Most people are aware that hydraulic fittings such as 37° Flare (JIC), O-Ring Face Seal, or Metric Flareless (DIN) tube fittings are designed to industry standards, such as SAE J514 or ISO 8434-1. These standards govern their dimensional characteristics. However, most of these standards also cover performance requirements including pressure, temperature and corrosion resistance. In the US, SAE standards governing hydraulic fittings, hose and tubing fall under the Fluid Conductors and Connectors Technical Committee and generally take precedence over International (ISO) or country-specific standards (DIN, BS).

These standards have evolved over the years with many of the latest versions also specifying performance criteria to improve consistency in the market. For example, SAE J1453 Part 2, O-Ring Face Seal Fittings, states the following: “The connector assembly shall meet or exceed all applicable test pressures shown in Table 5* when tested at the torques shown in Table 6*. Connectors shall pass the burst, cyclic endurance (impulse), vacuum and overtorque tests when tested per ISO 19879.”

In addition to pressure-performance requirements, SAE J1453 Part 1, shown in Figure 1, provides guidance on working temperature (-40°C to 120°C) and corrosion resistance (96 h in accordance with ASTM B117). This standard makes it clear for fitting manufacturers and their customers what the fitting should be capable of, at least for carbon steel products.

The requirements set forth in the standards, such as working pressure, are considered minimum design criteria and are often exceeded by some manufacturers, or modified for materials other than the standard carbon steel. Aluminum is a popular material option; however, the standards do not directly cover performance requirements for aluminum. Therefore, by using the testing guidelines such as those in SAE J1453, a manufacturer can develop material-specific working pressure recommendations for fittings materials other than carbon steel that will meet the performance criteria. The common approach to qualification of a new material typically has three steps.
Step 1 involves establishing the make-up torque for the new fitting material, which will be required for the next two steps. A good rule of thumb for this is to start with a multiplier of the ratio of the tensile strengths between the new material and low carbon steel. For example, aluminum has a tensile strength of about 30,000 psi, while low carbon steel tensile strength is about 60,000 psi. Therefore, a multiplier of 0.5 will be used to estimate the test torques in steps 2 and 3.

Step 2 involves a static pressure (burst) test per ISO 19879 to determine the failure pressure of the fitting using the make-up torques established in step 1. Using the minimum failure pressure of three test samples and dividing by four (4), a potential working pressure can be established with the required 4:1 design factor. An example of this is shown in Table 1. Failure must be tube or hose burst (external to the fitting). If not, return to step 1 to evaluate the make-up torque and either increase or further decrease the torque depending of the failure mode.

Step 3 involves a cyclic endurance (impulse) test to one million cycles per ISO 19879. The pressure established in step 2 is multiplied by 133% and this value is used as the test pressure for the impulse test. In the Table 2 example, the test was run at 5075 psi x 133% = 6765 psi. However, the final pressure was rounded down to 5000 psi for simplicity after the fitting test samples reached the end of the test without failure. If the fittings do not pass the test, either the pressure and/or torque will need to be adjusted, depending on the failure mode, and the test must be repeated. This step is repeated until all six test samples pass the one million cycle requirement. The final working pressure and make-up torque are based on the results of this test.

In addition to the burst and impulse tests, most fittings standards also require repeat assembly, leak, vacuum, vibration and corrosion resistance testing before a fitting can be fully qualified. The procedure described in steps 1–3 is required to ensure the other tests can be completed successfully. How or whether a company tests all of the fittings it sells is important. The industry standard is testing for carbon steel fittings, but there are specific procedures and standards for stainless steel, brass and every type of material from which a manufacturer makes fittings. Additional testing does add to the cost of fittings, but these extra quality-assurance procedures help ensure product integrity. Any questions about product qualification or specific test results should be directed to your fitting supplier.

Do you have any tips or stories about pressure ratings to share? If so, comment below! If you have any additional questions or comments, please post them and I’ll respond if warranted. If you want to talk to me directly, I can be reached at Parker Tube Fittings Division, 614.279.7070.

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