

6.6(B) - UNIONS FOR HYDRAULIC, FUEL, OIL, AND PNEUMATIC SYSTEMS

FLUID LINE END FITTINGS

Depending on the type and use, fittings will have either pipe threads or machine threads. Pipe threads are similar to those used in ordinary plumbing and are tapered, both internal and external. External threads are referred to as male threads and internal threads are female threads.

When two fittings are joined, a male into a female, the thread taper forms a seal. Some form of pipe thread lubricant approved for the particular fluid application should be used when joining pipe threads to prevent seizing and high pressure leakage. Use care when applying thread lubricant so that the lubricant will not enter and contaminate the system. Do not use lubricants on oxygen lines. Oxygen will react with petroleum products and can ignite (special lubricants are available for oxygen systems).

Machine threads have no sealing capability and are similar to those used on common nuts and bolts. This type of fitting is used only to draw connections together or for attachment through bulkheads. A flared tube connection, a crush washer, or a synthetic seal is used to make the connection fluid tight. Machine threads have no taper and will not form a fluid tight seal. The size of these fittings is given in dash numbers, which equal the nominal outside diameter in sixteenths of an inch.

UNIVERSAL BULKHEAD FITTINGS

When a fluid line passes through a bulkhead, and it is desired to secure the line to the bulkhead, a bulkhead fitting should be used. The end of the fitting that passes through the bulkhead is longer than the other end(s), which allows a locknut to be installed, securing the fitting to the bulkhead.

Fittings attach one piece of tubing to another, or to system units. There are four types: (1) bead and clamp, (2) flared fittings, (3) flareless fittings, and (4) permanent fittings (Permaswage™, Permalite™, and Cyrofit™).

The amount of pressure that the system carries and the material used are usually the deciding factors in selecting a connector.

The beaded type of fitting, which requires a bead and a section of hose and hose clamps, is used only in low or medium pressure systems, such as vacuum and coolant systems. The flared, flareless, or permanent type fittings may be used as connectors in all systems, regardless of the pressure.

AN FLARED FITTINGS

A flared tube fitting consists of a sleeve and a nut, as shown in *Figure 6-6*. The nut fits over the sleeve and, when tightened, draws the sleeve and tubing flare tightly against a male fitting to form a seal. Tubing used with this type of fitting must be flared before installation. The male fitting has a cone shaped surface with the same angle as the inside of the flare. The sleeve supports the tube so that vibration does not concentrate at the edge of the flare, and distributes the shearing action over a wider area for added strength.

Fitting combinations composed of different alloys should be avoided to prevent dissimilar metal corrosion. As with all fitting combinations, ease of assembly, alignment, and proper lubrication should be assured when tightening fittings during installation.

Standard AN fittings are identified by their black or blue color. All AN steel fittings are colored black, AN aluminum fittings are colored blue, and aluminum bronze fittings are cadmium plated and natural in appearance. A sampling of AN fittings are shown in *Figure 6-7* and *Figure 6-8*.

Figure 6-9 illustrates this process.

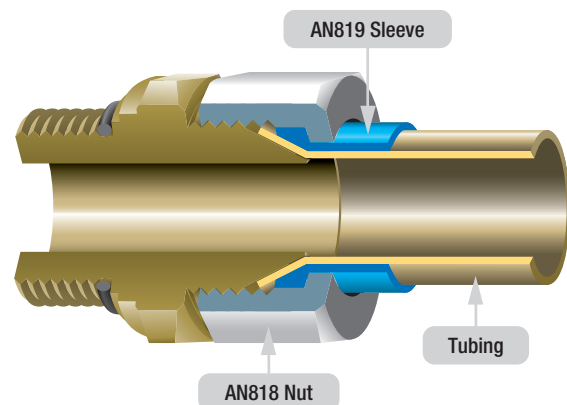


Figure 6-6. AN Flared tube fitting.

