allow it to perform a number of critical tasks necessary for system effectiveness and long-term health. Foremost, it is an energy transmission medium, but it is much more. Hydraulic fluids also act as a lubricant for the internal moving parts of the system, and they are sufficiently viscous to seal the clearances between them.

There is one significant difference between static and moving liquids. A moving liquid is affected by friction, which causes some of its energy to be lost as heat. This problem can be minimized in designing a system if you know the five major causes of friction: tubing that is too long, too sharp a bend in the tubing, too many fittings, too high a fluid velocity, and insufficient tube diameter. In the best possible of systems, however, heat is still a natural by-product of the work a hydraulic system performs. A major function of the fluid, therefore, is that it acts as a heat-transfer medium to help cool the system.

Finally, hydraulic fluid also resists chemical breakdown, is noncorrosive, is compatible with the synthetic seals in the system, prevents rust and corrosion, and resists foaming, which prevents air from entering the lines.

In the early days of aviation, hydraulics was limited to a simple brake system using castor oil and natural rubber seals. This simple system lasted a number of years until larger aircraft were built requiring retractable landing gear, flaps, and other movable systems. The demand for higher pressure exceeded the capability of simple castor oil, so manufacturers went to petroleum-based fluids with neoprene seals, which were used extensively on WW-II aircraft.

In 1946, a single accident changed the future of hydraulics dramatically. A United Airlines DC-6 flying from San Francisco to Denver experienced a hydraulic fire that rapidly destroyed the wing. The crew attempted to land the aircraft in Bryce Canyon, Utah, but the aircraft crashed short of the runway. The aftermath of that accident resulted in the development of fire-resistant hydraulic fluids.

Today, larger aircraft use phosphate ester-based nonflammable fluids such as Skydrol, but their expense still puts them outside the range of most light aircraft. The phosphate ester fluids are approximately seven times as expensive as mineral-based fluids. So the mineral-based MIL-H-5606 fluid is used in virtually all light aircraft and can be identified by its red dye. This type of hydraulic fluid is used with neoprene seals and hoses, so no other fluid should be used in its place, as they will cause seal and hose deterioration. But the continuing and significant drawback is flammability. Great caution must be taken while pouring and storing mineral-based fluids. Having said that, there really isn't any other reason for light aircraft to use the phosphate ester fluids. They are specifically designed to operate at very high loads and temperatures, neither of which occurs in light aircraft.

At best, hydraulic fluid is touchy stuff. Make sure the reservoir cap is fastened securely to prevent leakage, and always keep fresh fluid in the system. Old fluid smells sour and the color darkens. Drain old fluid, flush the system with Varsol or Stoddard solvent, and replace it with fresh fluid.

Hydraulic systems are very intolerant of contamination. In fact, the synthetic fluid systems are so intolerant that the fluid has to be inspected with a microscope. Whenever a hydraulic system component fails, the prudent owner will drain the fluid, flush the system,