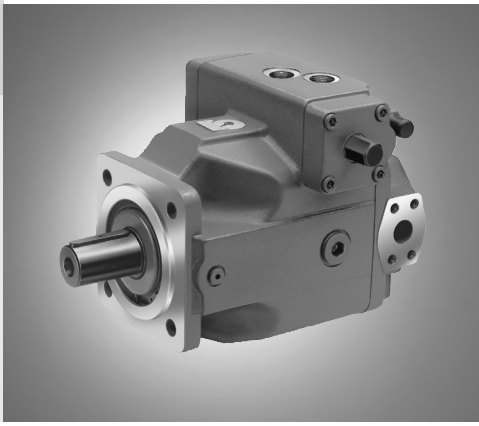
Rexroth
Bosch Group

Axial Piston Variable Pump AA4VSO for HFC Fluids

RA 92053-A/06.09 1/8
Supplementary to RA 92050
Replaces: 02.05

Data sheet



Series 10, 11 and 30
Size NG71 to 355
Nominal pressure 5100 psi (350 bar)
Peak pressure 5800 psi (400 bar)
Open circuit

Contents

Note

This data sheet shows only the particular information which is valid for operation of the axial piston pump with HFC-fluids.
All fundamental details on the AA4VSO must be taken from the main data sheet RA 92050.

Features

- Axial piston pump in swash plate design for hydrostatic drives in open circuit operation
- Especially suitable for operation with HFC fluids
- With the approved HFC fluids the units can be operated with the same speeds and pressures as on mineral oil
- The flow is proportional to the input drive speed and displacement. By adjusting the swash plate angle it is possible to infinitely vary the output flow.
- Good suction characteristics
- Low noise level
- Long service life
- High power/weight ratio
- Drive shaft capable of absorbing axial and radial loads
- Modular design
- Short control times
- Through drive and pump combinations possible
- Swivel angle indicator
- Optional mounting position

Ordering code for standard program

AA4VS	O			/			–	F					
01	02	03	04		05	06		07	08	09	10	11	12

Axial piston unit

01	Swashplate design, variable	**AA4VS**

Type of operation

02	Pump, open circuit	**O**

	Size			**71**	**125**	**180**	**250**	**355**
03	Displacement $V_{g\ max}$		in³/rev.	4.33	7.63	10.98	15.26	21.66
			(cm³/rev.)	(71)	(125)	(180)	(250)	(355)

Control device

04	Pressure control	(RA 92060)	DR	❍	●	●	●	●	**DR..**
	Pressure control for parallel operation		DP	❍	●	●	●	●	**DP..**
	Flow control		FR	❍	●	●	●	●	**FR..**
	Pressure and flow control		DFR	❍	●	●	●	●	**DFR..**
	Power control with hyperbolic curve	(RA 92064)	LR	❍	●	●	●	●	**LR..[1)]**
	Manual control	(RA 92072)	MA	❍	●	●	●	●	**MA..**
	Electric motor control		EM	❍	●	●	●	●	**EM..**
	Hydraulic control, control volume dependent	(RA 92076)	HM	❍	●	●	●	●	**HM..**
	Hydr. control, with servo/proportional valve		HS	❍	●	●	●	●	**HS..[1)]**
	Electronic control		EO	❍	●	●	●	●	**EO..[1)]**
	Hydraulic control, pilot pressure dependent	(RA 92080)	HD	❍	●	●	●	●	**HD..[1)]**
	Electro-hydraulic control system DFE1 System solution SYHDFEE	(RE 92088) (RE 30035)		❍	●	●	●	●	**DFE1..[1)]**

Series

05		❍	–	–	–	–	**10(11)[2)]**
		–	●	●	●	●	**30**

Direction of rotation

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

Seals and fluid

07	NBR Nitrile-rubber, shaft seal PTFE Teflon, special version for HFC-fluids	**F**

08	**Shaft end**	For further details see: RA 92050 – AA4VSO index number 10 to 14
09	**Mounting flange**	
10	**Ports for service connections**	
11	**Through drive**	
12	**Filtration**	

1) On operation with HFC-fluids make sure to observe the limitations in the individual data sheets of the control devices or the mounted control valves

2) Versions with HD-controls only in series 11

● = available ❍ = in preparation – = not available

Technical data

Hydraulic fluid

For extensive information on the selection of hydraulic fluids and for application conditions, please consult our data sheet RE 90223 (fire retardant HF fluids).

In comparison with mineral oil based fluids, HFC 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.