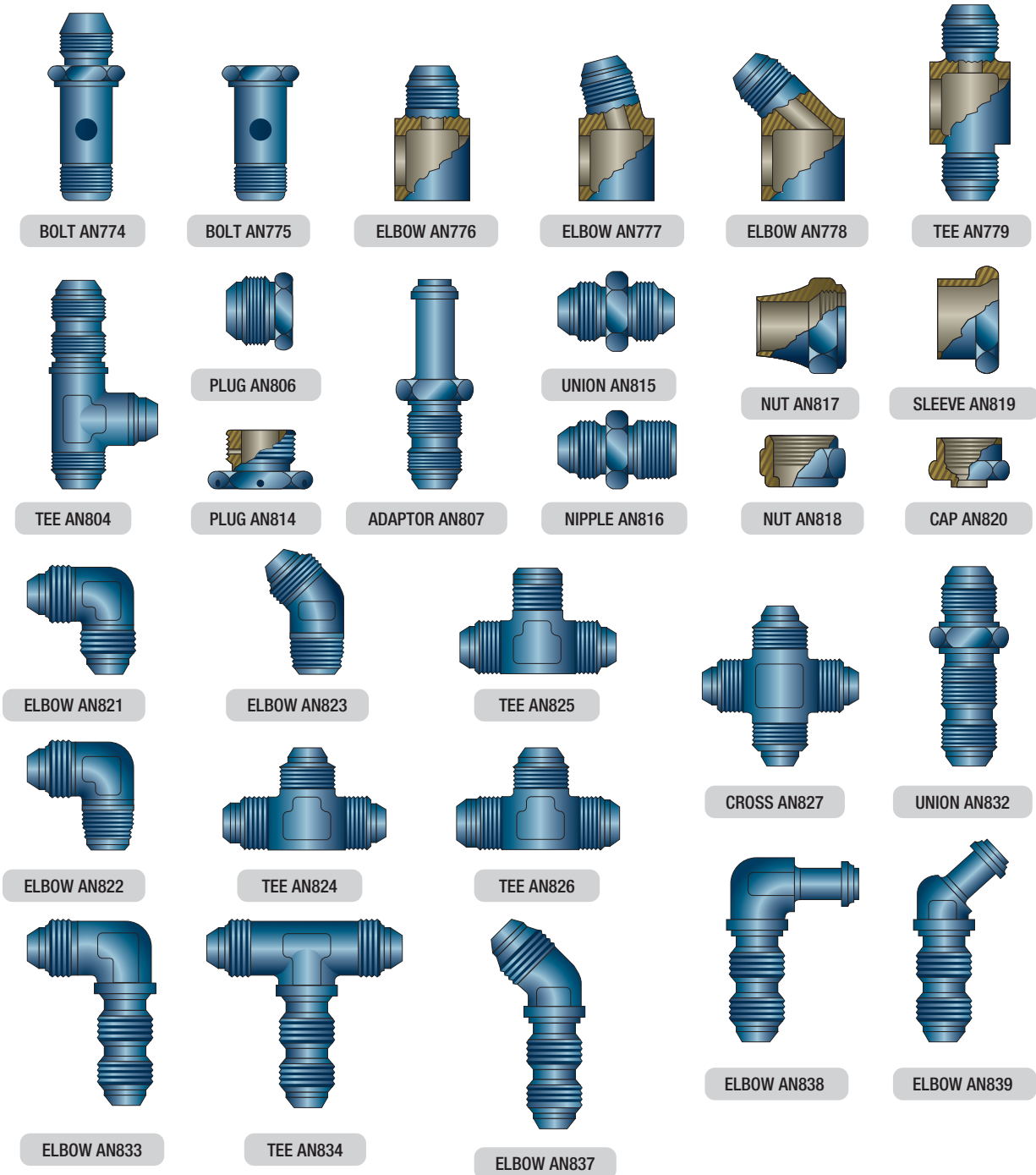
AN744 to AN932

Material:

Aluminum Alloy(code D)
 Steel(code, absence of letter)
 Brass(code B)
 Aluminum Bronze(code Z—for AN819 sleeve)

Size:

The dash number following the AN number indicates the size of the tubing (or hose) for which the fitting is made in 16ths of an inch. This size measures the outer diameter of tubing and the inner diameter of hose. Fittings that have pipe threads are coded by a dash number, indicating the pipe size in 8ths of an inch. The material code letter, as noted above, follows the dash number.



PIPES AND UNIONS

Figure 6-7. AN standard fittings.

