



4646 BAKER AVENUE • CINCINNATI, OHIO 45212-2594 USA  
TELEPHONE 513-531-1777 • FAX 513-531-0193  
SALES@INTERLUBECORPORATION.COM • WWW.INTERLUBECORPORATION.COM

## TECHNICAL ASSISTANCE FOR SELECTING THE PROPER HYDRAULIC FLUID

### THE FUNCTIONS OF HYDRAULIC FLUID

- 1) **Transmit power** – This is the primary function of hydraulic oil. It is very important that hydraulic fluid transfer power efficiently and economically. Many of the other functions are related to this function.
- 2) **Lubricate all moving parts** – This is essential to reduce friction and wear. Proper lubrication extends equipment life, which in turn also reduces both operating and maintenance costs.
- 3) **Act as a heat transfer medium** – This is often an overlooked but vital function. If the heat generated from the pumping action cannot be readily dissipated, excessive heat buildup will severely reduce the system's efficiency, increase wear, and may even make the system non-functional.
- 4) **Act as a sealing medium** – This is another often overlooked but vital function. The proper fluid helps the seals to function properly to reduce leakage. In acting as a sealant, the hydraulic fluid helps optimize the full power and efficiency of the hydraulic system, as well as keeping dirt (and other foreign substances) out of the system.
- 5) **Maintain the system in good working order** – The hydraulic fluid must keep the system from rusting, corroding and/or eroding, and must be compatible with the equipment's moving parts and seals.

### DESIRABLE PROPERTIES OF HYDRAULIC FLUID

- 1) **Proper viscosity** – This refers to a balanced situation of having a viscosity which is high enough to give good sealing and proper lubrication, while not being too high as to cause significant pressure drops, decreased system efficiency, or high power consumption. Viscosity is a measure of a fluid's resistance to flow. The higher the viscosity, the greater the resistance to flow. The lower the viscosity, the lower the resistance to flow. A fluid's viscosity changes with temperature. As a fluid's temperature increases, its viscosity decreases. Conversely, as a fluid's temperature decreases, its viscosity increases. It is very important to take into account the changes in the viscosity of a hydraulic fluid that will occur as the temperature of the hydraulic fluid changes. Manufacturers will sometimes specify use of multiple fluids of various viscosities in order to cover the wide range of operating temperatures. The responsible maintenance engineer must ascertain that the viscosity of the chosen hydraulic fluid is optimum for the operating conditions. Too low of a viscosity will result in high leakage, increased wear, reduced pump efficiency, lack of positive control, and loss of pressure. Too high of a viscosity will result in increased pressure drops in the system, sluggish performance, lower pump efficiency, and higher operating temperatures.
- 2) **Good lubricity** – Lubricity is a measure of the fluid's ability to carry high loads while maintaining low frictional properties. Many factors affect a fluid's lubricity, including its viscosity. In general, the higher a fluid's viscosity, the greater its load carrying ability. However, many other factors influence a fluid's load

carrying ability. For practical reasons, we will simply refer to these factors as lubricity aids. Good lubricity increases in importance as the operating system pressure increases. Those systems which operate at pressures greater than a few hundred PSI (pounds per square inch) requires incorporation of effective anti-wear agents in order to keep the frictional resistance and wear to a workable level.

- 3) **High viscosity index** – Viscosity index is a measure of the degree of change in the viscosity of a fluid as changes in temperature occur. The higher the viscosity index, the less the fluid thins when its temperature increases, and the less the fluid thickens when its temperature decreases. Viscosity Index becomes a more important factor in a hydraulic fluid’s performance when there are wide fluctuations in the fluid’s temperature.
- 4) **Compatible with system** – Compatibility of the hydraulic fluid with the system’s components is also very important. The fluid must be relatively inert in its reaction to the materials of construction and must be compatible with the system’s seals, finishes, etc.
- 5) **Stable/Non-degrading** – The fluid must be thermal and shear stable and should resist breakdown from oxidation and bacteria. It must also be non-reactive with all system components.
- 6) **Non-toxic/Poses few or no known health concerns** – This is particularly important for hydraulic fluids that are used in food grade applications. Material Safety Data Sheets describe hazardous materials.
- 7) **Low compressibility** – In general, the compressibility of fluids used for hydraulic purposes is insignificant at pressures up to 3000 PSI. High compressibility results in lower efficiency and higher apparent viscosity characteristics.
- 8) **Low foaming** – Low foaming properties are essential to efficient operation. Serious foaming problems can result in cavitation of the pumps and excessive wear.
- 9) **Cleanliness/No foreign material** – Cleanliness is extremely important in many of today’s modern high-pressure hydraulic systems. Equipment manufacturers rarely specify this property. The smaller the clearances and the greater the precision of the equipment, the more important cleanliness becomes. Properly designed and working filtration systems are extremely important for high precision operations.
- 10) **Low specific gravity** – The higher the specific gravity of the fluid, the lower the overall operating efficiency.
- 11) **High heat transfer capabilities** – This is important to aid in removal of the heat generated in normal pumping and use of the hydraulic fluid.
- 12) **Low vapor pressure** – This is important to prevent cavitation and high wear rates of the hydraulic pump. High vapor pressures of some water based hydraulic fluids result in very significant cavitation problems.
- 13) **Non-flammability (High flash point)** – This is often an essential property of the fluid. Some applications require a specially designed fire resistant fluid. Flammability is usually measured by flash and fire points.
- 14) **Low pour point** – This is important for fluids used outdoors in cold climates. Pour point is a measure of the lowest temperature at which a fluid can be poured. Pour points should be at least 10-20°F below the lowest actual operating temperature.
- 15) **Good demulsibility** – Demulsibility is a measure of oil’s ability to resist emulsification with water. In most systems, it is desirable that the hydraulic fluid resists emulsification and allow for separation and removal of water.
- 16) **Non-corrosive and rust inhibited** – Some types of oils contain reactive materials that discolor and degrade certain hydraulic system components. These are generally undesirable. All hydraulic oils should contain effective rust inhibitors.

