RE 90 223/11.99

Replaces: 09.90

Rexroth
Bosch Group

Axial Piston Units for Use with HF Fluids

For mineral oil based fluids for axial piston units, see data sheet RE 90220

For environmentally acceptable fluids for axial piston units, see data sheet RE 90221

Following relevant tests, the axial piston pumps and 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 axial piston machines (version **E**-...).

When using HFD fluids, the standard pressure ratings of the axial piston machine 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 (pump, 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 axial piston machines.

When ordering the axial piston units please state the fluid to be used in clear text.

Code	Type of Fluid	Water content (wt..-%)
HFA	oil-in-water emulsion [1])	95 ... 98 [2])
HFB	water-in-oil emulsion	> 40
HFC	water-based solutions (predominantly water-glycols)	35 ... 55
HFD	water-free fluids	≤ 0,1
HFD is sub-divided into:		
HFDR	phosphate-esters	
HFDU	- polyalkylene glycol - polyol esters	

[1]) This designation embraces the present development level of emulsions, micro-emulsions and synthetic solutions.

[2]) Our axial piston units 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 fatique.

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:

9 to NAS 1638

19/18/15 to ISO/DIS 4406.

Use of filters with a retention rate of »$\beta_{20} \geq 100$« 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 pump inlet is maintained. In order that the pressure on the suction side of the pump is not further reduced, use of suction filters should wherever possible be avoided when using HFC and HFD fluids.

Pumps /Motors

The manufacturer's specifications with regard to speed, operating pressure and suction characteristics must be strictly observed (see pages 3-8).

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 – 2 hrs
mineral oil to HFA/HFB:	8 hrs
mineral oil to HFC:	16 – 24 hrs
HFA/HFB/HFC to HFD:	16 – 24 hrs
HFD to HFA, HFB, HFC:	
1. flushing with mineral oil:	16 – 24 hrs
2. flushing w. HFA/HFB/HFC:	14 – 24hrs

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

1) VDMA-Standard 24 314

2) VDMA-Standard 24 317

R39 H (Cetop) • RP 86 H (Cetop)

General Technical Data for Axial Piston Units

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

Code	HFA	HFB	HFC	HFD
Code	Oil in water emulsion This designation embraces the present development level of emulsions, microemulsions and synthetic solutions	Water in oil emulsion	Water based solution (predominantly with Glycols)	Water free fluid (predominantly phosphate-ester)
Water content (in wt.-%)	95 (following data is with respect to 95/5 fluids)	> 40	35 ... 55	≤ 0,1
Circuit temperature				
max. circuit temperature t_{max}	50° C	50° C	50° C	80° C
opt. circuit temperature t_{opt}	40° C	40° C	40° C	70° C
min. starting temperature t_{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	Metal fibre or paper with special bonding agent
Seal material				
(consult fluid manufacturer)	NBR	NBR	NBR	FKM

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

Note:

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

$p_{s\,min}$ _____ 1,0 bar abs

Technical Data (max. perm. speed in rpm)

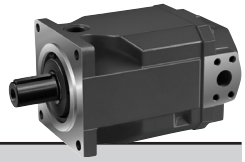
Fixed displacement pump A2FO /6

for open circuits (RE 91401)

Size		5	10	12	16	23	28	32	45	56	63	80
HFA	*not admissible*	–	–	–	–	–	–	–	–	–	–	–
HFB	*Nominal pressure p_N ___ 160 bar* *Peak pressure p_{max} _____ 210 bar*	4500	2520	2520	2520	2000	2000	2000	1800	1600	1600	1440
HFC	*Nominal pressure p_N ___ 200 bar* *Peak pressure p_{max} _____ 250 bar*	4500	2520	2520	2520	2000	2000	2000	1800	1600	1600	1440
HFD	HFDR, HFDU-Polyalkylene glycol	4500	2520	2520	2520	2000	2000	2000	1800	1600	1600	1440
	HFDU-Polyol Ester	5600	3150	3150	3150	2500	2500	2500	2240	2000	2000	1800

Size		90	107	125	160	180	200	250	355	500	710	1000
HFA	*not admissible*	–	–	–	–	–	–	–	–	–	–	–
HFB	*Nominal pressure p_N ___ 160 bar* *Peak pressure p_{max} _____ 210 bar*	1440	1280	1280	1160	1160	1240	1200	1060	950	950	750
HFC	*Nominal pressure p_N ___ 200 bar* *Peak pressure p_{max} _____ 250 bar*	1440	1280	1280	1160	1160	1240	1200	1060	950	950	750
HFD	HFDR, HFDU-Polyalkylene glycol	1440	1280	1280	1160	1160	1240	1200	1060	950	950	750
	HFDU-Polyol Ester	1800	1600	1600	1450	1450	1550	1500	1320	1200	1200	950

(HFA, HFB, HFC at size 250...1000: design **E-A2FLO**)



Fixed displacement pump A4FO

for open circuits (RE 91455)

