

Axial piston fixed pump A17FO Series 10

RE 91520

Issue: 11.2015

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- ▶ High-pressure pump for use in commercial vehicles
- ▶ Sizes 23 to 107
- ▶ Nominal pressure/maximum pressure 350/400 bar
- ▶ Bent-axis design
- ▶ Open circuit

Features

- ▶ Flange and shaft designed for direct mounting on the power take-off of commercial vehicles
- ▶ Weight-optimized thanks to diecast aluminum housing.
- ▶ No case drain line necessary
- ▶ Reduced noise
- ▶ Straightforward adjustment of direction of drive
- ▶ Excellent suction performance
- ▶ High total efficiency
- ▶ Long service life

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Ordering code

| | | | | | | | | | | | |
|-------------|----------|----|----------|-----------|----------|----------|----------|-----------|-----------|----------|----------|
| 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | |
| A17F | O | | / | 10 | N | L | W | K0 | E8 | 1 | - |

Axial piston unit

| | | |
|----|--|-------------|
| 01 | Bent-axis design, fixed, nominal pressure 350 bar, maximum pressure 400 bar, for commercial vehicles (truck) | A17F |
|----|--|-------------|

Operating mode

| | | |
|----|--------------------|----------|
| 02 | Pump, open circuit | O |
|----|--------------------|----------|

Sizes (NG)

| | | | | | | | |
|----|---|------------|------------|------------|------------|------------|------------|
| 03 | Geometric displacement, see table of values on page 5 | 023 | 032 | 045 | 063 | 080 | 107 |
|----|---|------------|------------|------------|------------|------------|------------|

Series

| | | |
|----|-------------------|-----------|
| 04 | Series 1, index 0 | 10 |
|----|-------------------|-----------|

Configuration of port and fastening threads

| | | |
|----|---|----------|
| 05 | Metric, port threads with profiled sealing ring according to DIN 3852 | N |
|----|---|----------|

Direction of rotation¹⁾

| | | | |
|----|-----------------------|-------------------|----------|
| 06 | Viewed on drive shaft | counter-clockwise | L |
|----|-----------------------|-------------------|----------|

Sealing material

| | | |
|----|--|----------|
| 07 | FKM (fluor-caoutchouc) including the 2 shaft seal rings in FKM | W |
|----|--|----------|

Mounting flange

| | | |
|----|---|-----------|
| 08 | Special flange ISO 7653-1985 (for trucks) | K0 |
|----|---|-----------|

Drive shaft

| | | |
|----|--|-----------|
| 09 | Splined shaft similar to DIN ISO 14 (for trucks) | E8 |
|----|--|-----------|

Service line port

| | | |
|----|--|----------|
| 10 | Threaded ports A and S at rear | 1 |
|----|--|----------|

Standard / special version

| | | |
|----|------------------|----------|
| 11 | Standard version | 0 |
| | Special version | S |

Note

Note the project planning notes on page 16.

¹⁾ Changing the direction of rotation see instruction manual 91520-01-B, chapter 6.4.2

Hydraulic fluid

The fixed pump A17FO is designed for operation with HLP mineral oil according to DIN 51524.

Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- ▶ 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- ▶ 90221: Environmentally acceptable hydraulic fluids
- ▶ 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

The axial piston unit is not suitable for operation with water-containing HF hydraulic fluid.

Notes on selection of hydraulic fluid

The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (v_{opt} see selection diagram).

Note

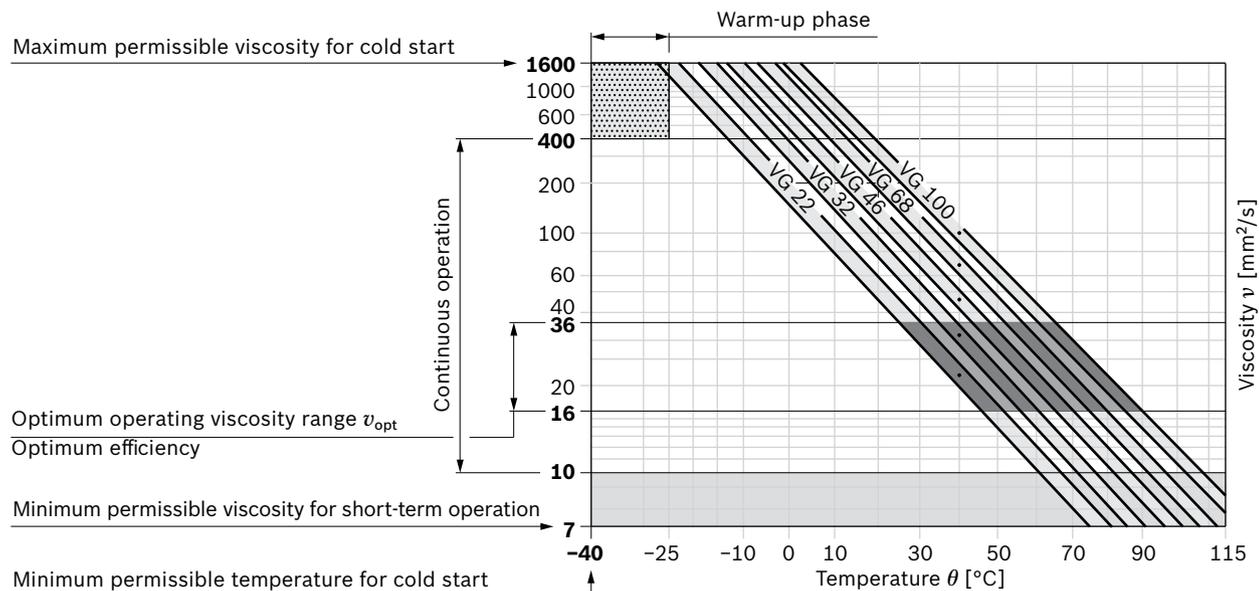
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.

