

Hydraulic Fluid Recommendations

Introduction

Oil in hydraulic systems performs the dual function of lubrication and transmission of power. It is a vital element in a hydraulic system, and careful selection should be made with the assistance of a reputable supplier. Proper selection of oil assures satisfactory life and operation of system components, especially hydraulic pumps and motors. Generally, oil selected for use with pumps and motors is acceptable for use with valves. Critical servo valves may need special consideration. When selecting oil for use in an industrial hydraulic system, be sure the oil:

- Contains the necessary additives to ensure excellent anti-wear characteristics
- Has proper viscosity to maintain adequate sealing and lubrication at the expected operating temperature of the hydraulic system
- Includes rust and oxidation inhibitors for satisfactory system operation

Types of Hydraulic Fluids

Hydraulic fluids are classified by the type of base stock used. Some fluids are further classified by fluid formulation and performance

Anti-Wear Hydraulic Fluids

For general hydraulic service, Eaton recommends the use of the new generation of anti-wear (AW) hydraulic oils containing adequate quantities of anti-wear additive.

Eaton requests that fluid suppliers test newly developed lubricants on an Eaton Vickers® 35VQ25A high-pressure vane pump, according to Eaton ATS-373 test procedure, ASTM Specification D-6973. Lubricants that pass the test are considered good quality,

anti-wear hydraulic fluids that can be used with Eaton vane pumps at high operating conditions. They offer superior protection against pump wear and long service life. In addition, they provide good demulsibility, as well as protection against rust.

Crankcase Oils

Automotive-type crankcase oils with American Petroleum Institute (API) letter designation SE, SF, SG, SH, or higher per SAE J183 classes of oils are recommended for hydraulic service. The “detergent” additive tends to hold water in a tight emulsion and prevents separation of water.

Automotive type crankcase oils generally exhibit less shear stability, which can result in higher loss of viscosity during service life. Multiple-viscosity, industrial-grade hydraulic fluids with better shear stability will provide improved viscosity control.

Other mineral oil-based lubricants commonly used in hydraulic systems are automatic transmission fluids (ATFs) and universal tractor transmission oils (UTTOs).

Synthetic Hydrocarbon

Synthetic hydrocarbon base stocks, such as polyalphaolefins (PAOs), are also used to formulate ATFs and UTTOs.

Environment Friendly Hydraulic Fluids

Environmental friendliness is becoming a critical need, and a number of biodegradable hydraulic fluids are being used more and more in environment sensitive areas.

Biodegradable hydraulic fluids are generally classified as vegetable oil based (HETG), synthetic ester (HEES), polyalkylene glycol (HEPG), and polyalphaolefin (HEPR). In addition, special

water-glycol hydraulic fluids are used in applications in which water miscibility is necessary, along with biodegradable properties.

Fire-Resistant Hydraulic Fluids

Fire-resistant fluids are classified as water-containing fluids or synthetic anhydrous fluids. Water acts as the fire-retarding agent in water-containing fluids. The chemical structure of synthetic anhydrous fluids provides fire resistance.

Many applications that are prone to fire hazard, such as steel mills, foundries, die casting, mines, etc., require the use of fire resistant hydraulic fluid for improved fire safety. Fire-resistant fluids may not be fire proof, but they have better fire resistance compared to that of mineral oil.

The alternative fluids are recommended when specific properties, such as fire resistance, biodegradability, etc., are necessary for the application. Keep in mind that alternative fluids may differ from AW petroleum fluids in properties such as pressure viscosity coefficient, specific gravity, lubricity, etc. Hence, certain pumps/motors may need to be de-rated, some can be operated under full ratings, and others are not rated. Be sure to confirm product ratings with the specific fluid in the intended application.

Viscosity

Viscosity is the measure of a fluid's resistance to flow. Selection of hydraulic oil with a specific viscosity range should be based on the needs of the system, limitations of critical components, or proper performance of specific types of units. At system startup and during operation, Eaton

recommends maintaining the oil's maximum and minimum viscosity ranges (see chart). Very high viscosities at startup temperatures can cause noise and cavitation damage to pumps. Continuous operation at moderately high viscosities will tend to hold air in suspension in the oil, as well as generate higher operating temperatures. This can cause noise, early failure of pumps and motors, and erosion of valves. Low viscosities result in decreased system efficiency and impairment of dynamic lubrication, causing wear.