Size		16	22	28	40	71	125	250	500
HFA	*Nominal pressure p_N ___ 140 bar* *Peak pressure p_{max} _____ 160 bar*	–	–	–	–	1650	1350	1120	1000
HFB	*Nominal pressure p_N ___ 160 bar* *Peak pressure p_{max} _____ 210 bar*	–	–	–	–	1760	1450	1200	1050
HFC	*Nominal pressure p_N ___ 250 bar* *Peak pressure p_{max} _____ 280 bar*	–	–	–	–	1760	1450	1200	1050
HFD	HFDR, HFDU-Polyalkylene glycol	3200	2880	2400	2200	1760	1450	1200	1050
	HFDU-Polyol Ester	4000	3600	3000	2750	2200	1800	1500	1320

(HFA, HFB, HFC at size 71...500: design **E-A4FO**)

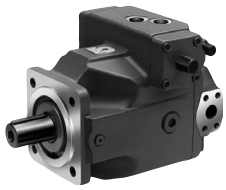
Technical Data (max. perm. speed in rpm)

Variable displacement pump A10VSO /3

for open circuits (RE 92711, RE 92712, RE 92713)

Size		10	18	28	45	71	100	140
HFA	*Nominal pressure p_N — 140 bar* *Peak pressure p_{max} — 160 bar*	2700	2450	2250	1950	1650	1500	1350
HFB	*Nominal pressure p_N — 140 bar* *Peak pressure p_{max} — 160 bar*	2900	2650	2400	2100	1760	1600	1450
HFC	*Nominal pressure p_N — 175 bar* *Peak pressure p_{max} — 210 bar*	2900	2650	2400	2100	1760	1600	1450
HFD	HFDR, HFDU-Polyalkylene glycol	2900	2650	2400	2100	1760	1600	1450
	HFDU-Polyol Ester	3600	3300	3000	2600	2200	2000	1800

(for HFA, HFB, HFC: Design **E-A10VSO**)



Variable displacement pump A4VSO

for open circuits (RE 92050)

Size		40	71	125	180	250	355	500	750	1000
HFA	*Nominal pressure p_N — 140 bar* *Peak pressure p_{max} — 160 bar*	1950	1650	1350	1350	1120	1120	1000	900	750
HFB	*Nominal pressure p_N — 160 bar* *Peak pressure p_{max} — 210 bar*	2100	1760	1450	1450	1200	1200	1050	960	800
HFC	*Nominal pressure p_N — 250 bar* *Peak pressure p_{max} — 280 bar*	2100	1760	1450	1450	1200	1200	1050	960	800
HFD	HFDR, HFDU-Polyalkylene glycol	2100	1760	1450	1450	1200	1200	1050	960	800
	HFDU-Polyol Ester	2600	2200	1800	1800	1500	1500	1320	1200	1000

(for HFA, HFB, HFC: design **E-A4VSO**) bearing flushing at port U necessary!

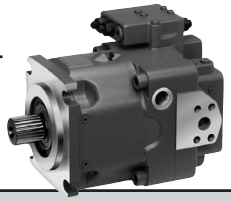
Variable displacement pump A4VSG

for closed circuits (RE 92100)

Size		40	71	125	180	250	355	500	750	1000
HFA	*Nominal pressure p_N — 140 bar* *Peak pressure p_{max} — 160 bar*	2750	2400	1950	1800	1650	1500	1350	1200	1200
HFB	*Nominal pressure p_N — 160 bar* *Peak pressure p_{max} — 210 bar*	3000	2550	2100	1920	1750	1600	1450	1300	1300
HFC	*Nominal pressure p_N — 250 bar* *Peak pressure p_{max} — 280 bar*	3000	2550	2100	1920	1750	1600	1450	1300	1300
HFD		3700	3200	2600	2400	2200	2000	1800	1600	1600

(for HFA, HFB, HFC: design **E-A4VSG**) bearing flushing at port U necessary!

Technical Data (max. perm. speed in rpm)



Variable displacement pump A11VO

for open circuits (RE 92500)

Size		40	60	75	95	130	190	260	A11VLO	130	190	260
HFA	*not admissible*	–	–	–	–	–	–	–		–	–	–
HFB	*not admissible*	–	–	–	–	–	–	–		–	–	–
HFC	*not admissible*	–	–	–	–	–	–	–		–	–	–
HFD	HFDR, HFDU-Polyalkylene glycol	2400	2200	2050	1900	1700	1700	1450		2000	2000	1850
	HFDU-Polyol Ester	3000	2700	2550	2350	2100	2100	1800		2500	2500	2300

Variable displacement double pump A20VO

for open circuits (RE 93100)

Size		60	75	95	130	520	A20VLO	130	190	260
HFA	*Nominal pressure p_N 140 bar* *Peak pressure p_{max} 160 bar*	2000	–	–	–	990		–	–	–
HFB	*Nominal pressure p_N 160 (140)[1] bar* *Peak pressure p_{max} 210 (160)[1] bar*	2150	–	–	–	1050		–	–	–
HFC	*Nominal pressure p_N 250 (175)[1] bar* *Peak pressure p_{max} 280 (210)[1] bar*	2150	–	–	–	1050		–	–	–
HFD	HFDR, HFDU-Polyalkylene glycol	2150	2050	1900	1700	1050		2000	2000	1850
	HFDU-Polyol Ester	2700	2550	2350	2100	1320		2500	2500	2300

