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Rexroth
Bosch Group

Environmentally Acceptable Hydraulic Fluids HEES, HEPG, HETG for Axial Piston Units

See VDMA 24 568 "Rapidly biodegradable hydraulic fluids" – Minimum Technical Requirements

At present, 3 different types of environmentally acceptable hydraulic fluids are available:

1. Ester-based synthetic hydraulic fluids, HEES
2. Polyglycol-based synthetic hydraulic fluids, HEPG, (e.g. polyethylene glycol PEG)
3. Vegetable fluid-based hydraulic fluids, HETG (e.g. rapeseed fluid-based)

General

You must choose the hydraulic fluid for the hydrostatic circuit very carefully on the basis of the guidelines below, if possible even during the early design and configuration of the system, in order to ensure problem-free, economic operation.

Not all requirements can be equally well met, for example due to reasons of price, and so the user must determine the appropriate balance of characteristics required.

The viscosity and viscosity/temperature curve are of primary importance, and the density and pour point must also be taken into account.

We recommend that you select an operating viscosity (at operating temperature) in the optimal range for efficiency and service life appropriate to the circuit temperature (closed circuit), as follows:

ν_{opt} = opt. operating viscosity 16 ... 36 mm^2/sec

The limit values are as follows:

ν_{min} = 5 mm^2/sec

for a short period at a max. temperature of t_{max} = 115°C.

Please note that the maximum fluid temperature of 115°C must never be exceeded, even locally (e.g. in the storage area).

ν_{max} = 1600 mm^2/sec

for a short period during cold starting (n ≤ 1000 rpm, t_{min} = -40°C).

Special precautions are required at temperatures of -25°C to -40°C. Please contact us (see also RE90300-03-B).

To adapt the viscosity to the various temperature conditions, there are different viscosity classes of between 22 and 68 mm^2/sec, depending on fluid type, based on a temperature of 40° C.

Standard HLP hydraulic fluids have a viscosity index of approx. 100.

HVLP hydraulic fluids or multigrade engine fluids have a viscosity index > 140 and are therefore better suited for higher temperature ranges (mobile applications).

Most currently known environment-friendly hydraulic fluids have a viscosity index >130, and values up to 220 can be attained.

To evaluate the wear protection characteristics of a hydraulic fluid and therefore the permissible pressure range, the test method applied is

FZG – Standard Test A/8, 3/90.

Without limiting the pressure values, the FZG Test (DIN 51354) must yield the following result:

Damage force level ≥ 10

To ensure a long service life for the system, good and reliable filtering is essential.

Primary measures, such as cleaning parts and installing filters in the filling and ventilation systems do not prevent contamination, because new dirt particles are generated by abrasive wear as a result of gap boundary friction, erosion and roller bearing fatigue.

Contamination of the hydraulic fluid by solid particles must not exceed the corresponding purity class:

ISO 4406: Class 19/16/13.

At very high fluid temperatures (90°C to max. 115°C), the following minimum purity class is required:

ISO 4406: Class 18/15/12.

These hydraulic fluids have very good detergent characteristics (high dirt breakdown capacity). In order to obtain the required purity class in systems operating under normal conditions, we therefore recommend the use of filters with a retention rate of »β_{10} ≥ 100«.

In open circuit, with all 3 types of fluid (HEES, HEPG and HETG), only high-pressure and/or return filters may be used.

In closed circuit, intake or feed filters must be used.

In the case of polyglycol-based synthetic fluids, please note that due to their higher density compared to mineral fluid, the suction pressure at the pump inlet must not fall below the permissible minimum value.

This requirement is especially important in the case of intake filtering.

Important Note:

All environmentally acceptable hydraulic fluids, like conventional mineralfluid-based hydraulic fluids, are subject to *special waste disposal obligations.*

In addition, the guidelines and instructions of the fluid manufacturers and the relevant legal provisions must be observed.