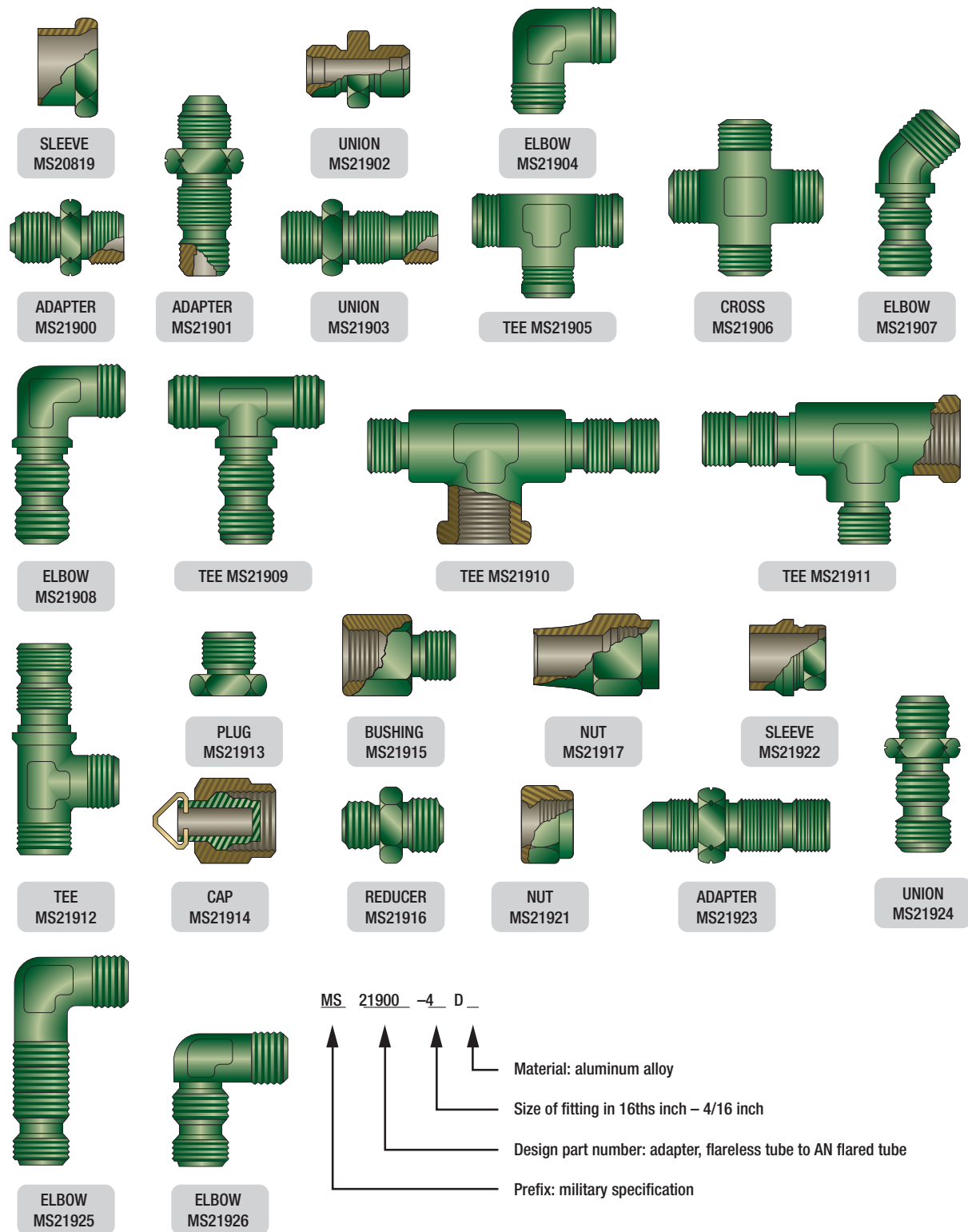


Figure 6-8. Typical MS flareless tube fittings.

FLARELESS FITTINGS

Flareless fittings are designed primarily for high pressure (3 000 psi) hydraulic systems that may be subjected to severe vibration or fluctuating pressure. Using this type of fitting eliminates all tube flaring, yet provides a safe and strong, dependable tube connection. (Figure 6-8)

The fitting consists of three parts: a body, a sleeve, and a nut. (Figure 6-9) The internal design of the body causes the sleeve to cut into the outside of the tube when the body and nut are joined. The counterbore shoulder within the body is designed with a reverse angle of 15° for steel connectors and 45° for aluminum fittings. This



Deburring inside of edge.



Setting tube in die (dime's thickness over top).



Ready to advance flaring cone.



Flared tube assembled with sleeve and nut.

Figure 6-9. Steps for flaring a tube.

reverse angle prevents inward collapse of the tubing when tightened and provides a partial sealing force to be exerted against the periphery of the body counterbore.

