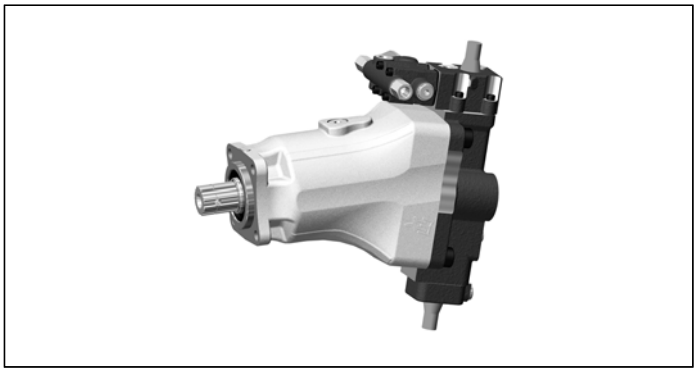
Axial Piston Variable Pump
A18VLO Series 11

RE 92280
Issue: 06.2012
Replaces: 06.2009



- Size 80
- Nominal pressure 350 bar
- Maximum pressure 400 bar
- For commercial vehicles
- Open circuit

Features

- Variable pump with axial tapered piston rotary group of bent-axis design with special characteristics and dimensions for use in commercial vehicles
- The flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the bent-axis angle.
- Favorable power-to-weight ratio, compact dimensions, optimum efficiency, economical design
- High self-suction capability
- Flange and shaft designed for direct mounting on the power take-off of commercial vehicles
- Low noise levels
- Increased pressure (350/400 bar) compared to standard pump A17VO
- Increased service life through use of long-life bearings

Contents

Ordering code

01	02	03	04	05	06		07	08	09	10	11	12	13	14		15
A18V	**LO**	**080**	**DRS**	**0**	**E**	**/**	**11**	**N**		**W**	**K0**			**0**	**–**	

Axial piston unit

01	Bent-axis design, variable, nominal pressure 350 bar, maximum pressure 400 bar, for commercial vehicles (trucks)	**A18V**

Operating mode

02	Pump, Open circuit, with long-life bearings	**LO**

Sizes (NG)

03	Geometric displacement, see table of values on page 6	**080**

Control devices

04	Pressure controller with load sensing	**DRS**

Additional functions 1

05	Without additional functions	**0**

Additional functions 2

06	DRS controller with external pump measuring pressure port and mechanically adjustable $V_{g\,min}$ stop	**E**

Series

07	Series 1, index 1	**11**

Configuration of ports and fastening threads

08	Metric, port threads with profiled sealing ring according to DIN 3852	**N**

Directions of rotation

09	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Seals

10	FKM (fluor-caoutchouc) including the 2 shaft seal rings in FKM	**W**

Mounting flange

11	Special flange ISO 7653-1985 (for trucks)	**K0**

Drive shaft

12	Splined shaft similar to DIN ISO 14 (for trucks)	**E8**
	Splined shaft E8 with coupling flange	**C8**

Port plate for service lines

13	Threaded ports A and S at rear	**1**
	Threaded ports A and S at rear, with suction stud mounted in S	**2**

Additional functions 3

14	Without additional functions	**0**

Standard / special version

15	Standard version	**0**
	Special version	**S**

Technical data

Hydraulic fluid

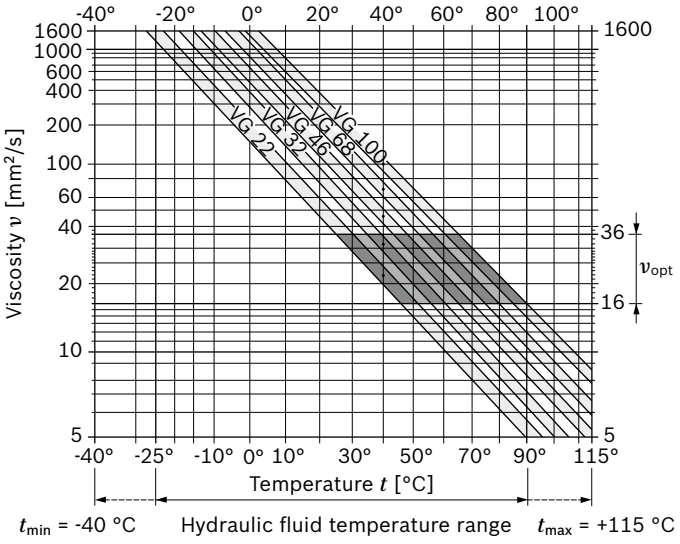
Before starting project planning, please refer to our data sheets RE 90220 (mineral oil) and RE 90221 (environmentally acceptable hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

If environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed. Please contact us.