1. HEES Fluids

HEES fluids are synthetic hydraulic fluids based on esters. These media are divided into two types of fluid:

- unsaturated synthetic esters (iodine number >10)

  These products have better and more stable properties than the natural HETG media, but are nevertheless only recommended for low and medium hydraulic loads.

- ***saturated synthetic esters (iodine number <10)***

  These media are ideal for maximum hydraulic loads (e.g. construction machinery).

- **excellent temperature response, even at low temperatures**
- **good lubrication properties**
- **good anti-corrosion properties**
- **soluble in mineral fluid**
- **very high resistance to ageing**
- **good compatibility with FPM seals**
- **good compatibility with suitable filters**

With correct handling, the higher price is offset by longer fluid change intervals and therefore more efficient environmental compatibility.

Permissible data

These media can be operated with the same high data as HLP mineral fluid. Long service life can be achieved, provided that certain important principles are observed:

- use FPM Viton seals
- the water content must never exceed 0.1% (hydrolysis, formation of corrosive acids)
- tanks must be designed to prevent any water entering the system
- filters must be made of glass fibre or metal wool
- use filters that can absorb moisture
- temperature limits:
  -20°C to +80°C (tank), locally <100°C in the system
- check the cooling system design: the temperatures are higher than during operation with a comparable mineral fluid
- long service life can be achieved with regular fluid analyses in the form of comparable trend analyses
  The important criteria in these analyses are:
  + wear particles
  + additives
  + water content
  + viscosity and viscosity index
  + purity class
  + TAN neutralisation number
  + etc.
  The fluid change intervals are determined by the current condition of the fluid, taking into account the operating conditions.
- the use of environmentally compatible hydraulic media should already be taken into account by appropriate design during the planning stage

Instructions for fluid conversion

Very often, machines that are operated e.g. with mineral fluid are subsequently converted to HEES media. The fault frequency with these conversions is very high.

The following instructions *must* imperatively be observed:

- **VDMA 24 569, "Conversion Guidelines", must be strictly followed**
- **check the seal quality: FPM seals are required**
- **check that the tank inner coatings are compatible with the new media**
- **although HEES media can be mixed with mineral fluid, flushing sequences must be implemented**

  <u>comply with the requirement for residual fluid content <2% (fluid analysis)</u>
  (for engine fluids: <1%)

  Caution:

  When using attachments that can be coupled to the main system (deep excavating scoops, grippers, rams etc.) the risk of a prohibited mixture of incompatible media is high. The consequences would be very premature wear, foaming and cavitation.
- **avoid mixing even different types of ester fluids**
- **check filter compatibility and replace the filters before converting**

  Caution:

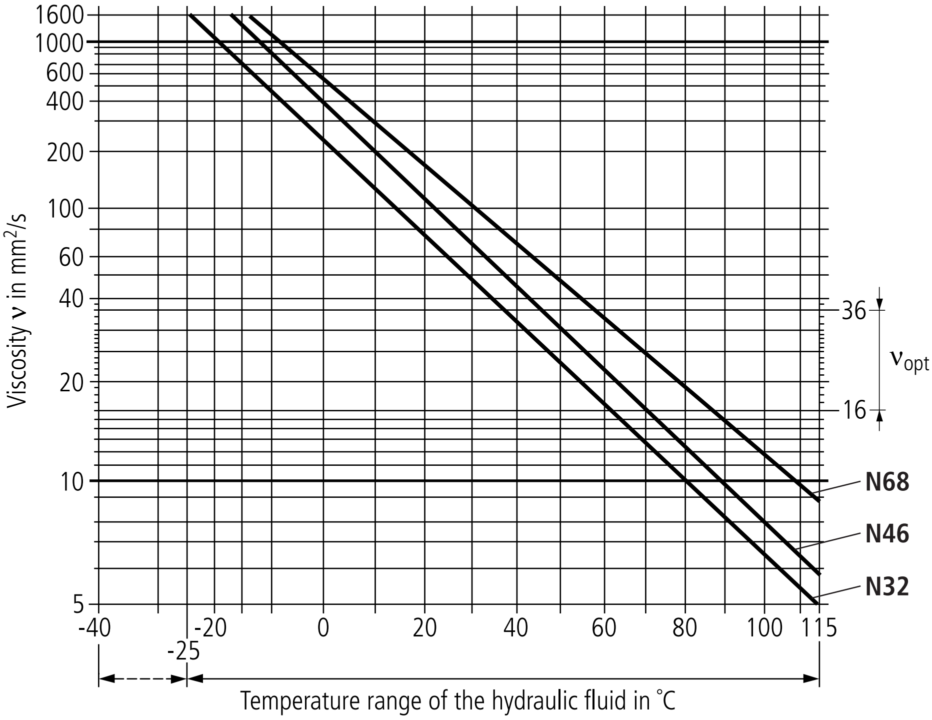
  Deposits from mineral fluid operation are dissolved and held in suspension. For safety, change the filters more often after the conversion (e.g. every 50 hours).
- **all types of environmentally compatible hydraulic fluids require special care and maintenance**