Please contact us if the above conditions cannot be met due to extreme operating parameters.

Viscosity and temperature of hydraulic fluids

| | Viscosity | Temperature | Comment |
|----------------------|---|---|---|
| Cold start | $v_{max} \leq 1600 \text{ mm}^2/\text{s}$ | $\theta_{St} \geq -25 \text{ °C}^{1)}$ | $t \leq 3 \text{ min}$, without load ($p \leq 50 \text{ bar}$), $n \leq 1000 \text{ rpm}$ |
| | Permissible temperature difference | $\Delta T \leq 25 \text{ K}$ | between axial piston unit and hydraulic fluid in the system |
| Warm-up phase | $v < 1600 \text{ to } 400 \text{ mm}^2/\text{s}$ | | at $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq 15 \text{ min}$ |
| Continuous operation | $v = 400 \text{ to } 10 \text{ mm}^2/\text{s}$ | | this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram) |
| | | $\theta = -25 \text{ °C to } +103 \text{ °C}$ | measured at air bleed port R observe permissible temperature range of the shaft seal ring ¹⁾ ($\Delta T = \text{approx. } 12 \text{ K}$ between bearing/shaft seal and port R) |
| | $v_{opt} = 36 \text{ to } 16 \text{ mm}^2/\text{s}$ | | range of optimum operating viscosity and efficiency |
| Short-term operation | $v_{min} \geq 7 \text{ mm}^2/\text{s}$ | | $t < 3 \text{ min}$, $p < 0.3 \times p_{nom}$ |

▼ Selection diagram



1) The FKM shaft seal is permissible for temperatures of -25 °C to +115 °C, please contact us for temperatures below -25 °C.

Filtration of the hydraulic fluid

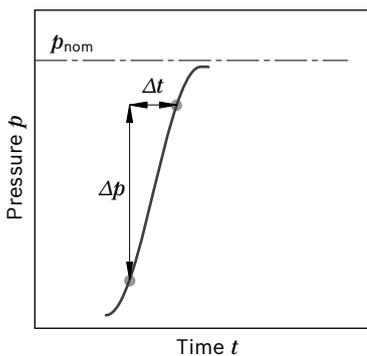
Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit. A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at air bleed port **R**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

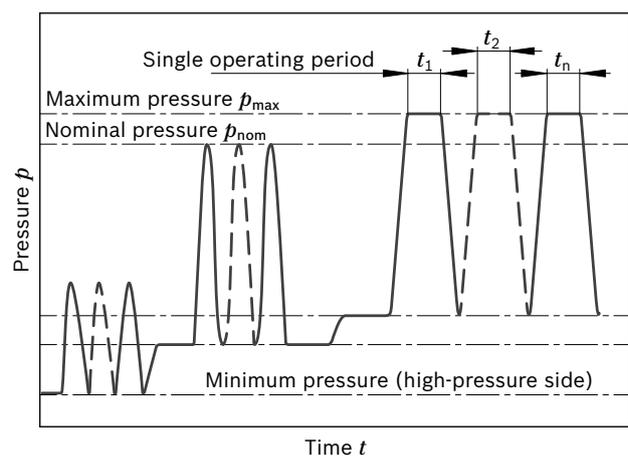
Operating pressure range

| Pressure at service line port A (high-pressure side) | | 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 of the axial piston unit. |
| Maximum pressure $p_{S\ max}$ | 2 bar absolute | |

