



### On-Line Leak Repair 101

The following article details typical procedures and considerations that are followed each time an experienced and thoroughly trained field technician from "Midwest Pipe Repair" surveys a leaking component in your facility.

Occasionally excessive corrosion, erosion, vibration or thermal stress can cause leaks to develop in a piping system. The leaks may occur in straight pipe, elbows, miter bends, tees, or at flanges or valves. In other instances, thinned areas of piping may be found during routine inspections required by API 570, *Inspection, Repair, Alteration, and Re-rating of In-Service Piping Systems*. In some cases, the leak can be stopped with a fiberglass or carbon fiber reinforced epoxy wrap (a service also available by MRP) or a gasket and pipe clamp until a permanent repair can be made to the piping. However, in many cases the temperature &/or pressure is too high, and the time required for the epoxy wrap to be relied on to contain the leak is considered too long, or the weakening of the piping component is so severe that separation of the pipe is possible. In these cases, a longer term and more reliable repair is required; such as a leak repair clamp or enclosure. *Midwest Pipe Repair* has the capabilities and the experience to design, fabricate and install such an enclosure and repair your leak on-line and under pressure.

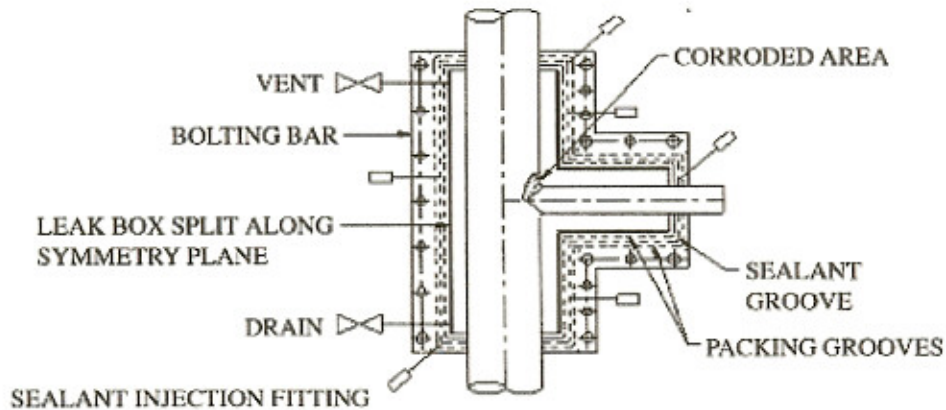


Figure 1 shows the typical design features of a bolt-on "Tee" enclosure. This type of enclosure typically uses bolts to:

- Restrain the internal pressure force acting on the component parts of the enclosure,
- Transmit forces across the weakened area of the piping, and
- Compress a gasket or packing material to make a leak tight enclosure.

The bolts and the bolting flanges must sometimes be quite large to restrain the pressure force in the piping. Basically, the pressure acting on the component parts of the clamp/enclosure must be designed to restrain the pressure forces that would tend to blow the box (enclosure) apart. The bolting flange must be designed

to transmit these loads and also limit distortion of the gasket or packing and make the clamp/enclosure leak tight. In many cases, the clamp/enclosure has to be precision machined so that it fits snugly to the pipe and so that there is just the right amount of compression on the tubing or packing seal. While the bolt-on type of clamp/enclosure can be used as a permanent repair, it is typically used as only a temporary repair until a conventional repair can be made to the piping system. This is because the bolting may relax with time and temperature, and the packing may leak with time.

### Basic Design Considerations

The design pressure, design temperature, pipe material, pipe thickness, corrosion allowance, fluid service, and any restrictions associated with the service should be determined. This usually entails checking the piping drawings, piping line list, and piping materials specifications for the existing line(s). In addition to the design pressure and temperature, it is important to determine any piping forces that must be transmitted through or across the clamp/enclosure. The piping forces may be due to pressure, weight, or thermal expansion. In addition to the weight of the line and its contents, the weight of the clamp/enclosure itself and the filling of the voids within the clamp/enclosure with the process fluid or sealant must be considered. The next step is to determine the size and type of box that must be used to completely enclose the affected area. Accurate measurements must be taken of the piping, including the exact diameters where the clamp/enclosure will close on the pipe. The location of all weld seams, small connections, pipe supports, or other obstructions must be determined. A field check should also be made to determine if there are any installation problems or safety concerns.

