Axial piston variable pump A4VSO Series 1x and 3x for HFC hydraulic fluids

RE 92053
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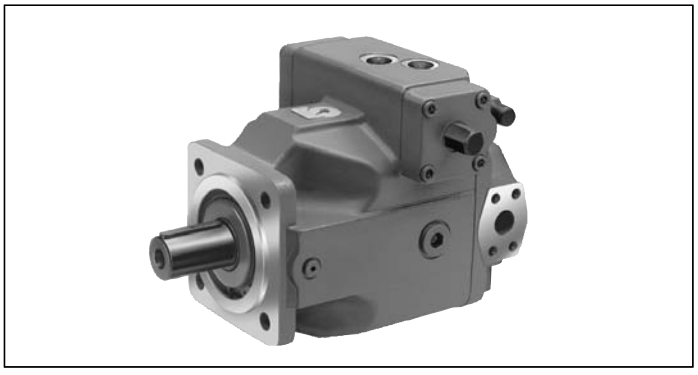


- Sizes 71 to 355
- Nominal pressure 350 bar
- Maximum pressure 400 bar
- Open circuit

Features

- Variable displacement pump with axial piston rotary group of swashplate design for hydrostatic drives in open circuit.
- Flow is proportional to the drive speed and displacement.
- Flow can be infinitely varied by adjusting the swashplate angle.
- Especially suited for the operation with HFC hydraulic fluids.
- Operation without external bearing flushing is possible.
- With selected HFC hydraulic fluids, equal pressures, rotational speeds and bearing service life as with operation based on mineral oil
- Excellent suction characteristics
- Low noise level
- Good power to weight ratio
- Axial and radial load capacity of drive shaft
- Modular layout
- Short control response times
- Possible through drive and pump combinations
- Swivel angle indicator
- Any installation position possible

Inhalt

Type code

01	02	03	04		05	06		07	08	09	10	11	12
A4VS	**O**			**/**			**–**	**F**					

Axial piston unit

01	Swashplate design, variable, nominal pressure 350 bar, maximum pressure 400 bar	**A4VS**

Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement, see technical data on page 5	**71**	**125**	**180**	**250**	**355**	

Control device

		for further information, please refer to data sheet						
04	Pressure controller	92060	●	●	●	●	●	**DR..**
	Pressure controller for parallel operation		●	●	●	●	●	**DP..**
	Flow controller		●	●	●	●	●	**FR..**
	Pressure and flow controller		●	●	●	●	●	**DFR.**
	Power controller with hyperbolic characteristic curve	92064	●	●	●	●	●	**LR..[1)]**
	Electric motor control	92072	●	●	●	●	●	**EM..**
	Hydraulic control, depending on quantity	92076	●	●	●	●	●	**HM..**
	Hydraulic control with servo valve / proportional valve		●	●	●	●	●	**HS..[1)]**
	Electronic control		●	●	●	●	●	**EO..[1)]**
	Hydraulic control, pilot-pressure related	92080	●	●	●	●	●	**HD..[1)]**
	Electro-hydraulic control system DFE1 System solution SYHDFE	92088 30035	●	●	●	●	●	**DFE.[1)]**

Series

05	Series 1, index 0	●	–	–	–	–	**10[2)]**
	Series 1, index 1	●	–	–	–	–	**11[2)]**
	Series 3, index 0	–	●	●	●	●	**30**

Direction of rotation

06	With view on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material and hydraulic fluid

07	NBR nitrile rubber, shaft seal PTFE Teflon, special version for HFC hydraulic fluids Bearing flushing required (port **U**)	●	●	●	●	●	**F**
	NBR nitrile rubber, shaft seal PTFE Teflon, special version for HFC hydraulic fluids Operation without external bearing flushing	○	○	○	●	○	**F2**

For further information on the basic unit for positions 08 to 12 as well as for the project planning notes and safety instructions, please refer to data sheet 92050

● = Available ○ = On request – = Not available

1) Please observe the notices and restrictions in the control data sheets regarding the operation with HFC hydraulic fluids.
2) Version with HD control only in series 11.

Hydraulic fluid

For detailed information on the selection of hydraulic fluids and the application conditions, please refer to our data sheet RE 90223 (HF hydraulic fluids) before project planning.
Compared to pressure media on mineral oil basis, HFC fluids have different and sometimes disadvantageous characteristics. The following instructions must be observed for the project planning, operation and maintenance of systems with HFC hydraulic fluids.
The following HFC fluids with a water content of approx. 35 to 55 weight percent are permissible without any restrictions of pressure and rotational speed compared to operation on mineral oil basis.