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



▼ Pressure definition



$$\text{Total operating period} = t_1 + t_2 + \dots + t_n$$

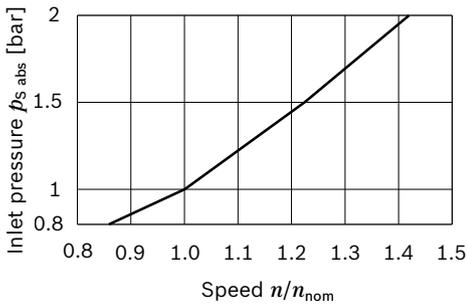
Note

Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical Data

| Size | NG | 23 | 32 | 45 | 63 | 80 | 107 | | |
|---|---------------------------------------|--------------------|--------|--------|-------|--------|--------|--------|-----|
| Displacement, geometric, per revolution | V_g | cm ³ | 22.9 | 32 | 45.6 | 63 | 80.4 | 106.7 | |
| Speed maximum ¹⁾ | n_{nom} ²⁾ | rpm | 3050 | 2750 | 2650 | 2200 | 2150 | 2000 | |
| | n_{max} ³⁾ | rpm | 4300 | 3900 | 3800 | 3200 | 3100 | 2800 | |
| Flow | at n_{nom} | q_v | l/min | 70 | 88 | 121 | 139 | 173 | 213 |
| Power | at n_{nom} and $\Delta p = 350$ bar | P | kW | 41 | 51 | 71 | 81 | 101 | 124 |
| Torque | at $\Delta p = 350$ bar | T | Nm | 127 | 178 | 254 | 351 | 448 | 594 |
| Rotary stiffness | c | kNm/rad | 2.56 | 3.12 | 4.18 | 6.25 | 8.73 | 11.2 | |
| Moment of inertia for rotary group | J_{TW} | kgm ² | 0.0012 | 0.0012 | 0.003 | 0.0042 | 0.0072 | 0.0116 | |
| Maximum angular acceleration | α | rad/s ² | 6500 | 6500 | 14600 | 7500 | 6000 | 4500 | |
| Case volume | V | l | 0.25 | 0.29 | 0.4 | 0.5 | 0.6 | 0.75 | |
| Mass moment | T_G | Nm | 4.7 | 4.7 | 8.6 | 9.9 | 15.3 | 20 | |
| Mass (approx.) | m | kg | 5.9 | 5.9 | 8.4 | 9.3 | 12.3 | 15.0 | |

▼ Maximum speed (limiting speed)



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 | Speed [rpm] |
| η_v | Volumetric efficiency |
| η_{hm} | Hydraulic-mechanical efficiency |
| η_t | Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$) |

Note

- ▶ 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. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

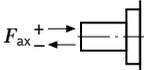
1) The values are applicable:

- for the optimum viscosity range from $\nu_{opt} = 36$ bis 16 mm²/s
- for hydraulic fluids based on mineral oils.

2) The values apply at absolute pressure $p_{abs} = 1$ bar at suction port **S**

3) Maximum speed (speed limit) with increased inlet pressure p_{abs} at suction port **S** (see diagram).

Permissible axial forces of the drive shaft

| Size | | NG | 23 | 32 | 45 | 63 | 80 | 107 |
|---|---|-----------------|----|----|----|----|----|-----|
| Maximum axial force, at standstill or pressure-free operation |  | + $F_{ax\ max}$ | N | 0 | 0 | 0 | 0 | 0 |
| | | - $F_{ax\ max}$ | N | 24 | 33 | 43 | 53 | 60 |

Note

- ▶ The values given are maximum values and do not apply to continuous operation.
- ▶ The permissible axial force in direction $-F_{ax}$ is to be avoided as the lifetime of the bearing is reduced.
- ▶ Radial forces are not permissible.

Direction of rotation

The direction of rotation of the axial piston unit is defined by means of a pressure connection screwed into the service line port and can easily be changed.

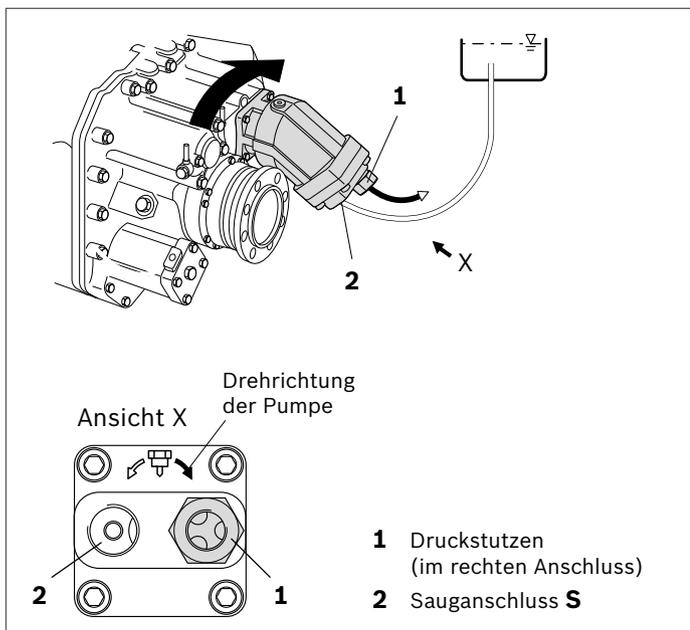
By changing the pressure connection, the service line port and the suction port are exchanged. As a result, the permissible drive direction is changed. This is necessary when mounting on a power take-off with counter-clockwise rotation, for example. The procedure for conversion of the pressure nipple can be found in the instruction manual (91520-01-B, chapter 6.4.2 “Direction of rotation and change of direction of rotation”).

