

0.5.1 HYDRAULIC FLUIDS

The hydraulic fluids, also known as hydraulic liquids, are the means by which the forces and movements are transmitted in the oleodynamic systems; the most common are based on mineral oil or water. In fact, is used the incompressibility of hydraulic fluid to transmit pressure in all directions equally.

The main characteristics of a hydraulic fluids are:

- Low compressibility.
- Low variation in viscosity with temperature variations.
- Stability of chemical composition as the temperature changes.
- Good lubrication circuit (anti-adhesion, low coefficient of friction).
- Hydrolytic stability (ability to maintain the characteristics in presence of high humidity).
- Low pour point (minimum temperature at which the oil is still fluid).
- Ability to separate the water that can enter into the system for leakage from the outside or can be formed by condensation.
- Ability to quickly dispose of the heat produced by the plant.
- Filterability (ability to quickly separate from the dirt around).
- Protection against oxidation and rust.
- Low flammability.
- Resistance to cavitation (formation of air bubbles within the oil, due to sudden pressure changes, which then implode causing erosion in the metal of the pump).
- Low foam production.
- Compatibility with pipes and gaskets.
- Low toxicity and high biodegradability.
- Resistance to aging.

The hydraulic fluid for excellence since the ancient Egypt was the water, from which derived the name "Hydraulic". Since 1920 it has been mostly used mineral oil for its intrinsic lubricating properties and the ability to work even at temperatures where the water is boiling. Later they were also introduced vegetable oils derived from seeds of plants and, with the evolution of chemistry, synthetic oils.

0.5.2 MINERAL OILS

- Unbound Oil: H or HH

Mineral oil without additives, with low capacity lubrication.

- Hydraulic oil HL

Mineral oil resistant to oxidation and rust, but which lack the necessary additives to protect against the risk of wear.

- Hydraulic oil: HM

Anti-wear and detergent mineral oil.

- Hydraulic oil: HV

Mineral oil anti-wear and high viscosity index.

- Hydraulic oil: HG

Anti-wear and detergent mineral oil with anti stick-slip.

- Hydraulic oil: HS

Long-life synthetic oil.

- Hydraulic oil: HLP

Mineral oil with additives to protect against corrosion, oxidation and wear. It's the most common hydraulic fluid.

- Hydraulic oil: HVLP

Mineral oil with additives to protect against corrosion, oxidation and wear but with a viscosity higher than the HLP hydraulic oils. It is used in wider temperature range.

- White oil USDA H1

Mineral oil without additives for use in systems where it might be contact with foodstuffs.

- Mineral oil: MIL-H

Mineral oil usually based naphthenic with extended temperature range. It is mainly used in aeronautics.

- Mineral oil: HD

Mineral oil developed for application in combustion engines.

0.5.3 COMPATIBLE LIQUID ENVIRONMENT

- Natural oil: HETG

Liquid-based natural oil such as rapeseed oil or sunflower oil with additives. These fluids have low resistance to temperatures exceeding 60 ° C. Above this temperature tend to resinify, cake together and premature aging.

- Polyethylene glycol HEPG

Polyethylene glycol-based liquid. Has properties similar to mineral oil.

- Ester synthetic: HEES

Liquid-based carbonic acid ester, ester, polyester. Has properties similar to mineral oil.

- Fluid: HEPR

Acceptable for the environment.

0.5.4 DIFFICULT FLAMMABLE LIQUIDS

- Oil in water emulsion: HFA

Oil in water emulsion with water percentage greater than 80% and minimum percentage of mineral oil greater by 4%, which promotes the lubricity and prevents freezing in systems located outside.

- Water in oil emulsion: HFB

The water in oil emulsion is characterized by a percentage of 50 - 60% of mineral oil. At the obtained emulsion, are normally added additives to improve the properties.

- Aqueous glycolic solution: HFC

Glycolic solution or polyglycolic aqueous solution with water percentage less than 35%.

Glycol, from English words glyc (Erin) and (Alch) ol, is chemically

defined as "bivalent aliphatic alcohol".