Although the use of flareless tube fittings eliminates all tube flaring, another operation, referred to as presetting, is necessary prior to installation of a new flareless tube assembly. Flareless tube assemblies should be preset with the proper size presetting tool or operation. The presetting operation, which is performed as follows: Cut the tube to the correct length, with the ends perfectly square. Deburr the inside and outside of the tube. Slip the nut, then the sleeve, over the tube, lubricate the threads of the fitting and nut with hydraulic fluid. Place the fitting in a vise, and hold the tubing firmly and squarely on the seat in the fitting. (The tube must bottom firmly in the fitting.) Tighten the nut until the cutting edge of the sleeve grips the tube. To determine this point, slowly turn the tube back and forth while tightening the nut. When the tube no longer turns, the nut is ready for tightening. Final tightening depends upon the tubing. For aluminum alloy tubing up to and including $\frac{1}{2}$ " outside diameter, tighten the nut from 1 to $1\frac{1}{4}$ turns. For steel tubing and aluminum alloy tubing over $\frac{1}{2}$ " outside diameter, tighten from $1\frac{1}{4}$ to $1\frac{1}{2}$ turns.

After presetting the sleeve, disconnect the tubing from the fitting and check the following points: The tube should extend $\frac{3}{32}$ " to $\frac{1}{8}$ " beyond the sleeve pilot; otherwise, blowoff may occur. The sleeve pilot should contact the tube or have a maximum clearance of 0.005" for aluminum alloy tubing or 0.015" for steel tubing. A slight collapse of the tube at the sleeve cut is permissible. No movement of the sleeve pilot, except rotation, is permissible.

SWAGED FITTINGS

A popular repair system for connecting and repairing hydraulic lines on transport category aircraft is the use of Permaswage™ fittings. Swaged fittings create a permanent connection that is virtually maintenance free. Swaged fittings are used to join hydraulic lines in areas where routine disconnections are not required and are often used with titanium and corrosion resistant steel tubing. The fittings are installed with portable hydraulically powered tooling, which is compact enough to be used in tight spaces. (Figure 6-10)

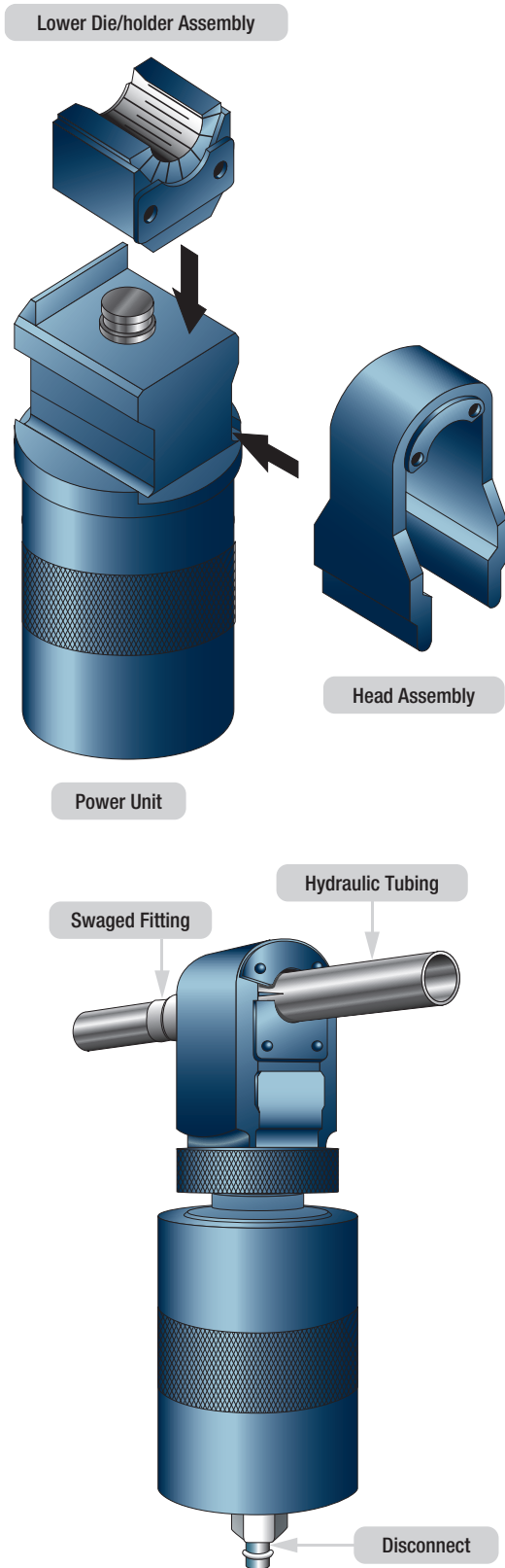


Figure 6-10. Swaged fitting tooling.