Trends

Due to their positive characteristics, saturated ester-based HEES fluids are increasingly being used for heavy-duty high-load systems, such as construction machinery.

With regular inspection of the media, such as trend analysis, the environmental compatibility increases due to the significantly increased fluid change intervals.

Selection graph for synthetic ester-based hydraulic fluids with a viscosity index VI of approx. 150...160.



Example:

		Viscosity ν (mm²/s) at 40°C	Viscosity ν (mm²/s) at 100°C
Avia-Syntofluid	**N32**	32	6,5
	N46	46	8
	N68	68	12
Panolin-HLP Synth	**N32**	32	6
	N46	46	8
	N68	68	11,3

2. HEPG Fluids

HEPG hydraulic fluids are polyglycol-based synthetic fluids.
For the conversion guidelines, see VDMA 24 569.

Disadvantages

- incompatible with mineral fluid
  permissible residual fluid content <1%
  (for engine fluids <0.5%)
- incompatible with polyurethane seals
- incompatible with standard paints and coatings
- corrosive to Plexiglas
- high density
  (>1g/ml - Caution is required when operating pumps in self-priming mode)
- water ingress can only be removed by evaporation
- foaming characteristics

Advantages

- good resistance to ageing
- good lubrication properties
- leakages are easily washed away and are invisible in water

Possible temperature range

- -30°C to +90°C

Fields of Application

- applications at or on water, such as locks, weirs, dredgers etc.
- concrete mixing systems
- isolated applications in the pharmaceuticals and foodstuffs industries
- ***we do not recommend the use of HEPG fluids in construction machinery***

Note

The use of HEPG fluids is in decline. Even in locks, the trend is towards HEES-type media.

3. HETG Fluids

HETG hydraulic fluids are based on natural products such as rapeseed fluid.
For the conversion guidelines, see VDMA 24 569.

Disadvantages

- incompatible with mineral fluid
  permissible residual fluid content <2%
  (for engine fluids <1%)
- reaction to cold temperatures
- thermal loading capacity
- ageing characteristics
- sensitivity to hydrolysis
  (all water ingress must be absolutely prevented)
- risk of gumming

Possible temperature range

- -10°C to +60°C (max. +70°C)

Compatibility with seal materials

- media based on rapeseed fluids, i.e. natural esters, are compatible with NBR

Water solubility

- HETG media are not water-soluble: leakages float on the water surface

Fields of Application

- we recommend the use of HETG fluids **only** in systems with low loads, such as the equipment-working hydraulic circuits of agricultural machines
- ***they are not suitable for use in the drives of construction machinery***

Note

The use of HETG fluids is in decline, because in practice the operating requirements are often not satisfied.

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