### Bolted-on Clamp/Enclosure Design Aspects

The clamp/enclosure enclosure is usually formed from cylindrical pipe sections or rolled plate; however, sometimes pipe caps or conical reducers are used. Each piece of the clamp/enclosure is then designed in accordance with ASME B31.3 (or other applicable Code). The box is typically split along a symmetry plane and bolting bars or flanges are installed along the cut edges and ends. Bolts are then used to clamp one half of the box to the other. This bolting must be designed to restrain the pressure acting on the symmetry plane that would tend to blow the box (enclosure) apart.

For tee-shaped clamp/enclosures, such as when a tee, branch connection, or a valve is enclosed, the enclosure is typically designed as a branch connection in accordance with ASME B31.3 (or other applicable Code). The opening in the main enclosure should be reinforced, if necessary, in accordance with the applicable Code. The bolting for a tee-shaped box must be appropriately proportioned between the run and the stem of the tee. The layout of the bolting must also be properly proportioned to contain the pressure forces that must be carried around the opening.

If the corrosion of the underlying pipe is very severe, such that separation of the piping is possible, it is usually necessary to design a "safety strong-back" to clamp the pipe outside of the weakened area to restrain the longitudinal pressure forces in the line. This feature can sometimes be incorporated into the design of the box, but is often designed separate from the box similar to the way tie rods span the flexible elements in a universal expansion joint.

The bolting must also be designed with sufficient reserve to maintain adequate pressure on the tubing/or packing seal to maintain a leak tight seal on the perimeter of the clamp/enclosure. The selection of the tubing or packing material (i.e., copper, stainless, graphite or teflon), the size (1/4" or 3/8") and the design of the tubing/packing grooves require the knowledge of an experience field technician. In some cases, tubing is used as a temporary sealing device and a pumpable sealant is injected into the sealant grooves to make the box leak tight. However, in most cases the clamp/enclosure will be pumped full with the appropriate sealant.

### Tubing/Packing Selection

The tubing or packing must also be suitable for the contained fluid, as well as the long time pressure and temperature conditions it will be subjected to.

Some types of packing are extruded square or rectangular in shape while other types are braided. Typical molded or extruded packing materials are Buna-N, Ethylene-Propylene Neoprene, Silicone, Viton or Teflon. Molded or extruded packing usually has better leak sealing capabilities. Braided packing materials such as Grafoil and Kevlar can be used at higher temperatures; however, because they are braided, they require higher compression forces to maintain a leak tight joint.

### Design for Pressure Thrust

If separation of the pipe is possible, then the repair clamp is usually designed for the pressure thrust. In this case the jacket, and especially the end plates, must be designed to transmit the load across the weakened pipe section. In cases when the pressure is relatively low and the box size is small, the end closures can be flat plates and be designed as flanges (e.g., ASME Code Section VIII, Div. 1, Appendix 2). If the pressure is high, either conical or formed reducers are typically preferred over flat end plates since flat plates can become very thick and the welds on the pipe can be very large. Pipe caps can sometimes be used as end closures, but special consideration must be given to reinforcing the opening in the pipe cap. In some designs, external tie rods (also referred to as a "safety strong-back") can be used to carry the pressure thrust over the weakened piping section in a manner similar to that used in a universal expansion joint. In these cases, the end closures can again be designed as end closures of a jacketed vessel.

### Summary

The above procedure outlines the typical considerations used in the design, fabrication, and installation of a leak repair clamp or enclosure provided by *Midwest Pipe Repair*. Our technicians collectively have over 50 years of experience in this industry which clearly qualifies *MPR* to be your choice for all of your on-line repairs on steam, water and process piping systems.