

Ports and Connectors 101



Hydraulics have been an essential part of industrial technology for well over a century, which means maintenance technicians may find themselves confronted with anything from the latest high-tech fittings to hundred year-old port configurations. Most of the time, there's no real way to know exactly what's under the accumulated paint and grime covering the valve or manifold that just failed, but the technician is still expected to be able to identify the connector and replace it quickly and without error. Here is some basic information, as well as tips to help you make the right choice to get your equipment up and running again as quickly as possible.

Dial Determination

If the equipment you're working on is old, chances are very good that it has ports that use NPT tapered pipe threads. These are easily identified because the threads get smaller as they reach the end of the male fitting, or go deeper into the port—that's why they're called tapered pipe threads.

If in doubt, just put the jaws of a dial caliper on the large diameter and then align them with the axis of the fitting. The jaws are parallel, so if it's a tapered fitting or port, you'll quickly see it. If it is, you then need to determine if it's a National Pipe Thread (NPT), a British Standard Pipe Thread (BSPT), or a Metric Pipe Thread. To do that, you will need a set of pitch gages.

While they're still very common, tapered thread ports generally are not the best

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Published on Industrial Maintenance & Plant Operation (<http://www.impomag.com>)

choice available today. They never were intended to be disassembled repeatedly, and joint integrity quickly deteriorates if they are.

In addition, the thread engagement leaves a spiral leakage path between the male and female threads. That is why thread sealants like “pipe dope” or Teflon tape is commonly used on tapered thread joints. There are variations of the tapered thread developed to provide better sealing, but all have essentially the same basic limitations.

Tapered threads are very torque sensitive which makes it difficult to achieve consistent sealing and good assemblies. They also generate high radial forces when they are tightened because the tapered shape acts like a 3D wedge. It is not uncommon for the casting containing the port to split if the joint is seriously over-torqued.

If you have to work on a component with tapered thread ports, it's best to replace the male fitting rather than attempt to re-assemble it. Also, be careful with the use of sealants like Teflon® tape on the threads to make sure none of the material gets into the hydraulic system where it can clog orifices and cause other problems.

Parallel Thread Ports

Parallel thread ports and fittings have a uniform thread diameter for their entire length, like nuts and bolts. Because they lack the “jamming” action that creates the seal in a tapered thread joint, they generally use an elastomeric or mechanical seal. If in doubt, apply the same caliper test used to identify a tapered thread. A parallel thread port or fitting will be the same diameter from end to end.

Parallel thread ports and fittings handle repeated assembly and disassembly very well. Eventually an elastomeric seal may have to be replaced, but that is a simple operation. They are also much less torque sensitive than tapered thread joints, making them easier to assemble consistently.

The advantages of parallel thread ports and fittings are significant enough to make the conversion from tapered to parallel worthwhile. One solution is to install what is commonly known as an “O-ring boss” or ORB connection using an O-ring in a chamfer gland in the port and use it to connect to the tube.

Inch Or Metric?

If your component uses tapered thread connections it is most likely inch-based. The most common sizes are 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1-1/4, 1-1/2, and 2, although other sizes do exist.

Things are more complicated if the component uses parallel threads, because it can be either inch or metric. One way to know for sure is to use a pitch gage and very carefully check the fit. Some inch and metric threads are very close, so a good deal of care is required to make an accurate identification.

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There are a couple of unique combinations that will identify an inch or metric fitting. For example a 37 or 45 degree flare fitting will probably be inch, and a 30 degree cone or 60 degree flare will probably be metric. For the more common 24 degree flare and flareless fittings, though, the pitch gage is the best solution. Regardless of the fitting type, don't forget that many special configurations exist, so use care in making your selection.

A metric ORB, or threaded stud end, conforms to the ISO 6149 standard which calls for the hex of the jam nut on shaped connectors to be turned down so its diameter is less than the wrench flats. For straight stud metric ORB connectors, an identification groove is added in the turned down area. This unique profile is a sure identifier of a metric ORB. Inch ORB's conform to SAE standards, which do not include the turning operation on the jam nut or the groove on the straight stud connectors.

Hose Or Tube? Flared Or Flareless?

Like NPT ports and fittings, if you're dealing with hose there is only one standard worldwide. Tubing, on the other hand, is available in both inch and metric sizes. The governing specification for tube fittings is ISO 8434, which has five parts:

- 24 degree cone connectors.
- 37" flared connectors.
- O-ring face seal connectors.
- 24 degree cone connectors with O-ring weld-on nipples.
- 60 degree cone connectors with or without O-ring.

Generally speaking, if the tubing is inch-based, the fittings and connectors will be either JIC/37 degree flare types, or O-ring face seal types. If the tubing is metric, the most common connectors are the 24 degree compression-type.

Another way of categorizing tube fittings and connectors is based on whether or not the end of the tube is straight or formed. While the flare is the most common formed configuration, others are available that offer assembly and performance advantages.

For example, Eaton's Walterscheid™ WALFORMplus™ system forms an annular ring near the tube end which captures a nut. The mating male connector traps an elastomeric sealing ring and presses it against the annular ring when the joint is tightened. The result is a quick, reliable, self-regulating connection that resists over-torque and other common assembly faults.

Flareless connections can further be categorized into metallic and elastomeric solutions. The most advanced metallic solutions use cutting rings that displace the tube material to form a metal-to-metal seal as the connector is tightened.

Step-By-Step

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Regardless of what kind of ports and connectors your system uses, the key to successful maintenance procedures is a deliberate, methodical, step-by-step approach:

- Identify the thread system—tapered or parallel.
- Identify the measurement system—inch or metric.
- Identify the conveyance system—hose or tube.
- Identify the tube sealing system—flare or flareless.
- Identify the sealing technology—metallic, elastomeric, or both.
- No matter what you find, your local hydraulic component distributor will have the fittings and connectors you need to affect a safe, efficient repair—even if your equipment has been at work for a century or more.

Source URL (retrieved on 12/27/2014 - 4:58pm):

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