[1]) size 60

(HFA, HFB, HFC at size 60, 520: design **E-A20VO**)

Variable displacement pump A7VO

for open circuits (RE 92202, RE 92203)

Size		55	80	107	160	250	355	500	1000
HFA	*not admissible*	–	–	–	–	–	–	–	–
HFB	*Nominal pressure p_N 160 bar* *Peak pressure p_{max} 210 bar*	2000	1800	1600	1400	1200	1060	950	750
HFC	*Nominal pressure p_N 200 bar* *Peak pressure p_{max} 250 bar*	2000	1800	1600	1400	1200	1060	950	750
HFD	HFDR, HFDU-Polyalkylene glycol	2000	1800	1600	1400	1200	1060	950	750
	HFDU-Polyol Ester	2500	2240	2150	1900	1500	1320	1200	950

(HFA, HFB, HFC at size 250...1000: design **E-A7VLO**)

Technical Data (max. perm. speed in rpm)

Variable displacement pump A4VG / A4VTG

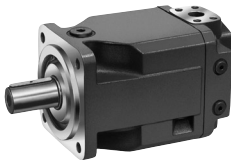
for closed circuits (RE 92003, RE 92012)

Size	28	40	56	71	90	125	180	250
HFA *not admissible*	–	–	–	–	–	–	–	–
HFB *not admissible*	–	–	–	–	–	–	–	–
HFC *not admissible*	–	–	–	–	–	–	–	–
HFD	4250	4000	3600	3300	3050	2850	2500	2400

Variable displacement pump A10VG

for closed circuits (RE 92750)

Size	18	28	45	63
HFA *not admissible*	–	–	–	–
HFB *not admissible*	–	–	–	–
HFC *not admissible*	–	–	–	–
HFD	5000	4250	3800	3500



Fixed displacement motor A4FM

for open and closed circuits (RE 91100, RE 91120)

Size	22	28	40	56	71	125	250	500
HFA *Nominal pressure p_N 140 bar* *Peak pressure p_{max} 160 bar*	–	–	–	–	2400	1950	1650	1350
HFB *Nominal pressure p_N 160 bar* *Peak pressure p_{max} 210 bar*	–	–	–	–	2550	2100	1750	1450
HFC *Nominal pressure p_N 250 bar* *Peak pressure p_{max} 280 bar*	–	–	–	–	2550	2100	1750	1450
HFD	4250	4250	4000	3600	3200	2600	2200	1800

(HFA, HFB, HFC at size 71...500: design **E-A4FM**)

Technical Data (max. perm. speed in rpm)

Fixed displacement motor A2FM / A2FE

for open and closed circuits (RE 91001, RE 91008)

Size		5	10	12	16	23	28	32	45	56	63	80
HFA	*not admissible*	–	–	–	–	–	–	–	–	–	–	–
HFB	*Nominal pressure p_N 160 bar* *Peak pressure p_{max} 210 bar*	6400	4800	4800	4800	3800	3800	3800	3400	3000	3000	2680
HFC	*Nominal pressure p_N 200 bar* *Peak pressure p_{max} 250 bar*	6400	4800	4800	4800	3800	3800	3800	3400	3000	3000	2680
HFD		10 000	8000	8000	8000	6300	6300	6300	5600	5000	5000	4500

Size		90	107	125	160	180	200	250	355	500	710	1000
HFA	*not admissible*	–	–	–	–	–	–	–	–	–	–	–
HFB	*Nominal pressure p_N 160 bar* *Peak pressure p_{max} 210 bar*	2680	2400	2400	2100	2100	2200	2000	1800	1600	1280	1280
HFC	*Nominal pressure p_N 200 bar* *Peak pressure p_{max} 250 bar*	2680	2400	2400	2100	2100	2200	2000	1800	1600	1280	1280
HFD		4500	4000	4000	3600	3600	2750	2500	2240	2000	1600	1600

HFA, HFB, HFC at size 250...1000: design **E-A2FLM**)

Variable displacement motor A6VM / A6VE

for open and closed circuits (RE 91604, RE 91606)

Size		28	55	80	107	140	160	200	250	355	500	1000
HFA	*not admissible*	–	–	–	–	–	–	–	–	–	–	–
HFB	*Nominal pressure p_N 160 bar* *Peak pressure p_{max} 210 bar*	3700	3000	2600	2300	2200	2100	1900	2000	1800	1600	1280
HFC	*Nominal pressure p_N 250 bar* *Peak pressure p_{max} 280 bar*	3700	3000	2600	2300	2200	2100	1900	2000	1800	1600	1280
HFD		5550	4450	3900	3550	3250	3100	2900	2500	2240	2000	1600

HFA, HFB, HFC at size 250...1000: design **E-A6VLM**)

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