Note

Variable pump A18VLO is not suitable for operation with water-containing HF hydraulic fluid.

▼ **Selection diagram**



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in an open circuit the reservoir temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see shaded area of the selection diagram). We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °C, an operating temperature of 60 °C is set in the circuit. In the optimum operating viscosity range (ν_{opt}, shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, can be higher than the reservoir temperature. At no point of the component may the temperature be higher than 115 °C. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be maintained due to extreme operating parameters, please contact us.

Viscosity and temperature of hydraulic fluid

	Viscosity [mm²/s]	Temperature	Comment
Transport and storage at ambient temperature		T_{min} ≥ -40 °C T_{opt} = +5 °C to +20 °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up	ν_{max} = 1600	T_{St} ≥ -40 °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 rpm
Permissible temperature difference		ΔT ≤ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 1600 to 400	T = -40 °C to -25 °C	at p ≤ 0.7 • p_{nom}, n ≤ 0.5 • n_{nom} and t ≤ 15 min
Operating phase			
Temperature difference		ΔT = approx. 12 K	between hydraulic fluid in the bearing and at port R
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port R
Continuous operation	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port R, no restriction within the permissible data
Short-term operation	ν_{min} ≥ 7	T_{max} = +103 °C	measured at port R, t < 3 min, p < 0.3 • p_{nom}
Shaft seal FKM		T ≤ +115 °C	see page 4

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, a gravimetric analysis of the hydraulic fluid is necessary to determine the amount of solid contaminant and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

If the above classes cannot be achieved, please contact us.

Case drain fluid

The case drain chamber is connected to the suction chamber. A case drain line from the case to the reservoir is not required (port "R" is plugged).

On versions with DRS control, a case drain line for discharge from port "T" to the reservoir is absolutely essential.

Shaft seal

The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C.

Note

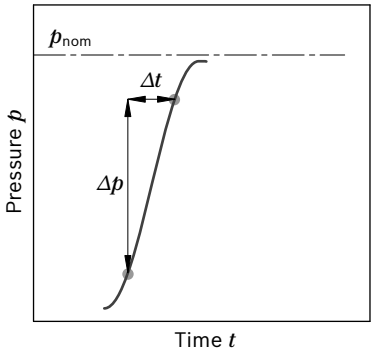
For the temperature range below -25 °C, the values in the table on page 3 are to be observed.

Operating pressure range

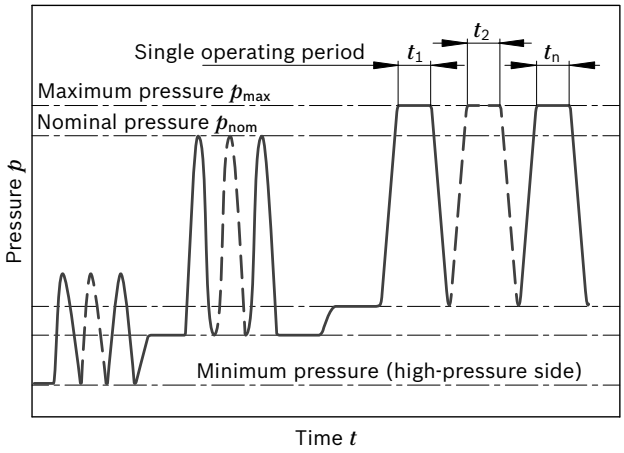
Valid when using hydraulic fluids based on mineral oils

Pressure at service line port A		**Definition**
Nominal pressure p_{nom}	350 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	400 bar absolute	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	5 s	
Total operating period	50 h	
Minimum pressure (high-pressure side)	10 bar absolute	Minimum pressure at the high-pressure side (A) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\,max}$	9000 bar/s	Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\,min}$	0.8 bar absolute	Minimum pressure at suction port S (inlet) which is required in order to prevent damage to the axial piston unit. The minimum pressure is dependent on the speed and displacement of the axial piston unit.
Maximum pressure $p_{S\,max}$	2 bar absolute	

▼ **Rate of pressure change $R_{A\,max}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

Note

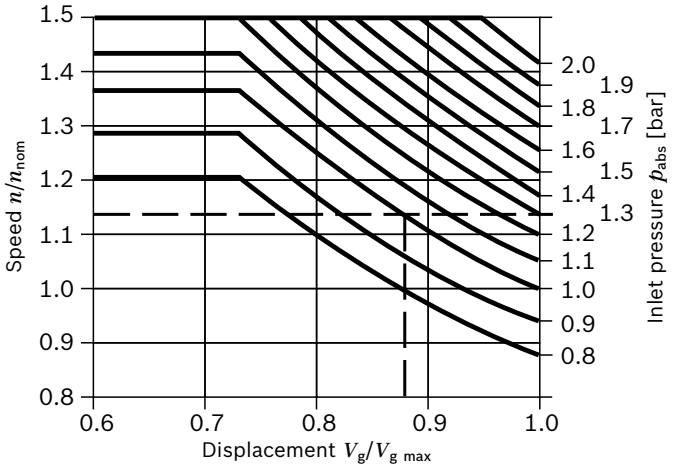
Values for other hydraulic fluids, please contact us.