The following fluids, with a water content of approx. 35 to 55% in weight, are approved without any restrictions for speed and pressure in comparison with operation on mineral oil based fluids.

– Fuchs Hydrotherm 46M

– Petrofer Ultrasafe 620

– Fuchs Renosafe 500

– Houghton Houghto Safe 620

– Union Carbide HP 5046

Operation on HFC-fluids is only possible when their properties and values correspond to ISO 12922.

For HFC-fluids, other than the above mentioned ones, limitations of the technical data according to RE 90223 must be observed.

For operation on rolling oils and HFA-fluids, please consult us.

The notes on filtration, limit of viscosity and temperature range must also be observed.

Operating viscosity range

see RA 92050

Limit of viscosity range

For critical operating conditions the following values apply:

ν_{min} = 60 SSU (10 mm²/s)
for short periods (t < 1min),
t_{max} < 122 °F (+50 °C)

ν_{max} = 4600 SSU (1000 mm²/s)
only during start (cold start, within 15 min an operating viscosity below 460 SSU (100 mm²/s) should be reached) t_{min} > +14 °F (–10 °C)

Selection diagram and notes on the selection of hydraulic fluid

see RA 92050

Temperature range

$t_{min} \geq$ +14 °F (–10 °C)

$t_{max} \leq$ 122 °F (+50 °C)

t_{opt} = 104 °F (+40 °C)

Higher temperatures are not permissible since this will result in a substantial loss of water content.

When meeting the limits of viscosity and temperature, operation on HFC-fluids is also allowed at low temperatures.

Important: The case drain fluid temperature is influenced by speed and pressure, and is always higher than the tank temperature. However the max. temperature at any point in the system may not exceed 122 °F (50 °C).

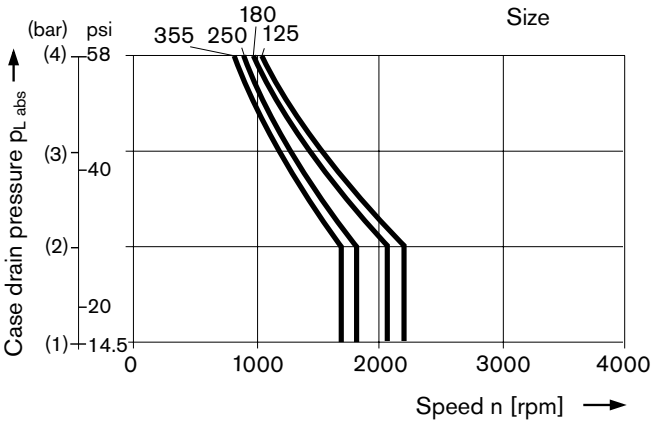
Filtration of the hydraulic fluid

Filtration improves the cleanliness level of the hydraulic fluid, which, in turn, increases the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, a gravimetric evaluation (weight of filtrations membranes) is necessary for the hydraulic fluid to determine the amount of contamination by solid matter and to determine the cleanliness level similar to ISO 4406. A cleanliness level of at least –/18/15 is to be maintained.

Case drain pressure

The permissible case drain pressure (housing pressure) depends on drive speed (see diagram).



Maximum case drain pressure (housing pressure)

$p_{L\ abs\ max}$ _____ 58 psi (4 bar) absolute

These are approximate values; under certain operating conditions a reduction in these values may be necessary

Direction of flow

S to B (like in RA 92050)

Technical data

Bearing flushing

Operating with HFC-fluids **requires external bearing flushing**.

The flushing flow is carried out via port „U“, located in the front flange of the axial piston pump. The flushing fluid flows through the front bearing and leaves the housing together with the case drain flow.

Important

1. Minimum required flushing flow $q_{fl\ min}$ in port U see table
2. Maximum permissible pressure p_{max} in port U see table
3. Reference flushing flow $q_{fl\ ref}$ to check the minimum required flushig flow (see example)

Size		125	180	250	355
$q_{fl\ min}$	gpm (L/min)	0.26 (1.0)	0.40 (1.5)	0.53 (2.0)	0.80 (3.0)
p_{max}	psi (bar)	72 (5.0)	72 (5.0)	72 (5.0)	72 (5.0)
$q_{fl\ ref}$	gpm (L/min)	0.92 (3.5)	1.32 (5.0)	1.72 (6.5)	2.64 (10.0)