- Fuchs Hydrotherm 46M
- Petrofer Ultrasafe 620
- Fuchs Renosafe 500
- Houghton Houghto Safe 620
- Union Carbide HP 5046

HFC hydraulic fluids can only be used if their characteristics and values comply with ISO 12922.
The restrictions of the technical data according to data sheet 90223 must be observed for any HFC hydraulic fluids other than those mentioned above.
Please contact us for the operation with rolling oils and HFA hydraulic fluids and other operating fluids with low viscosity.
Please also observe the notes for filtration, limiting viscosity and temperature range. Operation with mineral oil is always possible without restrictions (please consider the information on F/F2 bearing flushing on page 4).

Operating viscosity range
Selection diagram and detailed information on the selection of hydraulic fluid
see data sheet 92050

Limit of viscosity range
The following values apply to the threshold operating conditions:

n_{min} = 10 mm²/s
short-term (t < 1 min),
t_{max} < +50 °C

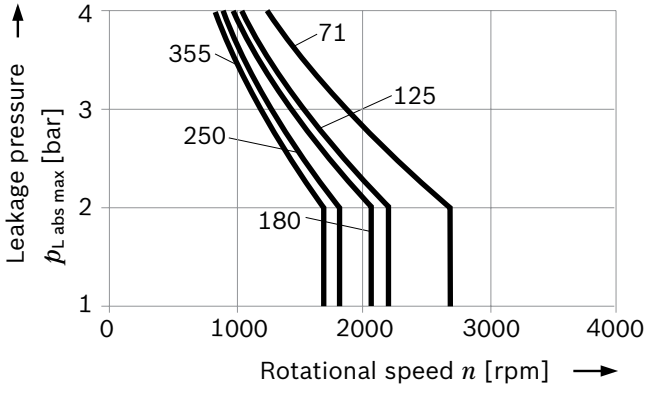
n_{max} = 1000 mm²/s
only for start (cold start, within 15 minutes, an operating viscosity below 100 mm²/s should be reached)
t_{min} > −10 °C

Temperature range		
t_{min}	≥	−10 °C
t_{max}	≤	+50 °C
t_{opt}	=	+40 °C

Higher temperatures are not permissible since they may lead to higher water losses.
If limiting viscosity and temperature range are complied with, HFC fluids may also be operated at low temperatures.
Please note: The leakage temperature which is influenced by pressure and rotational speed is always above the reservoir temperature.
However, at no point of the system may the temperature be higher than +50 °C.

Filtration of the hydraulic fluid
Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
To ensure the functional reliability of the axial piston unit, the gravimetric evaluation of the hydraulic fluid is required to determine the solid particle contamination and to determine the cleanliness level according to ISO 4406.
A cleanliness level of at least 20/18/15 must be complied with.

Leakage pressure
The permissible leakage pressure (case pressure) depends on the rotational speed (see diagram).



Maximum leakage pressure (case pressure)	
$p_{L\ abs\ max}$	4 bar abs.

The parameters are reference values; under certain operating conditions, restrictions may be required.

For further details see data sheet 92050

Bearing flushing

For the **"F"** variant (type code position 07), external bearing flushing is mandatory.
Variant **"F2"** (type code position 07) is operated without bearing flushing. Certain installation conditions must be observed. Please contact us for any operation with external bearing flushing.
Port **"U"** at the front flange of the variable displacement pump is used for bearing flushing. The flushing fluid flows through the front bearing and is discharged together with the leakage fluid.

Please see the table below for the following important values

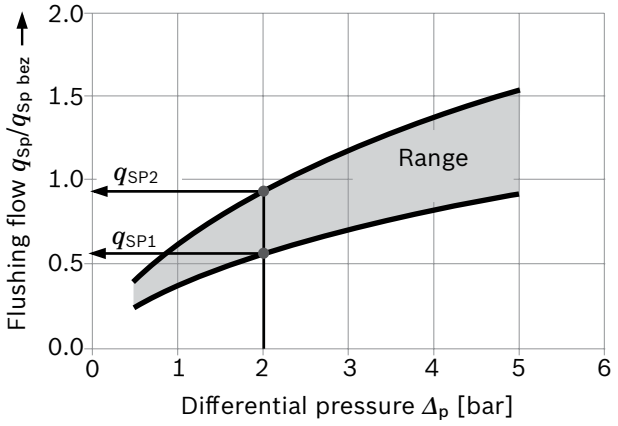
- Minimum required flushing flow $q_{Sp\ min}$ at port **U**
- Maximum permissible pressure p_{max} at port **U**
- Reference flow $q_{Sp\ bez}$ to check whether the minimum required flushing flow has been reached (see example)

NG		71	125	180	250	355
$q_{Sp\ min}$	l/min	1.0	1.0	1.5	2.0	3.0
p_{max}	bar	5.0	5.0	5.0	5.0	5.0
$q_{Sp\ bez}$	l/min	2.0	3.5	5.0	6.5	10.0

Notice
For variant "F" you must make sure for the operation with bearing flushing that the throttle screw at port **U** is screwed in to the stop.