Table of values

Theoretical values, without efficiency and tolerances;
values rounded

Size		NG		80
Displacement geometric, per revolution		$V_{g\,max}$	cm³	80
Speed maximum[1)]	at $V_{g\,max}$	n_{nom}	rpm	2240
	at V_g < 0.74 • $V_{g\,max}$	n_{max1}	rpm	3000
Speed maximum[2)]		n_{max2}	rpm	3350
Flow	at n_{nom} and $V_{g\,max}$	q_v	L/min	179
Power	at n_{nom}, $V_{g\,max}$ and Δp = 350 bar	P	kW	105
Torque	at $V_{g\,max}$ and Δp = 350 bar	T	Nm	446
Rotary stiffness	$V_{g\,max}$ to 0.5 • $V_{g\,max}$	c_{min}	Nm/rad	15911
	0.5 • $V_{g\,max}$ bis $0_{(interpolated)}$	c_{max}	Nm/rad	48971
Moment of inertia for rotary group		J_{GR}	kgm²	0.0066
Maximum angular acceleration		α	rad/s²	24200
Case volume		V	L	0.8
Mass moment		T_G	Nm	38
Mass (approx.)		m	kg	24.4

1) The values are valid:
   – at an absolute pressure p_{abs} = 1 bar at suction port S
   – for the optimum viscosity range from v_{opt} = 36 to 16 mm²/s
   – with hydraulic fluid based on mineral oils
2) Maximum rotational speed (limit speed) for increased inlet pressure p_{abs} at suction port S and V_g < $V_{g\,max}$, see the following diagram.



Note

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. Other permissible limit values, with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible start up angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

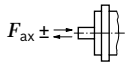
Determining the operating characteristics

Formulas		
Flow	$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000}$	[L/min]
Torque	$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$	[Nm]
Power	$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t}$	[kW]

Key		
V_g	=	Displacement per revolution in cm³
Δp	=	Differential pressure in bar
n	=	Speed in rpm
η_v	=	Volumetric efficiency
η_{mh}	=	Mechanical-hydraulic efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Permissible axial forces of the drive shaft

The values given are maximum values and do not apply to continuous operation. For drives with radial loading (pinion, V-belt drives), please contact us!

Size		NG		80
When standstill or when axial piston unit operating in non-pressurized conditions		$\pm F_{ax\ max}$	N	0
Permissible axial force per bar operating pressure	F_{ax} ± 	$+ F_{ax\ max}$	N/bar	86
		$- F_{ax\ max}$	N/bar	0

Note

Influence of the direction of the permissible axial force:

+ $F_{ax\ max}$ = Increase in service life of bearings

– $F_{ax\ max}$ = Reduction in service life of bearings (avoid)

DRS – Pressure control with load sensing

Function of the pressure controller

The pressure controller limits the maximum pressure at the pump outlet within the control range of the pump. The variable pump only delivers as much hydraulic fluid as the consumers actually need. If the operating pressure exceeds the pressure setpoint set at the integrated pressure valve, the pump will regulate to a smaller displacement to reduce the control deviation.

In a non-pressurized state, the pump is swiveled to its initial position to $V_{g\,max}$ by a return spring.

- Setting range for pressure control: 80 to 400 bar
- Standard setting: 350 bar

Note

A pressure-relief valve is provided to limit the maximum pressure in the system. This must be at least 20 bar above the control setting at the start of opening.

The pressure controller overrides the load sensing controller, i.e. the load sensing function operates below the set pressure.

Load sensing function

The load sensing controller works as a load-pressure controlled flow compensator and adjusts the displacement of the pump to the volume required by the consumer.

The flow of the pump is then dependent on the cross section of the external metering orifice (1), which is located between the pump and the consumer. Below the setting of the pressure control and within the control range of the pump, the flow is not dependent on the load pressure.

As a rule, the metering orifice is a separately located load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the metering orifice and thus the flow of the pump.

The load sensing controller compares the pressure before the metering orifice with that after the orifice and maintains the pressure drop encountered here (differential pressure Δp) and thus the flow constant.