Direction of rotation on delivery

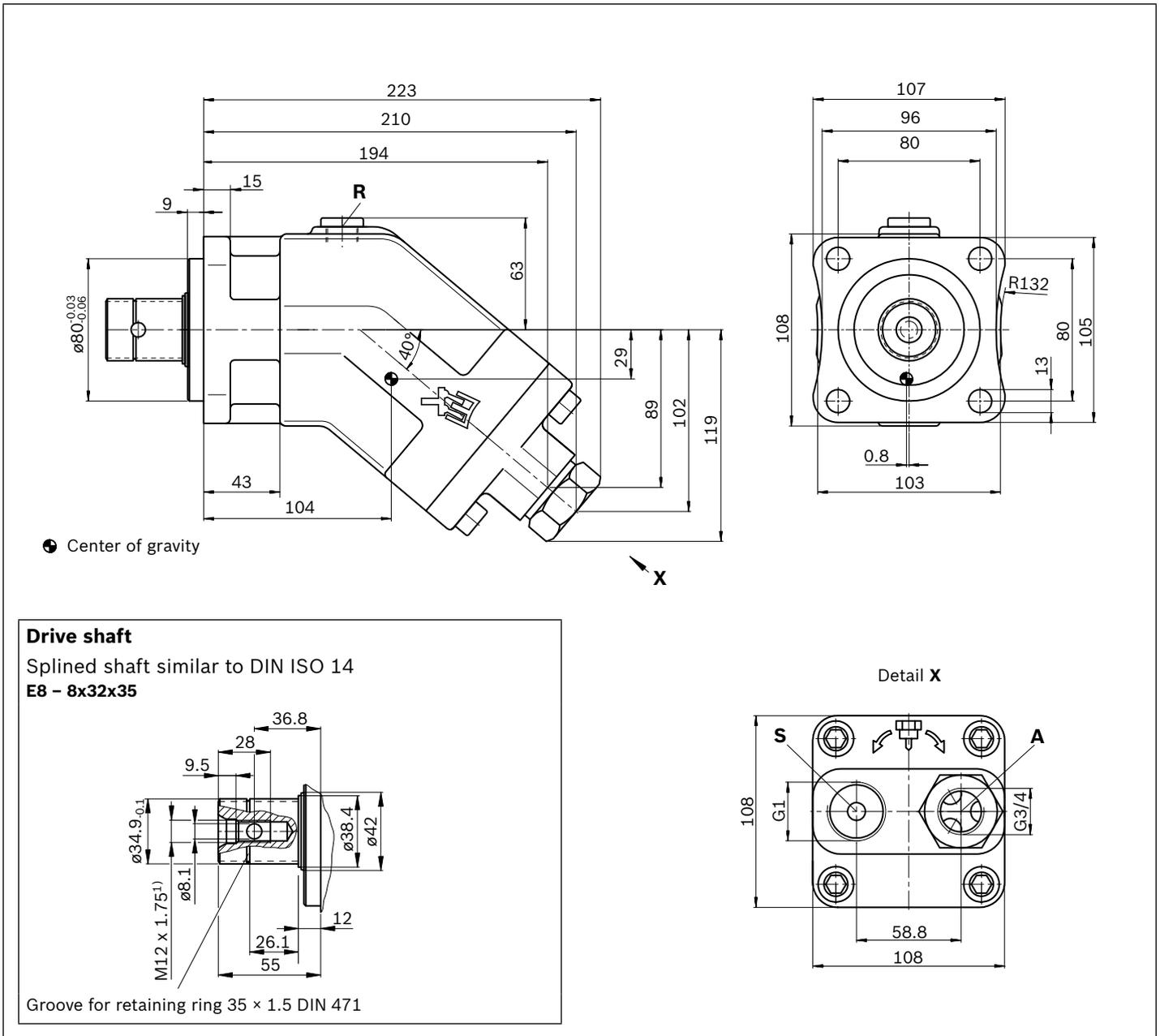
On delivery, the pressure connection (1) is pre-assembled in the right-hand service line port of the axial piston unit. The permissible drive direction of the pump looking at the drive shaft: counter-clockwise. The power take-off turns clockwise.