Notice regarding setting and inspection:
The flushing flow depends on the pressure difference between port **U** and housing ($\Delta p = p_U - p_{Geh}$).
This correlation is illustrated in the following diagram irrespective of the size.

Flushing flow at port U



Example using A4VSO 250.../30...F...				
Case pressure	p_{Geh}			1 bar
Pressure at port **U**	p_U			3 bar
	Δp			2 bar
Reference flow	$q_{Sp\ bez}$			6.5 l/min
Flushing flow (Flow range delimitation)	$q_{Sp\ 1}$	= 0.56 × $q_{Sp\ bez}$	=	3.6 l/min
	$q_{Sp\ 2}$	= 0.94 × $q_{Sp\ bez}$	=	6.1 l/min
required minimum flow	$q_{Sp\ min}$			2 l/min

Check the value on the basis of a confirmatory measurement.

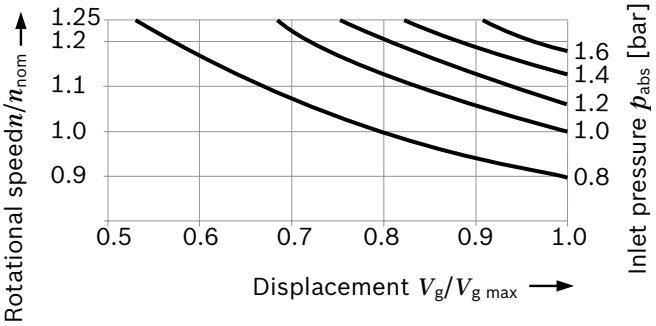
Working pressure range

Pressure at port **S** (inlet)	
$p_{abs\ min}$	0.8 bar abs.
$p_{abs\ max}$	30 bar abs.

Pressure at working port **B**	
Nominal pressure p_{nom}	350 bar abs.
Maximum pressure p_{max}	400 bar abs.

The density of almost all HF fluids is higher than that of mineral oil. It is absolutely vital to make sure that the minimum permissible suction pressure $p_{abs\ min}$ at the pump input is not fallen below.
Any measures which could affect suction must be avoided (e.g. no suction filter).

Determination of the inlet pressure p_{abs} at the suction opening **S** and/or reduction of the displacement with increasing speed



The inlet pressure is the static supply pressure and the minimum dynamic value, respectively, e.g. in case of pre-charge pressure.

Notice
For the maximum permissible rotational speed n_{max} please refer to "Technical Data" on page 5.

For the technical data regarding the outlet working pressure range, please refer to data sheet 92050.

Technical data

Size		NG		71	125	180	250	355
Geometric displacement, per revolution		$V_{g\,max}$	cm^3	71	125	180	250	355
Maximum rotational speed[1]	at $V_{g\,max}$	n_{nom}	rpm	2200	1800	1800	1500	1500
	at $V_g \leq V_{g\,max}$	n_{max}	rpm	2700	2200	2100	1800	1700
Minimum speed[2]		n_{min}	rpm	800	800	800	800	800
Flow	at n_{nom} and $V_{g\,max}$	q_v	l/min	156	225	324	375	533
	at n_E = 1500 rpm	$q_{E\,max}$	l/min	107	186	270	375	533
Power	at n_{nom}, $V_{g\,max}$ and Δp = 350 bar	P	kW	91	131	189	219	311
	at n_E = 1500 rpm	$P_{E\,max}$	kW	62	109	158	219	311
Torque	at $V_{g\,max}$ and Δp = 350 bar	T	Nm	395	696	1002	1391	1976
	at $V_{g\,max}$ and Δp = 100 bar	T	Nm	113	199	286	398	564
Rotary stiffness Drive shaft	P	c	kNm/rad	146	260	328	527	800
	Z	c	kNm/rad	146	263	332	543	770
Moment of inertia of the rotary group		J_{TW}	kgm^2	0.0121	0.03	0.055	0.0959	0.19
Maximum angular acceleration[3]		α	rad/s^2	11000	8000	6800	4800	3600
Case volume		V	l	2.5	5	4	10	8
Weight (with pressure controller) approx.		m	Kg	53	88	102	184	207

Determining the operating characteristics						
Flow	q_v	=	$\frac{V_g \times n \times \eta_v}{1000}$			[l/min]
Torque	T	=	$\frac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$			[Nm]
Power	P	=	$\frac{2\,\pi \times T \times n}{60000}$	=	$\frac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g Displacement per revolution [cm^3]
Δp Differential pressure [bar]
n Rotational speed [rpm]
η_v Volumetric efficiency
η_{hm} Hydraulic-mechanical efficiency
η_t Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Notice

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommend checking the loads by means of experiment or calculation / simulation and comparison with the permissible values.