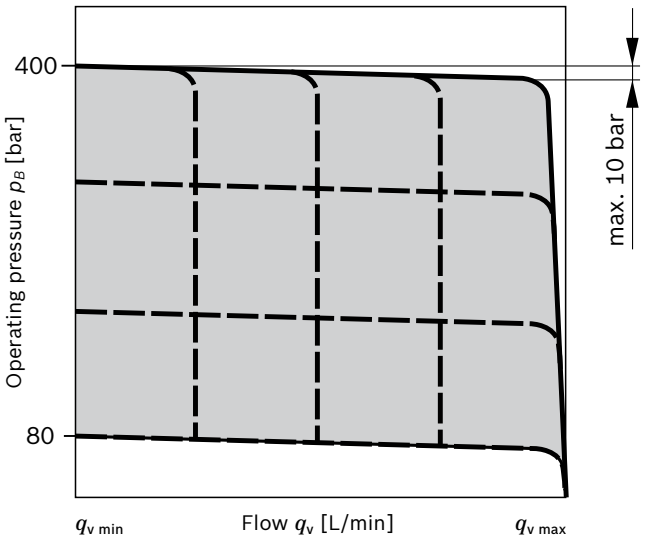
If the differential pressure Δp at the metering orifice rises, the pump is swiveled back (toward $V_{g\,min}$). If the differential pressure Δp drops, the pump is swiveled out (toward $V_{g\,max}$) until equilibrium at the metering orifice is restored.

$\Delta p_{\text{Metering orifice}} = p_{\text{Pump}} - p_{\text{Consumer}}$

- Setting range for Δp 19 to 40 bar
- Standard setting: 30 bar

The stand-by pressure in zero-stroke mode (metering orifice closed) is slightly higher than the Δp setting.

▼ **Characteristic DRS**

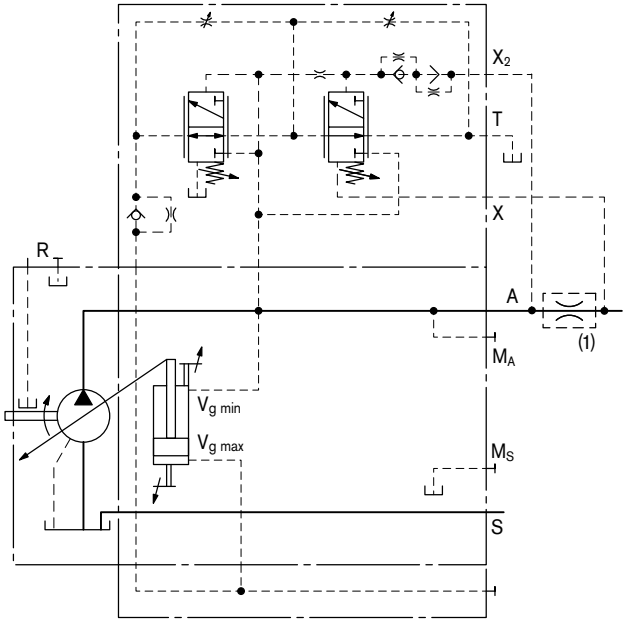


DRS.E

With external pump measuring pressure port

With the standard DRS controller, the internal pump pressure at the LS piston is compared to the load pressure from the X port. With the DRS.E controller, the pressure from the inlet line to the valve block is led via a separate external line to port X_2 where it is compared to the load pressure at the LS piston. For partial flow quantities, this results in better system efficiency.

▼ **Schematic DRS.E**



(1) The sensing orifice (control block) is not included in the delivery contents.

Zero-stroke mode

The standard version is designed for intermittent, constant-pressure operation. Short-term (< 1 min), zero-stroke operation is permissible up to an operating pressure p_{nom} = 350 bar with reservoir temperature ≤ 50 °C.

Note

To ensure thermal stability, a case drain line from port "T" to the reservoir is generally required with the DRS controller.

