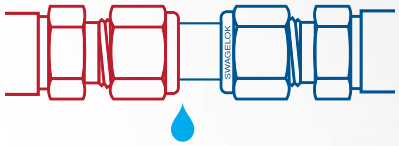
7 TIPS FOR BUILDING SAFER FLUID SYSTEMS

In a processing plant or refinery, potential risks lurk around every corner. As a plant manager, one of your primary responsibilities is to reduce those risks – so you can not only ensure safety, but also maintain uptime and preserve a steady revenue stream.

One critical area of focus is your plant's fluid systems. Such systems often transport high-pressure and high-temperature fluids and gases that could increase health, safety, and environmental concerns if something goes wrong. Failure of these systems is not an option. Fortunately, your engineers and technicians can take a variety of steps to enhance the safety of your fluid systems, particularly when designing them.

1. NEVER MIX COMPONENTS FROM DIFFERENT MANUFACTURERS

All products are not created equal. For instance, half-inch fittings from different manufacturers may not have the same tolerances. Combine the two, and you may open the door to increased potential for leaks or a dangerous blowout. Obtaining a leak-tight seal that will withstand high pressure, vibration, vacuum, and temperature changes depends on exacting tolerances, meticulous quality control, and time-tested design principles. Your best bet is to choose a consistent, reliable component supplier with quality products manufactured to rigorous standards, ensuring part compatibility throughout your operations.



Interchanging and intermixing components made by different manufacturers can result in unpredictable performance, environmental releases, safety problems, and increased costs.

(Source: Swagelok Energy Emission Survey Letter. January 2018. Available upon request.)

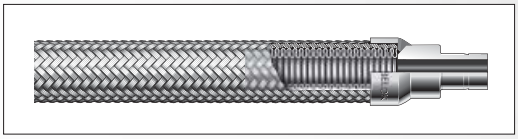
2. MINIMIZE OPPORTUNITIES FOR MISTAKES

Let's face it, mistakes can happen. However, you can do a lot to minimize the potential for errors by following safety-minded system design principles. For starters, better labeling can go a long way toward reducing mistakes. You can mount detailed tags on your equipment and hoses to indicate what takes place within the system, so operators know what's at stake when making adjustments. You can also color code handles, tubes, and pipes throughout your plant, so workers can immediately identify what types of fluids or gases are flowing through them. Another useful strategy is to install components to minimize the risk of accidental contact from moving objects or people. Even better, add a lockout on a critical process valve to prevent accidental actuation and eliminate a safety concern.

Color coding various parts enables immediate identification of system contents to reduce errors.

3. USE IDEAL COMPONENTS FOR THE JOB

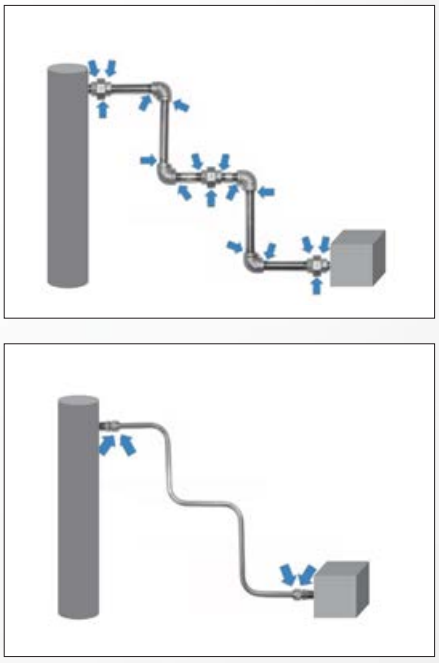
When the stakes are highest, it's rarely worth the risk to make a price-based decision. You won't be able to justify minor savings on a component if that part leads to a costly safety event. Instead, rely on brands with a proven reputation and track record in your application. Also, be sure to only purchase parts through trusted partners and authorized channels, as counterfeit and substandard inventory can harm your operations.



Selecting ideal components requires a complete understanding of process conditions. For example, if the system will generate a static charge, you want to use a hose with a conductive metal core (shown) or a PTFE core with carbon black, which will dissipate static rather than discharge it through the hose's core, preventing leakage.

4. REMOVE COMPLEXITY WHEREVER YOU CAN

Reducing system complexity wherever possible will help you minimize potential complications. Simplifying systems also enables maintenance efficiencies, as technicians will be able to troubleshoot problems easier when they have fewer components to analyze. In addition, consider removing some complexities from your operations altogether by having a supplier build custom fluid system assemblies for you. Whether an assembly consists of a few components or a complete panel or enclosure, there is room for error when piecing these parts together. A supplier that can repeatedly build high-quality assemblies, backed by a warranty, will take any guesswork out of your team's hands – and provide some peace of mind that the assembly is leak-tight.