### APPROXIMATE VISCOSITY REQUIREMENTS FOR NORMAL AMBIENT CONDITIONS

TYPE OF PUMP	RECOMMENDED VISCOSITY
Centrifugal for water based fluid	35 SUS @ 100°F
Vane Pump	100 – 300 SUS @ 100°F
Gear	300 – 500 SUS @ 100°F
Piston	250 – 900 SUS @ 100°F

## SELECTING A HYDRAULIC FLUID

The old adage of using any 10-weight oil available is not sufficient for today's modern, high-pressure, close tolerance systems. The responsible maintenance engineer should be guided by experience, the above factors, and local operational and environmental conditions.

If information from the manufacturer of the equipment is available, consult it, being careful to integrate the manufacturer's information with the operational and environmental conditions to which you expect the fluid to be exposed. Some manufacturers supply viscosity and general hydraulic fluid type information. Your hydraulic fluid supplier should be able to analyze your particular circumstances and recommend the proper hydraulic fluid for your needs.

If specific information is not available from the equipment manufacturer, review the list of desirable properties of hydraulic fluids and determine which are most important to your specific situation. Your hydraulic fluid supplier or qualified lubrication engineer can assist you completely in determining the proper fluid for your application.

## TYPES OF HYDRAULIC FLUIDS

**Water** is historically the oldest hydraulic fluid. Water has many properties that make it suitable as a hydraulic fluid, but also some properties, which make water very difficult with which to work. It is the least expensive and most fire resistant hydraulic fluid available. It is plentiful, compatible with most materials, and offers low compressibility. However, its low viscosity and poor boundary lubricant properties result in very low lubricity compared to available petroleum-based and synthetic-based fluids. Water's low vapor pressure makes pump design and handling difficult. Water lacks natural rust protective properties and readily contributes to rusting due to its ability to carry dissolved oxygen and ionic materials. It has a narrow operating temperature range, allows bacterial growth to go uninhibited, and foams easily upon contamination with very low levels of surface-active agents.

**Water based fluids** used for hydraulic purposes maintain most of the good properties inherent in water while modifying some or most of the difficulties. Water based fluids usually have a low use cost per gallon of fluid, but require much greater attention and control by a maintenance staff, as well as specially designed systems in order to function well. In general, water-based fluids offer only fair to poor pump life and require a high degree of maintenance. They have not gained a wide degree of acceptance.

**Soluble Oils:** These fluids offer low cost per unit of fluid, good fire protection, good lubricity, excellent heat transfer, good rust protection, and can be protected from excessive bacterial growth. They still carry many of the other problems noted above for water.

**Invert Emulsions:** These offer many of the same properties noted for soluble oils. They have a higher cost per unit than soluble oils, but offer some advantages in lubricity. They have found some acceptance for use as low unit cost fire resistant fluids.

**95-5 Fluids:** These fluids offer some improvement on soluble oils in the area of more stable emulsions and much research has been done to improve their lubricity. They still require specially designed systems and a high degree of attention from the maintenance staff. Some of these fluids are micro-emulsions and some are true water-soluble solutions.

**Water Glycol Fluids:** These fluids have found a wide degree of acceptance as fire resistant hydraulic fluids. They offer good pump wear protection and performance at a reasonable cost. Their per unit costs are much higher than water soluble products, but much lower than synthetics that do not offer as good of fire resistance properties. They do require some special handling as well as special seals and other system modification.

**Petroleum Based Hydraulic Oils:** These are, by far, the most commonly used hydraulic fluids, and are used in approximately 95% of all hydraulic systems. They are low to moderate in cost and, when properly treated with rust inhibitors, oxidation inhibitors, anti-wear agents, anti-foam agents, and a number of other additives, will pass all pump manufacturers' tests and requirements for hydraulic fluids. They generally require little maintenance and give long service life. Their availability in a broad range of viscosities allows use across a very wide range of temperatures. Due to the wide variety and quality of additives used by various manufacturers of petroleum based hydraulic fluids, it is very important to select a quality fluid that meets your requirements.

**Synthetic Based Hydraulic Lubricants:** There are a number of different types of synthetic fluids that are manufactured and marketed for modern hydraulic systems. They are most commonly used in situations that demand greater fire resistance or where lower temperature performance is required. Common synthetic bases used for hydraulic applications include esters and diesters of long chain fatty acids, phosphate esters, silicones, and chlorinated and fluorinated materials. Seal compatibility must be thoroughly determined.

We hope you found this technical information to be simple and helpful.

If you need additional information, please [contact us](#).

We can custom design a product to meet your requirements.

Thank you for considering Interlube Corporation as your lubricant and cleaning compound vendor and partner.

Interlube Corporation 4646 Baker Avenue Cincinnati, Ohio 45212-2594 USA

Telephone 513-531-1777 Fax 513-531-0193

<http://www.interlubecorporation.com>

[sales@interlubecorporation.com](mailto:sales@interlubecorporation.com)

Copyright, 2004, Interlube Corporation