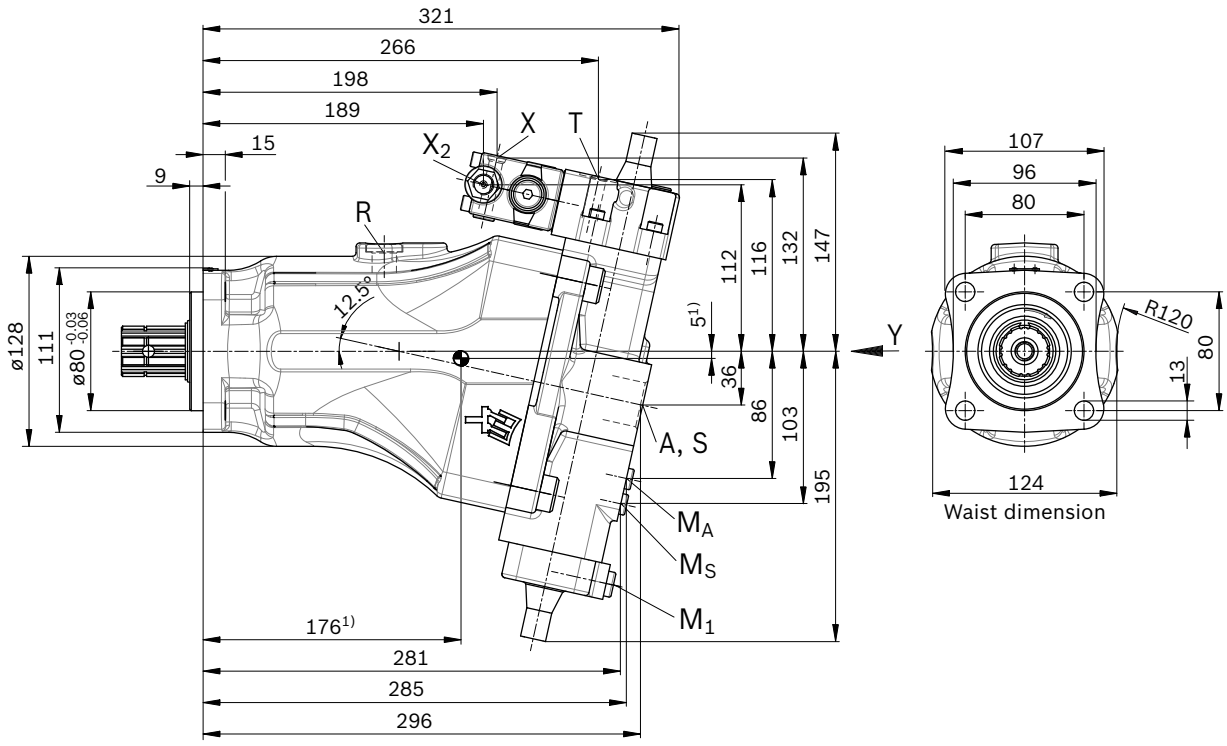
When ordering, please state in plain text:

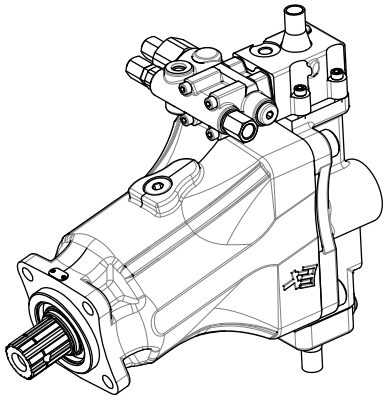
- Pressure control setting
- Δp setting for load sensing function

If these details are missing from the order, the pump will be delivered with the standard setting, see page 8.

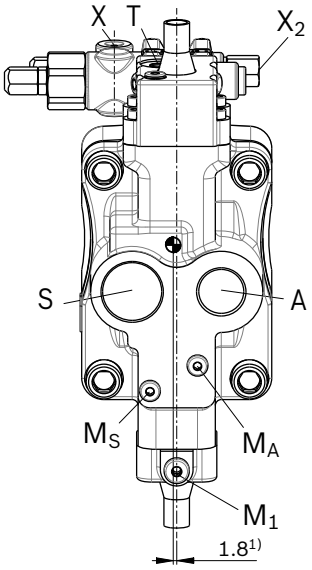
Dimensions size 80

DRS – Pressure controller with load sensing

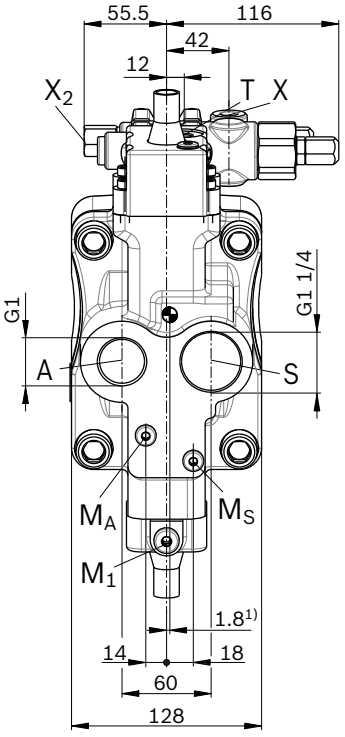




View Y
Counter-clockwise rotation



View Y
Clockwise rotation

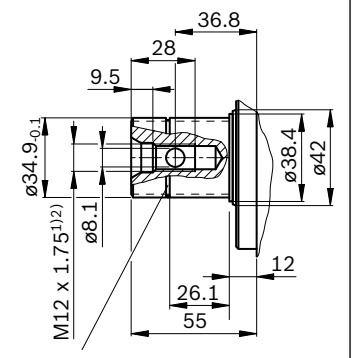


1) Center of gravity

Drive shaft

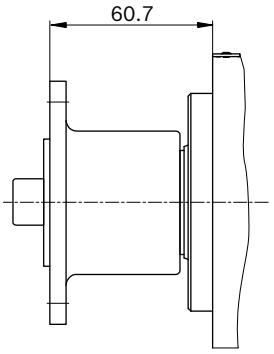
Splined shaft similar to DIN ISO 14 ...with coupling flange