Note

The pressure connection is pre-installed upon delivery and must be tightened with the torque stipulated for the appropriate thread size prior to installation (see instruction manual).



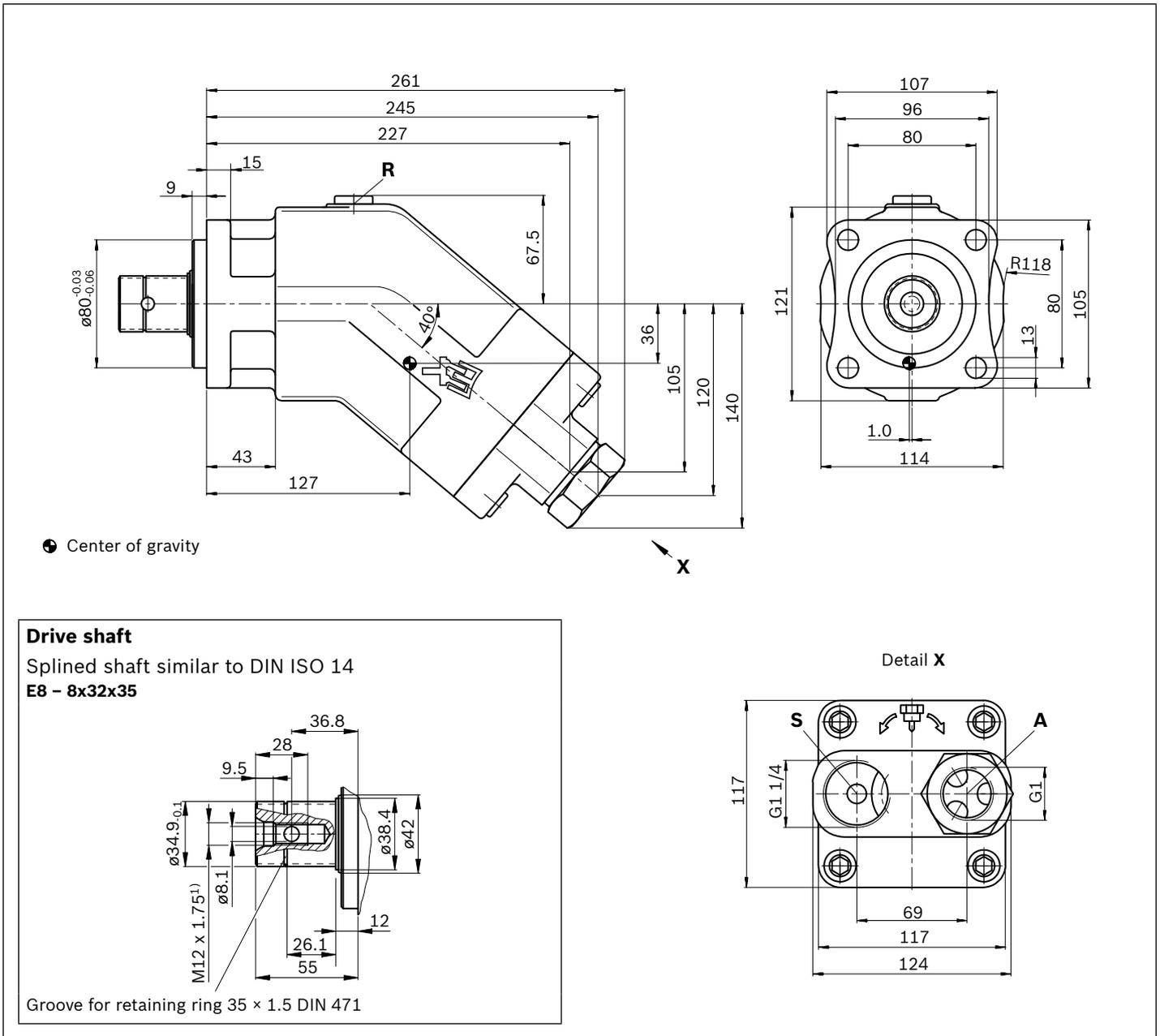
Dimensions, size 45



| Ports | Standard | Size | $p_{max\ abs}$ [bar] ²⁾ | State ⁵⁾ |
|----------|------------------------|-----------------|------------------------------------|---------------------|
| A | DIN ISO 228 | G3/4; 16 deep | 400 | O |
| S | DIN ISO 228 | G1; 18 deep | 2 | O |
| R | DIN 3852 ⁴⁾ | M10 x 1, 8 deep | 2 | X ³⁾ |