It is important to choose the proper oil viscosity for your particular system in order to achieve the startup viscosity and running viscosity range (see chart) over the entire temperature range encountered. Confirm with your oil supplier that the oil viscosity will not be less than the minimum recommended at the maximum oil temperature of your application.

A number of anti-wear hydraulic oils containing polymeric thickeners (Viscosity Index Improvers [VII]) are available for use in low temperature applications. Temporary or permanent viscosity loss of some of these oils at operating temperature may adversely affect the life and performance of components. Before using polymer containing oils, check the extent of viscosity loss (shear stability) to avoid hydraulic service below the recommended minimum viscosity. Oil with good shear stability is recommended for low temperature applications.

Multi-grade engine oils, ATFs, UTTOs, etc., also contain VIIs, and viscosity loss will be encountered during use.

Cleanliness

Fluid cleanliness is extremely important in hydraulic systems.

More than 70% of all failures are caused by contamination, which can reduce hydraulic system efficiency up to 20 percent before system malfunction may be recognized. Different hydraulic components require different cleanliness levels. The cleanliness of a hydraulic system is dictated by the cleanliness requirement of the most stringent component in the system. OEMs and distributors should provide their customers with cleanliness requirements for Eaton hydraulic components used in their system designs. Refer to Eaton product catalogs for specific cleanliness requirements of individual components.

Fluid Maintenance

The condition of a fluid has a direct bearing on the performance and reliability of the system. Maintaining proper fluid viscosity, cleanliness level, water content, and additive level is essential for excellent hydraulic system performance. In order to maintain a healthy fluid, Eaton recommends performing periodic checks on the condition of the oil.

System Design Considerations

When designing a hydraulic system, the specific gravity of the hydraulic fluid needs to be taken into consideration. If the specific gravity of the fluid is higher than that of mineral oil, be sure the reservoir oil level is adequately above the pump inlet to ensure a minimum of 1.0 bar absolute pressure at the pump inlet.

Filters

Proper filter type and size, which vary depending on the type of fluid used in a system, are essential for healthy system function. The primary types of filter materials are paper, cellulose, synthetic fiber, and metal.

Filter media, adhesive, and seals must be compatible with the fluid used in the system. To lengthen fluid change out intervals, special absorbent filter media may be used to remove moisture and acids from phosphate esters.

Seals/Elastomers

Select seal/elastomer materials that are suitable for the application, minimum and maximum operating temperature, and compatibility with the type of fluid used in the hydraulic system. The effect of hydraulic fluid on a particular elastomer depends on the constituents of the fluid, temperature range, and level of contaminants.

Replacing Hydraulic Fluid

Although sometimes valid, arbitrary hydraulic fluid change outs can result in wasted good oil and unnecessary machine downtime.

A regularly scheduled oil analysis program is recommended to determine when oil should be replaced. The program should include inspection of the oil's color, odor, water content, solid contaminants, wear metals, additive elements, and oxidation products. Clean the system thoroughly and flush with fresh, new fluid to avoid any contamination with the previous fluid/lubricant. Replace all seals and filters with new, compatible parts. Mixing two different fluids in the same system is not recommended.

Feel free to contact your Eaton representative with questions concerning hydraulic fluid recommendations.

