

## Routing and Clamping

Most hydraulic, pneumatic and lubrication system requires some form of tube line fabrication and fitting installation for completion. Proper fabrication and installation are essential for the overall efficiency, leak free performance, and general appearance of any system.

The following factors should be considered early in the design process, after sizing the tube lines and selecting the appropriate style of fitting:

1. Proper routing of tube lines
2. Adequate tube line support (clamping)

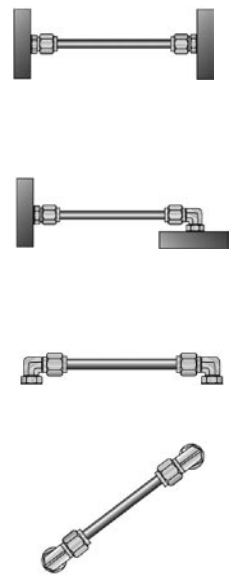
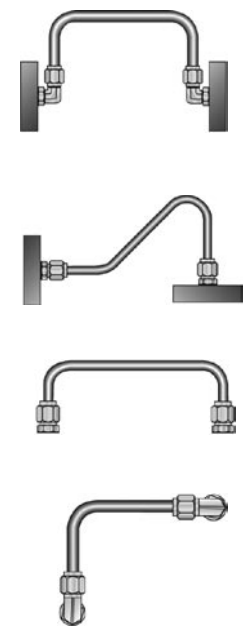

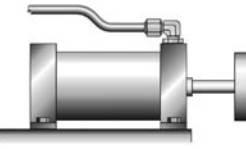
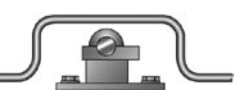



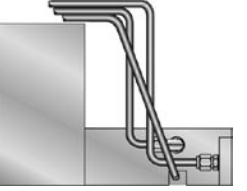
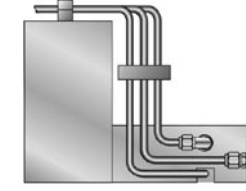
### Routing of Lines

Routing of lines is one of the most difficult, yet most significant of these system design considerations. Proper routing involves getting a connecting line from one point to another through the most logical path, while considering other factors as discussed below.

The most logical path is not always the direct path and should have the following characteristics:

- **Avoid excessive strain on joint** — A strained joint will eventually leak. A straight line tube assembly (with no bends) or a joint that is forced into position are common examples of strain applied to tube assemblies.
- **Allow for expansion and contraction** — Use a “U” bend or a hose in long lines to allow for expansion and contraction due to pressure or temperature fluctuations.
- **Allow for motion under load** — Even some apparently rigid systems do move under load. Use an offset (“S”) bend.
- **Get around obstructions without using excessive amount of 90° bends** — Pressure drop due to one 90° bend is greater than that due to two 45° bends.
- **Keep tube lines away from components that require regular maintenance.**
- **Leave fitting joints as accessible as possible** — Inaccessible joints are more difficult to assemble and tighten properly, and more time consuming to service.
- **Have a neat appearance and allow for easy trouble-shooting, maintenance and repair.**

The following illustrations provide several examples of typical routing situations. The graphics show the preferred and non-preferred path along with an explanation.

Non-preferred Routing	Preferred Routing	Explanation
		<p>Avoid straight tube lines. There is no margin for error on a straight line, resulting in excess joint strain.</p>
		<p>Allow for expansion and contraction of lines by utilizing “U” bend.</p>
		<p>Offset (“S”) bend allows for motion under load.</p>
		<p>Avoid excessive pressure drop by getting around obstructions without using 90° bends. One 90° bend causes more pressure drop than two 45° bends.</p>
		<p>Avoid creating an obstruction by routing lines around areas that require service. Leave adequate clearance for wrenches.</p>
		<p>Route lines to allow for proper clamping. When done properly, several lines can typically be clamped together.</p> <p>Route lines to allow for trouble-shooting. Lines that cross and are not in logical order tend to be difficult to work with during maintenance.</p>