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

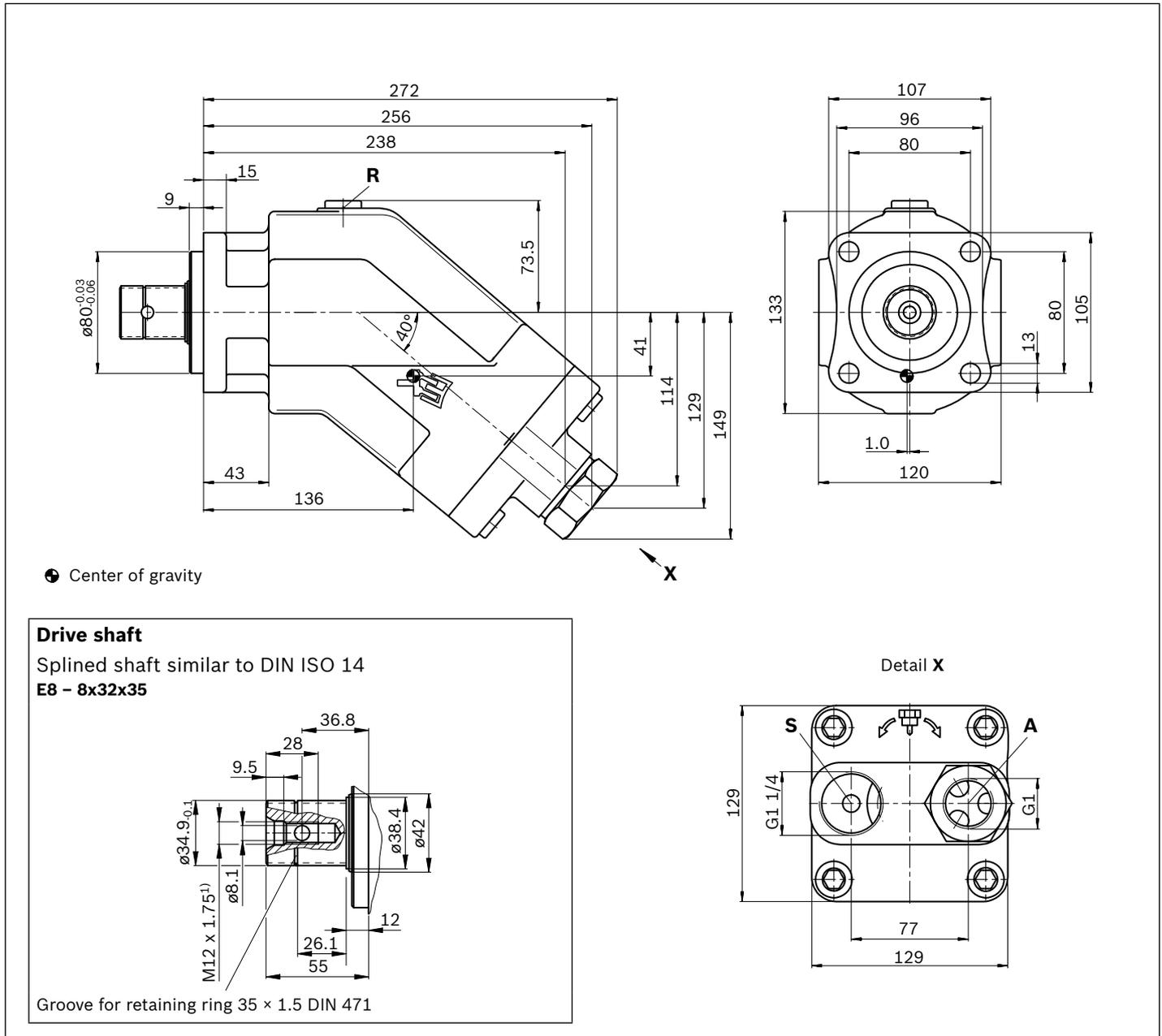
Dimensions, size 80



| Ports | Standard | Size | $p_{max\ abs}$ [bar] ²⁾ | State ⁵⁾ |
|----------|------------------------|-----------------|------------------------------------|---------------------|
| A | DIN ISO 228 | G1; 18 deep | 400 | O |
| S | DIN ISO 228 | G1 1/4; 20 deep | 2 | O |
| R | DIN 3852 ⁴⁾ | M10 x 1, 8 deep | 2 | X ³⁾ |

