Radial Piston Motors MCR for Use with HF Fluids

Data sheet

Hydraulic fluids based on mineral oil and related hydrocarbons see data sheet RE 90220
For environmentally acceptable fluids for axial piston motors, see data sheet RE 90221

Following relevant tests, the radial piston motors shown in this leaflet have been found suitable for use with fire-resistant fluids.

These fluids – hereinafter referred to as HF ("H": hydraulic fluid; "F": fire-resistant) fluids – are sub-divided into four groups A, B, C and D as defined in DIN 51502 and are accordingly designated HFA, HFB, HFC and HFD.

In comparison with mineral oil based fluids, these fluids demonstrate other, at times unfavourable, properties. The following guidelines will show how these special properties may be taken into account in the project design, operation and servicing of hydraulic systems. Indication of the measures which must be observed when changing a system over from one fluid to another is also given.

Operation with HFA, HFB and HFC hydraulic fluids requires a reduction of the permissible pressure ratings and drive speeds. Depending on the product or the nominal size, a special version is necessary for radial piston motors.

When using HFD fluids, the standard pressure ratings of the radial piston motor can remain unchanged. A reduction of the permissible drive speeds is only required for operation with HFDR and HFDU polyalkylene glycol in self-priming mode (motor, open circuit), due to the much higher density of the medium.

Please refer to page 3 for additional technical data and the requisite seal materials for radial piston machines.

When ordering the radial piston motors please state the fluid to be used in clear text.

<table>
<thead>
<tr>
<th>Code</th>
<th>Type of Fluid</th>
<th>Water content (wt.-%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFA</td>
<td>oil-in-water emulsion$^1$</td>
<td>95 to 98$^2$</td>
</tr>
<tr>
<td>HFB</td>
<td>water-in-oil emulsion</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>HFC</td>
<td>water-based solutions (predominantly water-glycols)</td>
<td>35 to 55</td>
</tr>
<tr>
<td>HFD</td>
<td>water-free fluids</td>
<td>≤ 0.1</td>
</tr>
<tr>
<td>HFD is sub-divided into:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HFDR</td>
<td>phosphate-esters</td>
<td></td>
</tr>
<tr>
<td>HFDU</td>
<td>polyalkylene glycol</td>
<td></td>
</tr>
<tr>
<td></td>
<td>poliol esters</td>
<td></td>
</tr>
</tbody>
</table>

1) This designation embraces the present development level of emulsions, micro-emulsions and synthetic solutions.
2) Our radial piston motors are partly approved for use with 95/5 fluids.

For details of properties and values of HF fluids see VDMA 24 317 and „7 Luxemburgian Report“.

For guidelines for the changeover of the fluid in a hydraulic system, see VDMA 24 314.
Selection of components

General Check on Components
It must be checked that every component in the system is suitable for the chosen hydraulic fluid. At the same time, it must be ascertained that seal and hose materials and casings, as well as paint finishes, are compatible with the hydraulic fluid (see VDMA 24 317 and VDMA 24 314). If anti-corrosion additives are present in the fluids, under certain circumstances treatment of individual components may not be necessary. If in doubt, consult the manufacturer.

Tanks
Because of the poor air and dirt elimination properties of HF fluids, standing time in the tank should be extended by using a larger tank than that for operation with mineral oil. In addition, bulkheads may be installed, either with openings or as weirs, with meshes fitted in the openings.

Because of the low temperature limits of HFA, HFB and HFC fluids and the poor heating properties of HFD fluids, the tank must have adequate cooling surfaces, or a separate cooling system must be installed. Again, because of the poor viscosity/temperature relationship of HFD fluids, it must be checked whether heating of the fluid may be necessary at low temperatures.

Evaporation losses occurring with HFA, HFB and HFC fluids may be considerably reduced by the use of a tank lid with breather (0.1 bar above atmospheric pressure where necessary).

Filters
Good and reliable filtration is required to promote long service life of a system. Primary measures such as cleaning of components and fitting of oil filler/breather filters cannot prevent the accumulation of dirt, since new dirt particles are caused by abrasive wear as a result of friction in clearances, erosion and roller bearing fatigue.

The poor dirt elimination characteristics of HF fluids must be counteracted by careful filtration and frequent monitoring of the effectiveness of the filtration.

The level of solid particle contamination of the hydraulic fluid must not exceed the relevant cleanliness grade:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>9 to NAS 1638</td>
</tr>
<tr>
<td>19/18/15</td>
<td>ISO/DIS 4406.</td>
</tr>
</tbody>
</table>

Use of filters with a retention rate of $b_{20}> 100$ will normally achieve the required cleanliness grade in systems operating under normal conditions.

Almost all HF fluids have a higher density than mineral oil, and for this reason care must be taken that the required minimum suction pressure at the motor inlet is maintained. In order that the pressure on the suction side of the motor is not further reduced, use of suction filters should wherever possible be avoided when using HFC and HFD fluids.

Motors
The manufacturer's specifications with regard to speed, operating pressure and suction characteristics must be strictly observed (see pages 3 and 4).