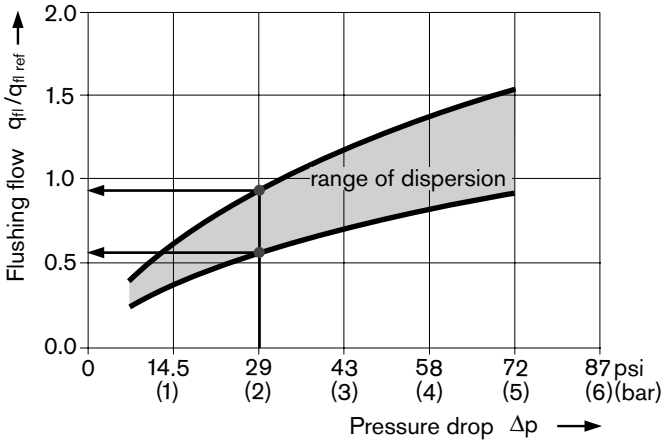
Note

Make sure that the throttle screw in port U is turned in all the way.

Notes for setting and checking the flushing flow:

The flushing flow is dependent on the pressure difference Δp between U-port inlet and housing ($\Delta p = p_U - p_{hous}$).
This correlation is depicted, independently of the pump size, in the following diagram.

Flushing flow through the U-port



Example:

Type: AA4VSO 250...F
Housing pressure: p_{hous} = 14.5 psi (1 bar)
Pressure in port U: p_U = 43 psi (3 bar)
Δp = 29 psi (2 bar)

– The table on the left side of this page shows a reference flushing flow $q_{fl\ ref}$ = 1.72 gpm (6.5 L/min)

– The above diagram shows the limits of the flushing flow range
$q_{fl\ 1} = 0.56 \bullet q_{fl\ ref}$ = 0.95 gpm (3.6 L/min)
$q_{fl\ 2} = 0.94 \bullet q_{fl\ ref}$ = 1.61 gpm (6.1 L/min)

– with this pressure drop of 29 psi (2 bar) the minimum required flushing flow of $q_{fl\ min}$ = 0.53 gpm (2 L/min) is reached. A flow check should confirm a flushing flow within this range

Technical data

Operating pressure at pump inlet

Absolute pressure at port S (inlet port)

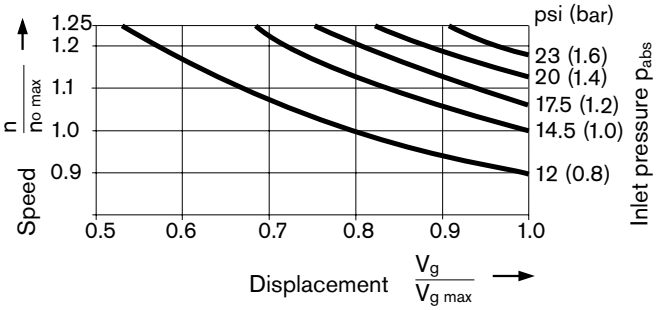
$p_{abs\ min}$ _____ 12 psi (0.8 bar) absolute

$p_{abs\ max}$ _____ 435 psi (30 bar) absolute

The density of almost all HF-fluids is higher than the density of mineral oil. It is therefore absolutely necessary to ensure, that the inlet pressure $p_{abs\ min}$ does not fall below the min. permissible 12 psi (0.8 bar) value.

All measures, which could obstruct the suction performance must be avoided (eg. suction filter).

Determination of inlet pressure p_{abs} at the inlet port S or reduction of displacement with increase of drive speed



The inlet pressure is the static feed pressure or the minimum dynamic value of the boost pressure.

Important:
Observe the maximum permissible drive speed $n_{o\ max.\ zul.}$ (speed limit) see page 6

Operating pressure range outlet

see RA 92050

Technical data

Table of values (theoretical values, without considering efficiencies and tolerances; values rounded)