E8 – 8x32x35



Groove for retaining ring
35 x 1.5 DIN 471

C8



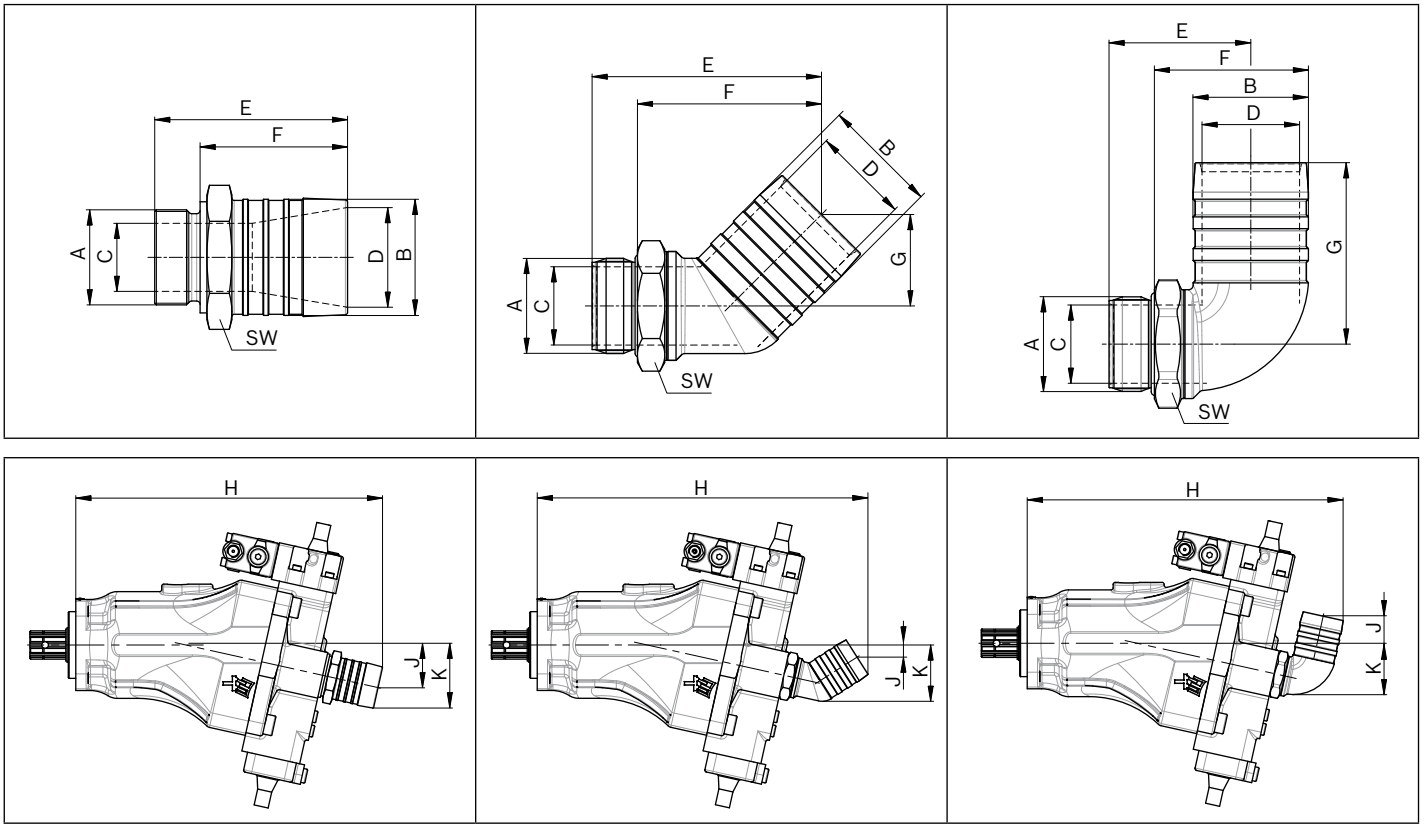
Ports

Designation	Port for	Standard	Size[2)]	Maximum pressure [bar][3)]	State[6)]
A	Service line	DIN ISO 228	G1; 18 deep	400	O
S	Suction line	DIN ISO 228	G1 1/4; 20 deep	2	O
T	Drain line (DRS only)	DIN 3852[5)]	M12 x 1.5; 12 deep	2	O
M_A	Measuring pressure A	DIN 38525[)]	M10 x 1; 8 deep	400	X
M_S	Measuring suction pressure	DIN 38525[)]	M10 x 1; 8 deep	2	X
M_1	Measuring stroking chamber	DIN 3852[5)]	M12 x 1.5; 12 deep	400	X
R	Air bleed	DIN 3852[5)]	M18 x 1.5; 12 deep	2	X[4)]
X	Load pressure (load sensing)	ISO 11926[5)]	7/16-20UNF-2B; 11.5 deep	400	O
X_2	Pump working pressure	DIN 3852[5)]	M14 x 1.5; 12 deep	400	O

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Observe the general instructions on page 16 for the maximum tightening torques.
3) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Only open port R for filling and air bleed.
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Suction stud

Dimensions



Axial piston unit		Suction stud												
NG	Port S A	Inner ⌀ B [in]	Inner ⌀ B [mm]	Version	Material number	⌀C	⌀D	E	F	G	SW	H	J	K
80	G1 1/4	2	51	Straight	R902600252	30	44	85	65	–	55	368	51	76
				45°	R909831597	34	43	101	81	40	50	397	15	68
				90°	R909831598	35	43	63	43	80	50	379	33	66

Notes on suction line

- Keep as short and straight as possible, without bend
- Use a supporting ring for plastic hoses
- Use two hose clamps to protect the suction hose against air suction
- Note pressure resistance of suction hose compared to ambient pressure