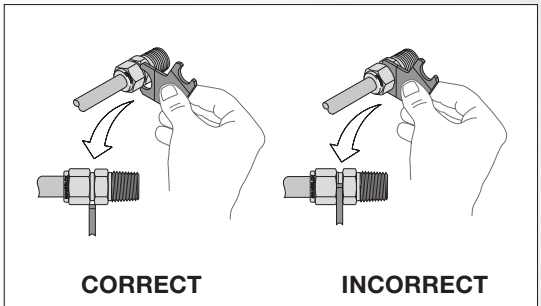


When simplifying your designs, consider changing piping runs to bendable tubing instead to reduce potential leak points. The pipe assembly (top) has seven fittings and 17 potential leak points, compared to just two fittings and four potential leak points when using tubing (bottom).

5. CAREFULLY FOLLOW MANUFACTURER'S INSTRUCTIONS

Failure to follow documented assembly and disassembly procedures might seem like a minor mistake, but it can lead to major consequences. The best practice is to follow the manufacturer's installation steps to avoid common errors, such as:

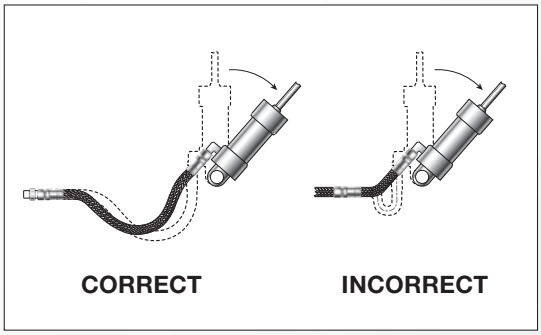
- Undertightening fittings, which creates opportunities for leaks and blowouts
- Overtightening fittings, which limits the potential number of remakes
- Not ensuring tubing rests firmly on the shoulder of the tube fitting body before tightening
- Failing to properly check tubes for ovality, defects, or scratches that can compromise a seal
- Failing to check extremes of wall thickness against fitting manufacturers' suggested limitations



Not using a proper gap inspection gauge to ensure sufficient fitting pull-up is a common installation oversight. Be sure installers always position a gap inspection gauge next to the gap and tighten the fitting further if the gauge can enter the gap (right).

6. FACTOR FOR VIBRATION AND MOTION IN YOUR DESIGNS

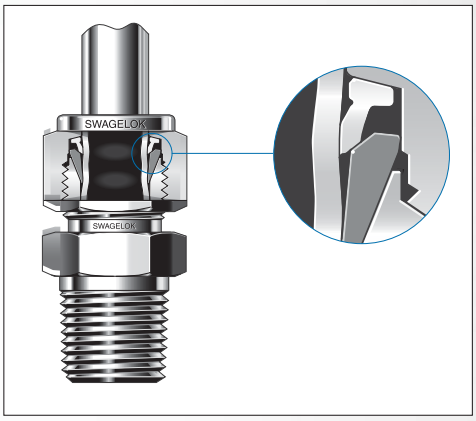
When assembling a deenergized system, it can be easy to forget about the effects of machine vibration. Your team will need to account for this in their designs to avoid the potential for vibration or movement to damage tubing or cause fittings to loosen and leak. They'll want to add proper supports to ensure tubes and fittings will not become fatigued or dislodged during high-pressure usage. In addition, they should allow for a proper range of motion for moving components, as motion can place added strain on components and connection points. In some cases of vibration, they may want to switch to a hose, which may absorb the vibration better than tubing. However, remember hoses will need to be replaced over time. Therefore, component life should be part of design considerations as well.



When using a hose in a motion application, distribute movement over a sufficient length of hose to prevent any bends that are smaller than the hose's minimum bend radius. Too small of a bend can lead to premature hose failure.

7. ACCOUNT FOR TUBING HARDNESS AND MATERIAL COMPATIBILITY

To ensure a leak-tight fitting connection, it's important for component materials to be compatible with each other and have the appropriate hardness to stay connected. Metal tubing should be softer than the fitting components so they can effectively grip the tube. For example, avoid using brass fittings with stainless steel tubing, as the fitting material is too soft to provide a sufficient hold on the tube. If your team needs to use tubing and fittings made from the same material, they should try to use fully annealed tubing to reduce its hardness and make it more workable for a better connection.



A tube fitting with a hardened back ferrule (light gray) provides the differential hardness needed to achieve a robust, leak-tight tube grip with excellent vibration resistance over a broad range of specifications.

KEEP YOUR TEAM UP TO SPEED

While the above steps sound simple, they're often overlooked. Ensuring your team keeps best system design and installation practices top of mind will help your operations stay on track. It is also a good practice to offer your team training opportunities and refresher courses. Taking appropriate precautions and following sound design principles on the front-end can help to prevent costly errors and enhance plant safety over the long term.

For more pointers on designing risk out of your systems, contact your local **Swagelok sales and service center** or sign up for a **Swagelok Essentials training course**.