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

Dimensions, size 107



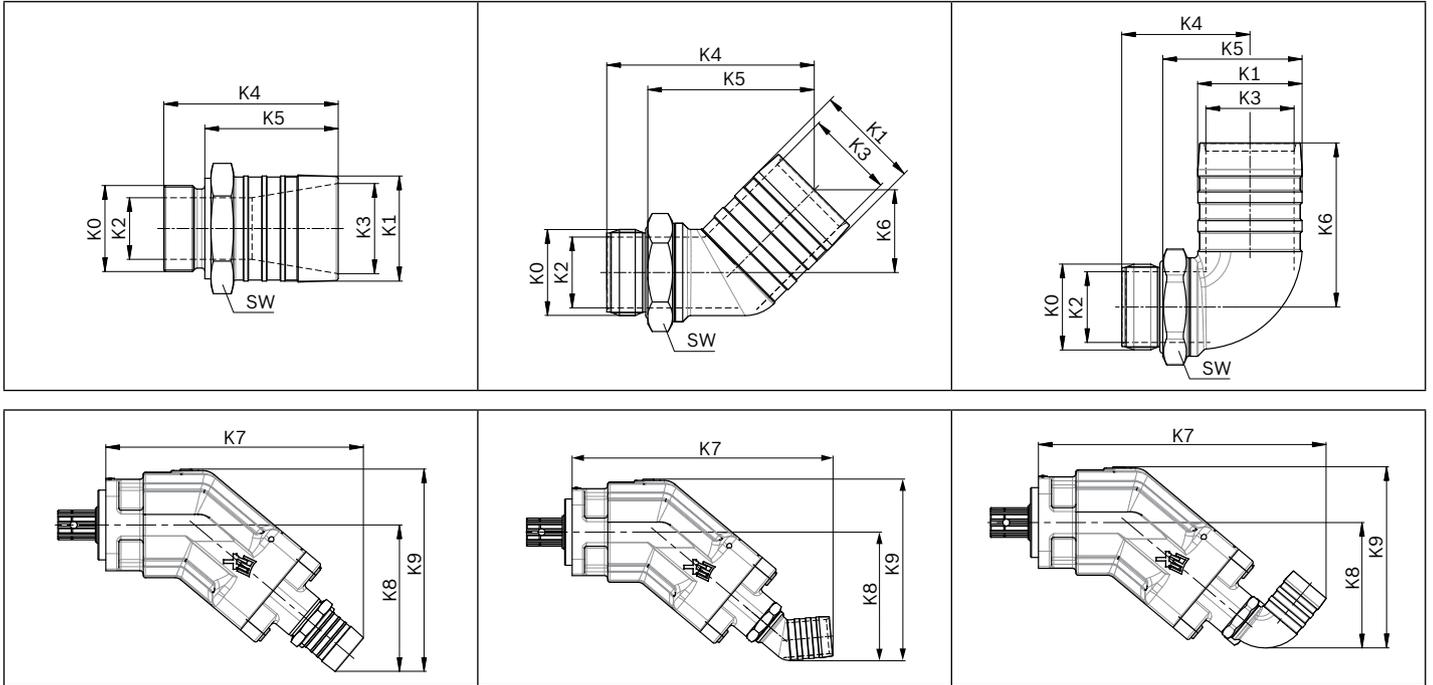
| Ports | Standard | Size | $p_{\max \text{ abs}}$ [bar] ²⁾ | State ⁵⁾ |
|----------|------------------------|-----------------|--|---------------------|
| A | DIN ISO 228 | G1; 18 deep | 400 | O |
| S | DIN ISO 228 | G1 1/4; 20 deep | 2 | O |
| R | DIN 3852 ⁴⁾ | M10 x 1, 8 deep | 2 | X ³⁾ |