Replacing seals

The O-rings used as seals to prevent air from entering the suction line are to be replaced after every removal and new installation in order to guarantee complete sealing.

Material number for O-rings:

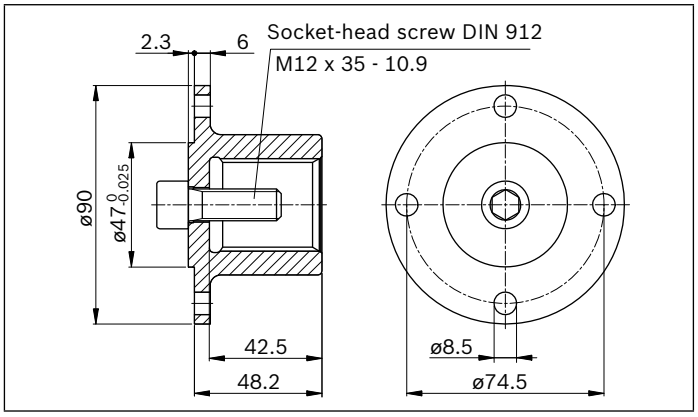
- R902083808: O-ring for suction stud G1 1/4

Coupling flange

There are specially modified coupling flanges in 4-hole and 6-hole designs for the cardan-shaft drive.

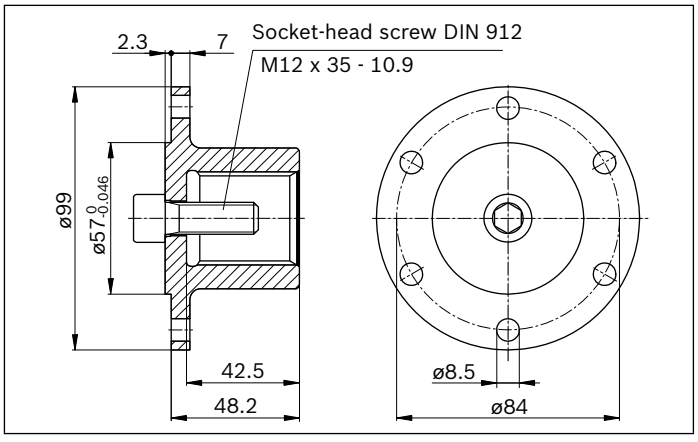
4-hole coupling flange, complete – Ø90

Material number: R902060152



6-hole coupling flange, complete – Ø100

Material number: R902060153



Note

The coupling flange is installed by screwing it onto the drive shaft with the help of the threaded bore in the end of the drive shaft.
The coupling flange must be glued onto the splined drive shaft with Loctite 574 and clamped (= 130 Nm).
Sudden or abrupt forces acting on the drive shaft could lead to damage to the rotary group and must therefor be avoided.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

The case drain chamber is internally connected to the suction chamber. A case drain line from the case to the reservoir is not required. However, to ensure thermal stability, a case drain line from port "T" to the reservoir is generally required with the DRS.E controller.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction and case drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure; it must not, however, be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port S must also not fall below 0.8 bar absolute during operation and during cold start.