1) The following values apply:
– for the optimum viscosity range from v_{opt} = 36 to 16 mm^2/s
– with hydraulic fluid on the basis of mineral oils
– at a pressure of $p_{saug} \geq 1$ bar abs.at suction port **S**.

2) Other values depend on viscosity, please contact us.

3) The data are valid for values between the minimum required and maximum permissible rotational speed. Valid for external excitation (e.g. diesel engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connection parts must be considered.

Installation instructions

General check of each component
Each component provided for the circuit must be checked whether it is suitable for the hydraulic fluid used. It must also be ensured that the seal and hose materials and their coating and paint, respectively, are compatible with the hydraulic fluid.

Reservoir
HF hydraulic fluids have poor air and dirt separation characteristics.
The separation ability can be supported by a longer dwell time of the fluid in the reservoir (using a larger reservoir than for mineral oil) and by tilted partition panels with openings and sieves (to settle the fluid).
The low temperature limits require the controlled cooling of the hydraulic fluid. which can be supported by a large reservoir surface.
Evaporation losses are significantly reduced by covers with air bleed.

General
The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.
The case drain in the case interior must be directed to the reservoir via the highest reservoir port (**T**, **R**(**L**)). For combinations of multiple units, the case drain fluid must be drained off at each pump. If a shared drain line is used for this purpose, make sure that the case pressure in each pump is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.
To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
In all operating conditions, the suction and drain lines must flow into the reservoir below the minimum fluid level. The minimum suction pressure at port **S** must also not fall below 1 bar abs. during operation and during a cold start.

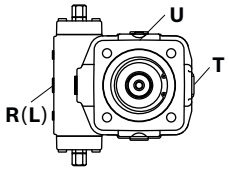
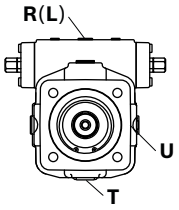
Make sure to provide adequate distance between suction line and drain line for the reservoir design. This prevents the heated return flow from being drawn directly back into the suction line.

Notice
In certain installation positions, an influence on the adjustment or control can be expected. Gravity, dead weight and case pressure can cause minor characteristic shifts and changes in actuating time.

To avoid the generation of air pockets at the front bearing area, port **U** for bearing flushing must always be positioned laterally or vertically.
See the following examples **1** to **4**.

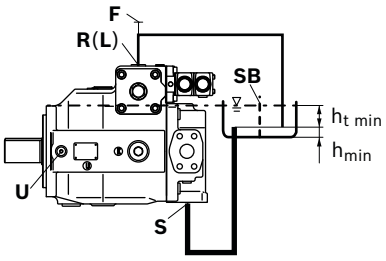
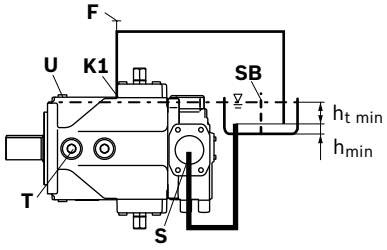
Installation position "F"
For the variant **"F"** A4VSO units (type code 07), external bearing flushing is mandatory. For permissible installation positions, see data sheet 92050.

Installation position "F2" (operation without external bearing flushing)
For the following positions of the **U** port, variant **"F2"** can be used.
Further installation positions are available upon request.

U port position	Air bleed	Filling
	**U**	**U**
	**R**(**L**)	**R**(**L**)

Below-reservoir installation (standard)

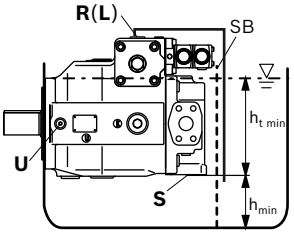
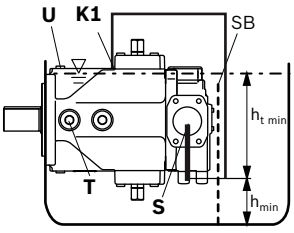
Below-reservoir installation is when the axial piston unit is installed outside of the reservoir below the minimum fluid level. The upper edge of the mounting flange of the axial piston unit must be below the hydraulic fluid level.

Installation position	Air bleed	Filling
1 	**R(L)**	**R(L)**
2 	**K1**	**K1**

Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid. In case of minimum fluid level, the upper edge of the mounting flange of the axial piston unit must not be below the hydraulic fluid level.

Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

Installation position	Air bleed	Filling
3 	Via the highest available port **R(L)**	Via port **R(L)**
4 	Via the highest available port **K1**	Via port **K1**

Key	
R(L)	Filling / Air bleeding
K1	Filling / Air bleeding
S	Suction port
T	Tank port
U	Bearing flushing port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)

Notice

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

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