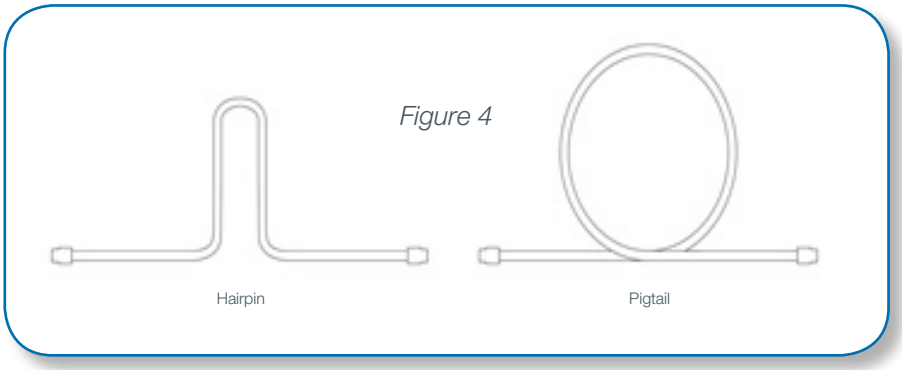


Figure 4

Power Plant Instrumentation and Control Applications

An EHC system is only one of many systems in a power plant whose efficiency can be greatly improved by switching from pipe to stainless steel tubing, including the chemical feed system, water sampling system, duel fuel systems, generator and lube oil systems, and hydrogen cooling for the generator. Many control and process support systems employ piping 2 inches or less in diameter and, therefore, could be converted to stainless steel tubing. Ask yourself, how critical is the efficiency of this system? If it were faster, more accurate or consumed less power, how significantly would that affect overall plant efficiency and revenue? How frequently is maintenance required on the system? If maintenance could be performed more quickly and easily, how significant would that benefit be to your power plant?

For more information on how small bore tubing can enhance your performance and reduce maintenance, contact your local Swagelok authorized sales and service center or visit us at www.swagelok.com.

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