Circuit
Since the response characteristics of control valves are dependent on the density and compressibility of the hydraulic fluid, the manufacturer must be consulted as to their suitability. Systems which tend towards pressure peaks (e.g. compact transmissions) should, because of the low compression modulus of HF fluids, be damped by means of hoses, accumulators etc.

Changing the hydraulic fluid in hydraulic systems

Preliminary Check
On the basis of VDMA 24 314 first check whether the materials and system layout including components are suitable for use with the replacement fluid.

Cleaning the System
Many system components must be drained and cleaned. Cylinders, mesh filter housings, pumps, motors, accumulators, etc must be dismantled.

Particular care must be taken in the cleaning of "dead" spaces. Filter cartridges or elements should be replaced with new ones. Suitable cleaning materials are listed in VDMA 24 314.

Flushing
For reasons of economy, the system need be filled with only enough new fluid as is necessary to allow it to function. For flushing, the system should be started at low power, followed by a gradual run-up to full power within 50% of the flushing time.

During flushing, continuous bleeding should take place when operating many of the system components. It is desirable to reach the permissible operating temperature wherever possible.

Recommended flushing times are:

- for changeover from
  - mineral oil to HFD: 1 to 2 hrs
  - mineral oil to HFA/HFB: 8 hrs
  - mineral oil to HFC: 16 to 24 hrs
  - HFA/HFB/HFC to HFD: 16 to 24 hrs
  - HFD to HFA, HFB, HFC:
    - 1. flushing with mineral oil: 16 to 24 hrs
    - 2. flushing with HFA/HFB/HFC: 14 to 24 hrs

Draining of the flushing fluid should, wherever possible, be carried out when the system is warm. The condition of the flushing fluid should be checked and, if necessary, a second flushing process carried out using new fluid.

Clean cooler and filter; if necessary replace filter elements. Re-use of flushing fluid is possible only after regeneration and with the agreement of the fluid manufacturer.

Commissioning
Following correct filling with the operating fluid, the system should if possible be started under partial load and gradually run up to full load. Again, the system must be carefully bled upon operation of many of the system components.

Filters and fluid must be carefully monitored, especially during the first few days of operation. Paint deposits and any remaining old fluid must be removed.

Bibliography
- VDMA-Standard 24 314
- VDMA-Standard 24 317
- R39 H (Cetop) • RP 86 H (Cetop)
General technical data for radial piston motors

Operation with HFA, HFB, HFC- and HFD-Fluids

<table>
<thead>
<tr>
<th>Code</th>
<th>HFA</th>
<th>HFB</th>
<th>HFC</th>
<th>HFD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of fluid</td>
<td>Oil in water emulsion</td>
<td>Water in oil emulsion</td>
<td>Water based solution</td>
<td>Water free fluid</td>
</tr>
</tbody>
</table>

This designation embraces the present development level of emulsions, microemulsions and synthetic solutions

(Predominantly with Glycols)

(Predominantly phosphate-ester)

| Water content (in wt.-%) | 95 | > 40 | 35 to 55 | ≤ 0.1 |

(following data is with respect to 95/5 fluids)

Circuit temperature

| Maximum circuit temperature $t_{\text{max}}$ | 50 °C | 50 °C | 50 °C | 80 °C |
| Optimum circuit temperature $t_{\text{opt}}$ | 40 °C | 40 °C | 40 °C | 70 °C |
| Minimum starting temperature $t_{\text{min}}$ | 5 °C | 5 °C | -10 °C | 0 °C |

Bearing life

Achievable life in approx. % of life obtained when operating using mineral oil (bearing manufacturer’s figures).
In practice, results considerably higher than this figure have been obtained.

| 10 % | 20 % | 20 % | 100 % |

Filtration

| Filtration grade (consult fluid manufacturer) | 9 to NAS 1638 | 19/18/15 to ISO/DIS 4406 |
| Filter material | Metal fibre | Metal fibre | Metal fibre |
| Filter material | Metal fibre or paper with special bonding agent |

Seal material

(Consult fluid manufacturer) NBR NBR NBR FKM

Piston ring material

(Metal rings must be specified by special order) Metal Metal Metal Plastic

Please consult the application engineering department at Bosch Rexroth Glenrothes for a motor life calculation based on a particular operating case.

The designation of the hydraulic fluid is obtained by adding the viscosity grade to the fluid code e.g. HFD 32.

Note

For motor operation in open circuits there is a min. inlet pressure at suction port S of 1 bar absolute.

$P_{s\text{ min}}$ = 1.0 bar absolute
## Technical data

**Radial piston motor MCR**

for open and closed circuits (RE 15205 to 15214)

<table>
<thead>
<tr>
<th>Sizes</th>
<th>Nominal pressure $p_N$</th>
<th>Peak pressure $p_{max}$</th>
<th>3</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>40</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFA</td>
<td>140 bar</td>
<td>160 bar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HFB</td>
<td>160 bar</td>
<td>210 bar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HFC</td>
<td>250 bar</td>
<td>280 bar</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>HFD</td>
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</tr>
</tbody>
</table>

*Subject to change.*

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