If the fittings need to be disconnected, cut the tubing with a tube cutter. Special installation tooling is available in portable kits. Always use the manufacturer's instructions to install swaged fittings. Typical Permaswage™ fittings are shown in *Figure 6-11*.

One of the latest developments is the Permalite™ fitting. Permalite™ is a tube fitting that is mechanically attached to the tube by axial swaging. Permalite™ works by deforming the fitting into the tube being joined by moving a ring, a component of the Permalite™ fitting, axially along the fitting length using a Permaswage Axial swage tool. Typical Permalite™ fittings are shown in *Figure 6-12*.

CRYOFIT™ FITTINGS

Many transport category aircraft use Cryofit™ fittings to join hydraulic lines in areas where routine disconnections are not required. Cryofit™ fittings are standard fittings with a cryogenic sleeve. The sleeve is made of a shape memory alloy, Tinel™. The sleeve is manufactured 3 percent smaller, frozen in liquid nitrogen, and expanded to 5 percent larger than the line. During installation, the fitting is removed from the liquid nitrogen and inserted onto the tube. During a 10 to 15 second warming up period, the fitting contracts to its original size (3 percent smaller), biting down on the tube, forming a permanent seal. Cryofit™ fittings can only be removed by cutting the tube at the sleeve, this leaves enough room to replace it with a swaged fitting without replacing the hydraulic line. It is frequently used with titanium tubing. The shape memory technology is also used for end, flared, and flareless fittings. (*Figure 6-13*)

FLEXIBLE HOSE FITTINGS

Flexible hose may be equipped with either swaged fittings or detachable fittings, or they may be used with beads and hose clamps. Hoses equipped with swaged fittings are ordered by correct length from the manufacturer and ordinarily cannot be assembled by the mechanic. They are swaged and tested at the factory and are equipped with standard fittings. The detachable fittings used on flexible hoses may be detached and reused if they are not damaged; otherwise, new fittings must be used. (*Figure 6-14*)



Figure 6-11. Permaswage™ fitting.



Figure 6-12. Permalite™ fitting.

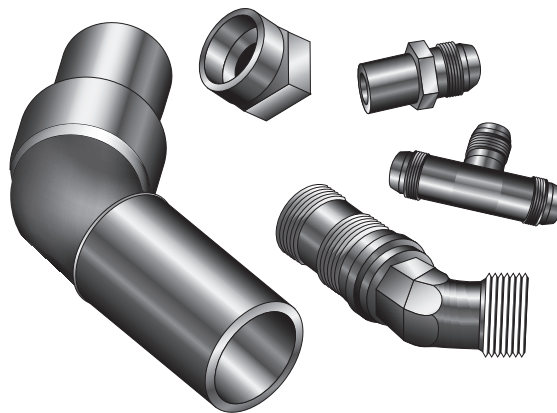


Figure 6-13. Cryofit fittings.

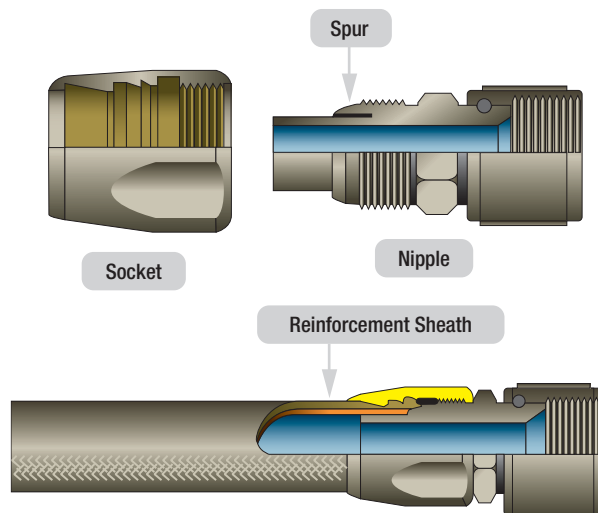


Figure 6-14. Reusable fittings for medium-pressure hose.