Size	NG		125	180	250	355
Displacement	$V_{g\ max}$	in³ (cm³)	7.63 (125)	10.98 (180)	15.26 (250)	21.65 (355)
Speed [1]						
maximum at $V_{g\ max}$	$n_{o\ max}$	rpm	1800	1800	1800	1500
maximum at $V_g \leq V_{g\ max}$ (speed limit)	$n_{o\ max\ zul.}$	rpm	2200	2100	1800	1700
minimum	$n_{o\ min}$	rpm	800	800	800	800
Flow						
at $n_{o\ max}$	$q_{vo\ max}$	gpm (L/min)	59.4 (225)	85.6 (324)	99 (375)	141 (533)
at n_E = 1500 rpm	$q_{VE\ max}$	gpm (L/min)	49.1 (186)	71.3 (270)	99 (375)	141 (533)
Power Δp = 5100 psi (350 bar)						
at $n_{o\ max}$	$P_{o\ max}$	HP (kW)	176 (131)	254 (189)	294 (219)	417 (311)
at n_E = 1500 rpm	$P_{E\ max}$	HP (kW)	146 (109)	212 (158)	294 (219)	417 (311)
Torque						
at $V_{g\ max}$ Δp = 5100 psi (350 bar)	T_{max}	lb-ft (Nm)	513 (696)	739 (1002)	1026 (1391)	1457 (1976)
Δp = 1450 psi (100 bar)	T	lb-ft (Nm)	147 (199)	211 (286)	294 (398)	416 (564)
Torsional stiffness						
Shaft end K	c	lb-ft/rad (kNm/rad)	191765 (260)	241920 (328)	388695 (527)	590050 (800)
Shaft end S	c	lb-ft/rad (kNm/rad)	193980 (263)	244870 (332)	400495 (543)	567920 (770)
Moment of inertia Rotary unit	J_{TW}	lb-ft² (kgm²)	0.712 (0.03)	1.305 (0.055)	2.276 (0.0959)	4.503 (0.19)
Angular acceleration maximum [2]	α	rad/s²	8000	6800	4800	3600
Case volume	V	gal (L)	1 (4)	1.3 (5)	2.6 (10)	2.1 (8)
Weight (with pressure control) approx.	m	lbs (kg)	194 (88)	224 (102)	409 (184)	455 (207)

1) Values are valid with inlet pressure p_{abs} 14.5 psi (1 bar) at inlet port S, with increased speed up to speed limit please observe diagram, page 5

2) – The range of validity lies between the minimum required and the maximum permissible drive speeds. Valid for external excitation (eg. diesel engine 2- to 8-fold rotary frequency, cardan shaft 2 fold rotary frequency).
– The limiting value is only valid for a single pump.
– The loading capacity of the connecting parts must be considered..

Caution: Exceeding the maximum or minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit.
The permissible values can be determined through calculation.

Determination of pump size

Flow $q_V = \frac{V_g \cdot n \cdot \eta_V}{231}$ [gpm] $\left(\frac{V_g \cdot n \cdot \eta_V}{1000} \text{ [L/min]} \right)$

Torque $T = \frac{V_g \cdot \Delta p}{24 \cdot \pi \cdot \eta_{mh}}$ [lb-ft] $\left(\frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} \text{ [Nm]} \right)$

Power $P = \frac{q_V \cdot \Delta p}{1714 \cdot \eta_t}$ [HP] $\left(\frac{q_V \cdot \Delta p}{600 \cdot \eta_t} \text{ [kW]} \right)$

V_g = geometr. displacement per rev. in in³ (cm³)
Δp = pressure difference in psi (bar)
n = speed in rpm
η_V = volumetric efficiency
η_{mh} = mechanical-hydraulic efficiency
η_t = overall efficiency ($\eta_t = \eta_V \cdot \eta_{mh}$)

Permissible radial and axial forces on the drive shaft

see RA 92050

Installation notes

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.

Reservoir

HF fluids feature poor air and contamination seperating properties.

The seperating capacity can be improved by a longer dwell time in the tank, thus by using a larger reservoir. In addition, baffles may be installed, either with openings or as weirs, with meshes fitted in the openings (settling of the fluid).

The lower temperature limits require a controlled cooling of the fluid. A large reservoir surface improves the natural cooling capacity of the system.

Evaporation losses may be considerably reduced by using a tank breather.

Installation position

No restrictions in comparison with the AA4VSO (RA 92050).

Commissioning

Following correct filling with the operating fluid, start the system under partial load and gradually increase to full load. After operation of all components, the system must carefully bled.

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.

Literature references

ISO 12922 similar to the 7. Luxembourg report

VDMA standard 24314 (Conversion guidelines)

General information

– The pump AA4VSO was designed for operation in open loop circuits.

– Systems design, installation and commissioning requires trained technicians or tradesmen.

– All hydraulic ports can only be used for the fastening of hydraulic service lines.

– Tightening torques:
  - All tightening torques mentioned in this data sheet are maximum values and may not be exceeded. (Maximum values for the female threads in the castings).
    Please comply with the manufacturer‘s information regarding the max. permissible tightening torques for the used fittings.
  - For fastening screws to ISO 68 / DIN 13 we recommend to check the permissible tightening torque in each individual case acc. to VDI 2230 issue 2003.

– During and shortly after operation of a pump the housing and especially a solenoid can be extremely hot. Take suitable safety measures (e.g. wear protective clothing).

– All given data and information has to be adhered to.

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