Installation position

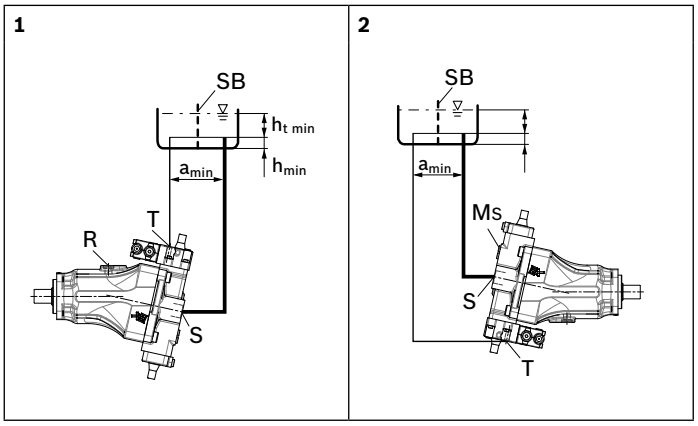
See the following examples 1 to 4.

Further installation positions are available upon request.

Recommended installation position: 1 and 2.

Below-reservoir installation (standard)

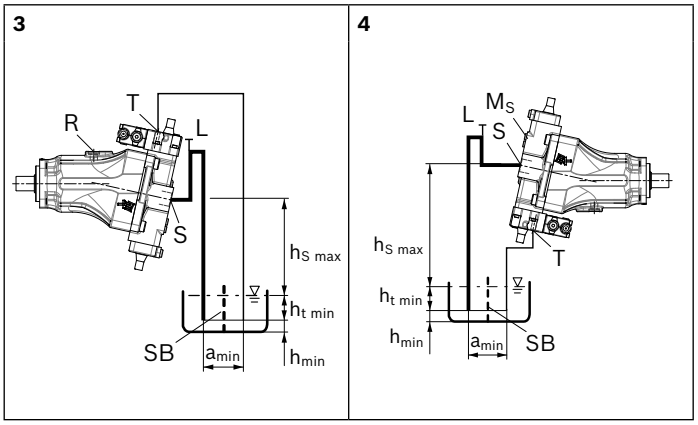
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



Installation position	Air bleed	Filling
1	R	S
2	M_S	S

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.



Installation position	Air bleed	Filling
3	R	L
4	M_S	L

Key	
L	Filling / air bleed
R	Air bleed port
S	Suction port
T	Drain port (DRS only)
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)
M_S	Measuring port suction pressure
a_{min}	When designing the reservoir, ensure adequate space between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Other related documents

Other pumps with special characteristics and dimensions for use in commercial vehicles can be found in the following data sheets:

- RE 91510: Fixed pump A17FNO, 250/300 bar
- RE 91520: Fixed pump A17FO, 300/350 bar
- RE 91540: 2-circuit fixed pump A18FDO, 350/400 bar
- RE 92260: Variable pump A17VO, 300/350 bar
- RE 92270: Variable pump A18VO, 350/400 bar

General instructions

- The pump A18VLO is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Service line ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.
- The data and notes contained herein must be adhered to.
- Before finalizing your design, request a binding installation drawing.
- The product is not approved as a component for the safety concept of a general machine according to ISO 13849.
- Pressure controls are not backups against pressure overload. A pressure-relief valve is to be provided in the hydraulic system.
- The following tightening torques apply:
  - Fittings:
    Observe the manufacturer's instructions regarding the tightening torques of the fittings used.
  - Mounting bolts:
    For mounting bolts with metric ISO threads according to DIN 13, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.
  - Female threads in the axial piston unit:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values of the female threads and must not be exceeded. For values, see the following table.
  - Threaded plugs:
    For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

Ports **Standard**	**Size of thread**	**Maximum permissible tightening torque of the female threads $M_{G\ max}$**	**Required tightening torque of the threaded plugs M_V**	**WAF** **Hexagon socket of the threaded plugs**
DIN 3852[1)]	M10 x 1	30 Nm	15 Nm[2)]	5 mm
	M12 x 1.5	50 Nm	25 Nm[2)]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M18 x 1.5	66 Nm	60 Nm	8 mm
ISO 11926	7/16-20UNF-2B	40 Nm	15 Nm	3/16 in
DIN ISO 228	G1	480 Nm	–	–
	G1 1/4	720 Nm	–	–

1) The tightening torques apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation.
2) In the “lightly oiled” condition, the M_V is reduced to 10 Nm for M10 x 1 and to 17 Nm for M12 x 1.5.

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