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 mineral base anti-wear (AW) hydraulic oils meeting Eaton specification E-FDGN-TB002-E.

Eaton requests that fluid suppliers test newly developed lubricants on Eaton 35VQ25A high-pressure vane pump, according to Eaton ATS-373 test procedure, ASTM D 6973 test method and meet other requirements of the Eaton specification E-FDGN-TB002-E. Lubricants meeting the Eaton specification are considered good quality anti-wear hydraulic fluids that can be used with Eaton components at maximum allowable operating conditions. They offer superior protection against pump wear and long service life.

Crank case 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 AW hydraulic fluids, crankcase oils, ATFs and UTTOs.

Environmentally Friendly Hydraulic Fluids

Eco-friendly characteristics is becoming a critical need, and a number of bio-degradable hydraulic fluids are being used more and more in environmentally 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 fireproof, but they have better fire resistance compared to 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 selection of hydraulic fluid 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 fluid's maximum and minimum viscosity ranges (see chart). Very high viscosities at startup temperatures can cause noise and cavitational damage to pumps. Continuous operation at moderately high viscosities will tend to hold air in suspension in the fluid, 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 fluid 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 fluid supplier that the fluid viscosity will not be less than the minimum recommended at the maximum fluid temperature of your application.

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

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 fluid level is adequately above the pump inlet to meet the recommended inlet operating condition of minimum 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 wasting good fluid and unnecessary machine downtime.

A regularly scheduled oil analysis program is recommended to determine when fluid should be replaced. The program should include inspection of the fluid'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.

Contact your Eaton representative with questions concerning hydraulic fluid recommendations.

Viscosity Requirements

Product Line	Minimum	Optimum Range	Maximum Allowed - Startup	Cleanliness Requirement (ISO 4406:99)	Comments
Gear Pumps and Motors	6 cSt (45 SUS)	16-40 cSt (82-185 SUS)	2000 cSt (8800 SUS)	20/18/13	
Vane Pumps V10, V20, V, and VT Series	13 cSt (70 SUS)	13-54 cSt (70-250 SUS)	860 cSt (4000 SUS)	18/16/13	
Vane Pumps VMQ (Industrial), VQ, and VQH Series	10 cSt (60 SUS)	16-40 cSt (82-185 SUS)	860 cSt (4000 SUS)	18/16/13	Except VMQ (Industrial) with Water Glycol Fluids
Vane Pumps VMQ (Mobile) Series	10 cSt (60 SUS)	16-40 cSt (82-185 SUS)	2000 cSt (8800 SUS)	18/16/13	
Vane Pumps VVS and VVP Series	10 cSt (60 SUS)	22-68 cSt (106-315 SUS)	860 cSt (4000 SUS)	18/16/13	
Vane Motors	13 cSt (70 SUS)	16-40 cSt (82-185 SUS)	860 cSt (4000 SUS)	18/16/13	
Heavy-Duty Piston Pumps and Motors	10 cSt (60 SUS)	16-39 cSt (82-180 SUS)	2158 cSt (10,000 SUS)	21/18/13	
Medium-Duty Piston Pumps and Motors, Closed-Circuit	6 cSt (45 SUS)	10-39 cSt (60-180 SUS)	2158 cSt (10,000 SUS)	21/18/13	
Medium-Duty Piston Pumps and Motors, Non-Charged System	10 cSt (60 SUS)	10-39 cSt (60-180 SUS)	432 cSt (2000 SUS)	21/18/13	
Light-Duty Transaxles and Transmissions	10 cSt (60 SUS)	16-39 cSt (82-180 SUS)	2158 cSt (10,000 SUS)	21/18/13	
Open Circuit Piston Pumps - 420 and 620 Series	10 cSt (60 SUS)	16-40 cSt (82-185 SUS)	2100 cSt (9720 SUS)	21/18/13	
Open Circuit Piston Pumps - PVH Series	10 cSt (60 SUS)	16-40 cSt (82-185 SUS)	5000 cSt (23000 SUS)	21/18/13	
Open Circuit Piston Pumps - PVM and PVE Series	10 cSt (60 SUS)	16-40 cSt (82-185 SUS)	1000 cSt (4550 SUS)	21/18/13	
Open Circuit Piston Pumps - PVQ Series	10 cSt (60 SUS)	16-40 cSt (82-185 SUS)	220 cSt (1000 SUS)	21/18/13	
Open Circuit Piston Pumps - PVB Series	13 cSt (70 SUS)	13-54 cSt (70-250 SUS)	220 cSt (1000 SUS)	21/18/13	
ME Motors (Dowmax)	15 cSt (78 SUS)	25-100 cSt (120-465 SUS)	500 cSt (2300 SUS)	20/18/13	

