HYDRAULIC OILS

Hydraulic oil is a fluid lubricant used in hydraulic systems for transmitting power.

Common hydraulic system consists of:

- ⊡ Oil tank;
- ⊡ Hydraulic pump;
- ⊡ Oil filter;
- ⊡ Control valves;
- ⊡ Pistons;
- ⊡ Pipes.

The following characteristics and properties are important for hydraulic oils:

- ⊡ Low temperature sensitivity of viscosity;
- ⊡ Thermal and chemical stability;
- ⊡ Low compressibility;
- ⊡ Good lubrication (anti-wear and anti-stick properties, low coefficient of friction);
- ⊡ Hydrolitic stability (ability to retain properties in the high humidity environment);
- ⊡ Low **pour point** (the lowest temperature, at which the oil may flow);
- ⊡ Water emulsifying ability;
- ⊡ Filterability;
- ⊡ Rust and oxidation protection properties;
- ⊡ Low **flash point**(the lowest temperature, at which the oil vapors are ignitable);
- ⊡ Resistance to cavitation;
- ⊡ Low foaming;
- ⊡ Compatibility with sealant materials.

Hydraulic systems are widely used in industrial machinery, construction equipment, automotive, aircraft and marine applications.

- ⊡ **Types of hydraulic fluids**
- ⊡ **Viscosity of hydraulic oils**
- ⊡ **SAE Designation of hydraulic oils by viscosity**
- ⊡ **ISO Designation of hydraulic oils**
- ⊡ **Properties of some hydraulic oils**

Types of hydraulic fluids

Optimal properties of hydraulic oils are achieved by a combination of a base oil and additives (anti-wear additives, detergents, Anti-oxidants, anti-foaming agents,Corrosion inhibitors etc.).

⊡ Mineral hydraulic oil (petroleum base).

Mineral based oils are the most common and low cost hydraulic fluids. They possess most of the characteristics important for hydraulic oils. The disadvantages of mineral (petroleum) based oils are their low fire resistance (low flash point), toxicity and very low biodegradability.

⊡ Phosphate ester based synthetic hydraulic fluids.

Phosphate esters are produced by the reaction of phosphoric acid with aromatic alcohols. Phosphate esters based hydraulic fluids possess excellent fire resistance, however they are not compatible with paints, adhesives, some polymers and sealant materials. They are also toxic.

⊡ Polyol ester based synthetic hydraulic fluids.

Polyol esters are produced by the reaction of long-chain fatty acids and synthesized alcohols. Polyol ester based hydraulic fluids are fire resistant and possess very good lubrication properties. They are environmentally friendly but their use is limited by high cost.

⊡ Water glycol synthetic hydraulic fluids.

Water glycol based fluids contain 35-60% of water in form of solution (not emulsion) and additives (anti-foam, anti-freeze, rust and corrosion inhibitors, anti-wear etc.). Water glycol based hydraulic fluids possess excellent fire resistance, they are non-toxic and biodegradable. However their temperature range is relatively low: 32°F - 120°F (0°C - 49°C). Water evaporation causes deterioration of the hydraulic fluids properties.

⊡ Vegetable hydraulic oils.

Vegetable hydraulic oils are produced mainly from Canola oil. Their chemical structure is similar to that of polyol esters. Vegetable hydraulic oils possess very good lubrication properties and high viscosity index (low temperature sensitivity of viscosity). They are non-toxic and biodegradable. The main disadvantage of vegetable hydraulic oils is their relatively low oxidation resistance.

Viscosity of hydraulic oils

Viscosity of a hydraulic fluid depends on its composition and the temperature. Low viscosity limit is determined by the lubrication properties of the oil and its resistance to cavitation. Upper viscosity value is limited by the ability of the oil to be pumped.

Common viscosity of hydraulic oils is in the range 16 - 100 centistokes. Optimum viscosity value is 16 - 36 centistokes.

SAE Designation of hydraulic oils by viscosity

The Society of Automotive Engineers (SAE) established a viscosity grading system for oils.

According to the SAE viscosity grading system all oils are divided into two classes: monograde and multigrade:

⊡ **Monograde hydraulic oils**

Monograde hydraulic oils are designated by one number (10, 20, 30, 40, etc.). The number indicates a level of the oil viscosity at a particular temperature. The higher the grade number, the higher the oil viscosity.
Viscosity of hydraulic oils designated with a number only without the letter “W” (SAE 10, SAE 20, SAE 30 etc.) was specified at the temperature 212°F (100°C). These oils are suitable for use at high ambient temperatures.
Viscosity of hydraulic oils designated with a number followed by the letter “W” (SAE 10W, SAE 20W, SAE 30W etc.) was specified at the temperature 0°F (-18°C). The letter “W” means *winter*. These grades are used at low ambient temperatures.

- **Multigrade hydraulic oils**

Viscosity of hydraulic oils may be stabilized by polymeric additives (viscosity index improvers). Viscosity of such oils is specified at both high and low temperature. These oils are called multigrades and they are designated by two numbers and the letter “W” (SAE 5W30, SAE 10W20, SAE 10W30 etc.). The first number of the designation specify the oil viscosity at cold temperature, the second number specifies the oil viscosity at high temperature.
For example: SAE 10W30 oil has a low temperature viscosity similar to that of SAE 10W, but it has a high temperature viscosity similar to that of SAE 30.
Multigrade hydraulic oils are used in a wide temperature range.

ISO Designation of hydraulic oils

International Standardization Organization (ISO) established a viscosity grading (VG) system for industrial hydraulic oils. According to the system hydraulic oils are designated by the letters ISO followed by a number equal to the oil viscosity measured in centistokes at 40°C (104°F): ISO VG 32, ISO VG 46 etc.

Properties of some hydraulic oils

(Materials Data)

- Biodegradable hydraulic oil SAE 10W
- Low temperature hydraulic oil ISO 22
- Hydraulic oil ISO 32
- Hydraulic oil ISO 46
- Hydraulic oil ISO 68
- Hydraulic oil ISO 100
- Hydraulic oil ISO 150

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