Water glycol has a viscosity slightly higher than the mixture of water and oil and it's less flammable, it has a poor lubricity and is incompatible with zinc plated parts and most of the varnish (with the exception of epoxidic and vinyl).

- Liquid anhydrous: HFD

Anhydrous liquid with properties similar to mineral oil

- Derivatives:
- phosphate acid ester: HFDR
 - chlorinated hydrocarbon: HFDS
 - Mixture of HFDR and HFDS: HFDT
 - other composition: HFDU

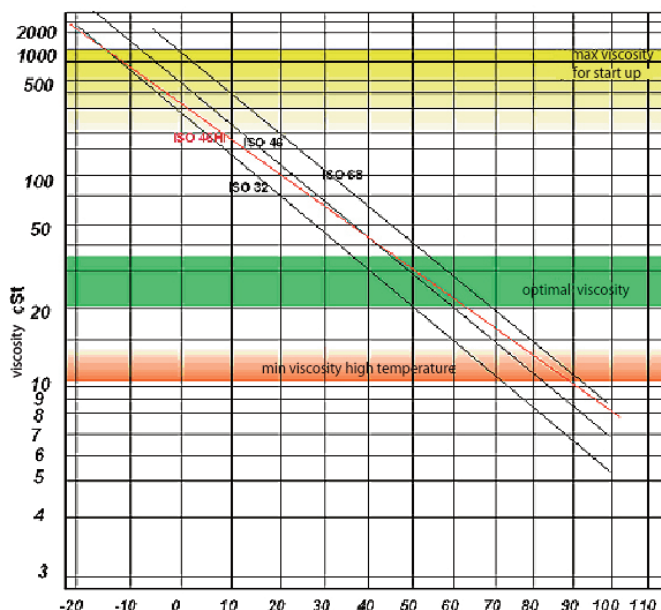
0.5.5 SPECIAL LIQUIDS

- Brake fluid: AT

Glycol-based brake fluid.

- SKYDROL

Liquid for use in aeronautics



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0.5.6 CLASSIFICATION OF HYDRAULIC OILS

The International Standardization Organization (ISO) has established with the rule 3448 (currently the most widely used in hydraulic oils) a classification of oils according to their viscosity grade (VG). Under this standard, the oils are labeled with letters VG followed by a number corresponding to viscosity of the oil measured in "centistokes" at a temperature of 40 °C (eg, ISO VG 46). The scale ranges from ISO VG 2 to ISO VG 1500, but the most common grades in use are: 32, 46 and 68.

Viscosity is the resistance that a fluid opposes to the reciprocal flow of its particles. The viscosity of lubricating oil decreases with increasing temperature, so it's normally measured at a given temperature of 40°C.

The viscosity of the lubricant determines the thickness of oil film between metal surfaces in reciprocal movement.

The unit of measurement of viscosity that is generally used is centistokes (cSt) or "Engler" (E) degrees.

0.5.7 KINEMATIC VISCOSITY CHANGE DEPENDING ON THE TEMPERATURE

From the table showed below, you can see how temperature changes modify the viscosity of the oil.

The more horizontal is the characteristic oil curve, the better is the behavior of the oil at the temperature changes.

ISO gradation	Kinematic viscosity cSt a 40 °C			Medium viscosity °E a 50°C
	min.value	max. value	med. value	
VG 2	1,98	2,42	2,2	1,10
VG 3	2,88	3,52	3,2	1,17
VG 5	4,14	5,06	4,6	1,29
VG 7	6,12	7,48	6,8	1,40
VG 10	9	11	10	1,60
VG 15	13,5	16,5	15	1,90
VG 22	19,8	24,2	22	2,30
VG 32	28,8	35,2	32	3
VG 46	41,4	50,6	46	4
VG 68	61,2	74,9	68	5,7
VG 100	90	110	100	8
VG 150	135	165	150	12
VG 220	198	242	220	16,5
VG 320	288	352	320	24
VG 460	414	506	460	32
VG 680	612	748	680	45
VG 1000	900	1100	1000	66
VG 1500	1350	1650	1500	100

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