Product Line	Minimum	Optimum Range	Maximum Allowed - Startup	Cleanliness Requirement (ISO 4406:99)	Comments
Bent Axis Motors - BAV, BAF, BAV7, and BAF7	10 cSt (60 SUS)	15-40 cSt (78-185 SUS)	800 cSt (3700 SUS)	21/19/16	
Heavy Duty Industrial Pumps PVW, PFW, PVX, PFX, TVW, and TVX	10 cSt (60 SUS)	16-75 cSt (82-349 SUS)	1000 cSt (4550 SUS)	18/15/13	
Heavy Duty Industrial Motors MVW, MFW, MVX and MFX	10 cSt (60 SUS)	16-75 cSt (82-349 SUS)	1000 cSt (4550 SUS)	18/15/13	
DuraForce™ Piston Pumps and Motors	10 cSt (60 SUS)	15-30 cSt (78-141 SUS)	1000 cSt (4550 SUS)	18/16/13	
XCEL Motors	20 cSt (100 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	20/18/13	
Axial Piston Motors JMF & JMV	10 cSt (60 SUS)	16-40 cSt (82-185 SUS)	2100 cSt (9720 SUS)	17/15/12	
Gerotor/Geroler® Motors - Disc Valve, VIS, Spool Valve J, S, W, and T and HP 30	13 cSt (70 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	20/18/13	
Gerotor/Geroler Motors Spool Valve Series H	20 cSt (100 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	20/18/13	
Steering Control Units	9 cSt (55 SUS)	20-43 cSt (100-200 SUS)	1900 cSt (8000 SUS)	20/18/13	When emergency manual steering is required, maximum viscosity is 450 cSt (2000 SUS)
Standard Cylinders	6 cSt (45 SUS)	16-40 cSt (82-185 SUS)	2000 cSt (8800 SUS)	20/18/13	
Directional Valves (DG)	6 cSt (45 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	19/17/14	
STAK Valves	6 cSt (45 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	19/17/14	
Slip In, Screw In, and Valvistor Cartridge Valves	6 cSt (45 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	18/16/13	
Brake Valves, Priority Valves, and Bucket Leveling Valves	6 cSt (45 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	19/17/14	
CM and Mono Block Directional Control Valves	6 cSt (45 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	19/17/14	
CMX and CML Proportional Control Valves	6 cSt (45 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	18/16/14	

Product Line	Minimum	Optimum Range	Maximum Allowed - Startup	Cleanliness Requirement (ISO 4406:99)	Comments
KDG and K series Proportional Control Valves	13 cSt (70 SUS)	13-54 cSt (70-245 SUS)	500 cSt (2300 SUS)	17/15/12	
Line or Flange Mounted Pressure and Flow Control Valves	6 cSt (45 SUS)	20-43 cSt (100-200 SUS)	2158 cSt (10,000 SUS)	19/17/14	
Servo Valves	10 cSt (60 SUS)	20-54 cSt (100-250 SUS)	325 cSt (1500 SUS)	16/14/11	15/13/10 is recommended for longer life

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