Viscosity Requirements

| Product Line | Minimum Range | Optimum Range | Maximum Allowed Startup | ISO 4406:99 Cleanliness Requirements | Comments |
|--|-------------------|-------------------------|-------------------------|--------------------------------------|---|
| Heavy-Duty Piston Pumps and Motors | *45 SUS (6 cSt) | 60-180 SUS (10-39 cSt) | 10,000 SUS (2158 cSt) | 21/18/13 | |
| Medium-Duty Piston Pumps and Motors Charged Systems | *45 SUS (6 cSt) | 60-180 SUS (10-39 cSt) | 10,000 SUS (2158 cSt) | 21/18/13 | |
| Medium-Duty Piston Pumps and Motors Non-Charged Systems | *45 SUS (6 cSt) | 60-180 SUS (10-39 cSt) | 2,000 SUS (432 cSt) | 21/18/13 | |
| Light-Duty Transaxles Transmission, Pumps and Series 1150 Transaxles | *60 SUS (10 cSt) | 82-180 SUS (16-39 cSt) | 10,000 SUS (2158 cSt) | 21/18/13 | |
| Char-Lynn® J,R,T and S Series Motors, Disc Valve Motors and VIS Motors | *70 SUS (13 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 20/18/13 | |
| Char-Lynn A Series and H Series Motors | *100 SUS (20 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 20/18/13 | |
| Char-Lynn Steering Control Units | *55 SUS (9 cSt) | 100-200 SUS (20-43 cSt) | 8,000 SUS (1900 cSt) | 20/18/13 | When emergency manual steering is required, maximum viscosity is 2000 SUS (450 cSt) |
| Gear Pumps, Motors and Standard Cylinders | *45 SUS (6 cSt) | 60-200 SUS (10-43 cSt) | 10,000 SUS (2158 cSt) | 20/18/13 | |
| Global Gear (A-AI) Products | 52 SUS (8 cSt) | 82-185 SUS (16-40 cSt) | 8800 SUS (2000 cSt) | 20/18/13 | |
| Vane Pumps (Industrial) | 60 SUS (10 cSt) | 82-188 SUS (16-40 cSt) | 4000 SUS (860 cSt) | 18/16/13 | |
| Vane Pumps (Mobile) | 47 SUS (6.5 cSt) | 82-188 SUS (16-40 cSt) | 8800 SUS (2000 cSt) | 18/16/13 | |
| Open-Circuit Piston Pumps PVM, PVH, PVE | 60 SUS (10 cSt) | 82-188 SUS (16-40 cSt) | 4550 SUS (1000 cSt) | 21/18/13 | |
| Open-Circuit Piston Pumps PVQ, PVB | 60 SUS (10 cSt) | 82-188 SUS (16-40 cSt) | 1000 SUS (220 cSt) | 21/18/13 | |
| Open-Circuit Piston Pumps 420 | 60 SUS (10 cSt) | 82-188 SUS (16-40 cSt) | 9720 SUS (2100 cSt) | 21/18/13 | |
| Hydrokraft™ Pumps PVW, PFW, PVX, PFX,TVX, TVW | 60 SUS (10 cSt) | 82-349 SUS (16-75 cSt) | 4550 SUS (1000 cSt) | 18/15/13 | |
| Hydrokraft Motors MVX, MFX, MWV, MFW | 60 SUS (10 cSt) | 82-349 SUS (16-75 cSt) | 4550 SUS (1000 cSt) | 18/15/13 | |

*Minimum viscosity applies at intermittent condition of 10% of every minute.



Powering Business Worldwide

| Product Line | Minimum Range | Optimum Range | Maximum Allowed Startup | ISO 4406:99 Cleanliness Requirements | Comments |
|--|--------------------|----------------------------|--------------------------|--------------------------------------|---|
| Directional Valves (DG) | 45 SUS (6 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 19/17/14 | |
| STAK Valves | 45 SUS (6 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 17/15/12 | |
| Cartridge Valves | 45 SUS (6 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 19/17/14 | |
| K Series Proportional (Directional/Throttle) | 45 SUS (6 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 17/15/12 | |
| DG, CM and Mono Block Directional Control Valves | 45 SUS (6 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 20/18/15 | |
| CMX and CML Proportional Control Valves | 45 SUS (6 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 18/16/14 | |
| KDG Proportional Control Valves | 70 SUS (13 cSt) | 100-250 SUS (20-54 cSt) | 2300 SUS (500 cSt) | 17/15/12 | |
| Pressure and Flow Control Valves | 45 SUS (6 cSt) | 100-200 SUS (20-43 cSt) | 10,000 SUS (2158 cSt) | 19/17/14 | |
| Servo Valves | 45 SUS (6 cSt) | 100-250 SUS (20-54 cSt) | 10,000 SUS (2158 cSt) | 16/14/11 | 15/13/10 is recommended for longer life |

Note: This document supersedes Eaton 03-401 and Vickers 694 (M-2950-S and I- 286-S) documents.

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