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

Accessories

Suction stud

▼ Dimensions



| Version | Pump size | Hose nominal width | Material number | Thread K0 | K1 | K2 | K3 | K4 | K5 | K6 | K7 | K8 | K9 | SW |
|----------|-----------|--------------------|-----------------|-----------|----|------|------|-----|----|-----|-----|-----|-----|----|
| Straight | 23, 32 | 1 1/2" | R909831856 | G3/4 | 39 | 18 | 33.5 | 70 | 54 | - | 221 | 132 | 186 | 41 |
| | 45 | 1 1/2" | R902600251 | G1 | 39 | 23.5 | 33.5 | 72 | 54 | - | 248 | 139 | 197 | 41 |
| | 63 | 1 1/2" | | G1 | 39 | 23.5 | 33.5 | 72 | 54 | - | 257 | 146 | 204 | 41 |
| | 63 | 2" | R902602028 | G1 | 51 | 26 | 44 | 82 | 64 | - | 268 | 157 | 215 | 55 |
| | 80 | 2" | R902600252 | G1 1/4 | 51 | 30 | 44 | 85 | 65 | - | 295 | 168 | 232 | 55 |
| | 107 | 2" | | G1 1/4 | 51 | 30 | 44 | 85 | 65 | - | 306 | 177 | 245 | 55 |
| | 107 | 2 1/2" | R902601630 | G1 1/4 | 63 | 31 | 54 | 82 | 64 | - | 308 | 180 | 248 | 65 |
| 45° | 23, 32 | 1 1/2" | R909831601 | G3/4 | 39 | 20 | 31 | 101 | 82 | 43 | 259 | 126 | 180 | 36 |
| | 45 | 1 1/2" | R909831600 | G1 | 39 | 26 | 31 | 101 | 82 | 45 | 287 | 132 | 190 | 41 |
| | 63 | 1 1/2" | | G1 | 39 | 26 | 31 | 101 | 82 | 45 | 296 | 139 | 197 | 41 |
| | 63 | 2" | R902602029 | G1 | 51 | 26 | 43 | 100 | 81 | 44 | 295 | 145 | 203 | 41 |
| | 80 | 2" | R909831597 | G1 1/4 | 51 | 34 | 43 | 101 | 81 | 40 | 317 | 156 | 220 | 50 |
| | 107 | 2" | | G1 1/4 | 51 | 34 | 43 | 101 | 81 | 40 | 328 | 165 | 234 | 50 |
| | 107 | 2 1/2" | R902601631 | G1 1/4 | 63 | 35 | 54 | 100 | 81 | 44 | 331 | 169 | 237 | 50 |
| 90° | 23, 32 | 1 1/2" | R909831602 | G3/4 | 39 | 20 | 31 | 62 | 43 | 81 | 265 | 117 | 171 | 36 |
| | 45 | 1 1/2" | R909831599 | G1 | 39 | 26 | 31 | 64 | 44 | 85 | 296 | 127 | 185 | 41 |
| | 63 | 1 1/2" | | G1 | 39 | 26 | 31 | 64 | 44 | 85 | 305 | 134 | 192 | 41 |
| | 63 | 2" | R902602030 | G1 | 51 | 26 | 43 | 62 | 42 | 81 | 305 | 138 | 196 | 41 |
| | 80 | 2" | R909831598 | G1 1/4 | 51 | 35 | 43 | 63 | 43 | 80 | 330 | 144 | 208 | 50 |
| 107 | 2" | G1 1/4 | | 51 | 35 | 43 | 63 | 43 | 80 | 341 | 153 | 221 | 50 | |

The suction stud is not included in the scope of delivery and must be ordered separately.

Notes on suction line

- ▶ Keep as short and straight as possible, without sharp 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:

- ▶ R909083796: O-ring for suction stud G3/4
- ▶ R909083802: O-ring for suction stud G1
- ▶ R909083808: O-ring for suction stud G1 1/4

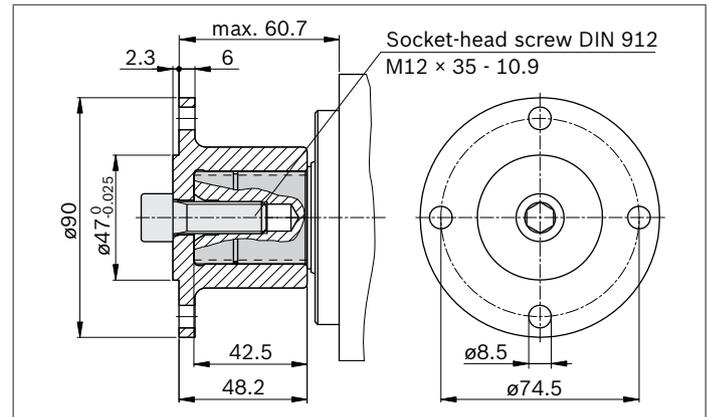
Coupling flange

There are special, modified coupling flanges in 4-hole and 6-hole design for the cardan shaft drive.

The coupling flange is not included in the scope of delivery and must be ordered separately.

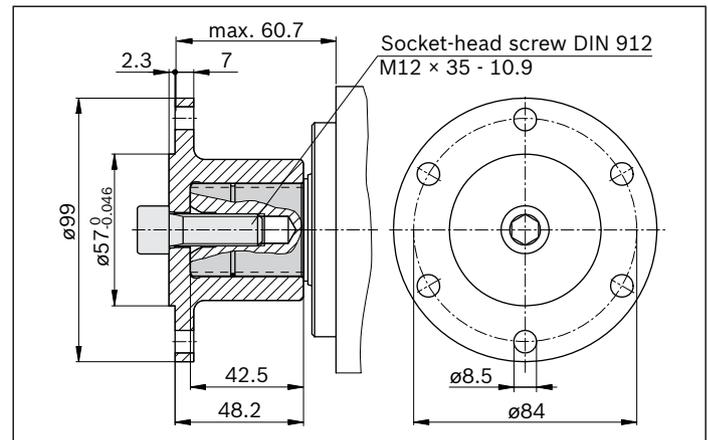
▼ 4-hole coupling flange, complete – ø 90

Material number: R902060152



▼ 6-hole coupling flange, complete – ø 100

Material number: R902060153



Note

- ▶ Assembly of the coupling flange is carried out by pulling onto the drive shaft with the aid of the threaded bore in the drive shaft end.
- ▶ The coupling flange must be clamped on the drive shaft using a socket-head screw. In addition, permanent lubrication should be applied between the drive shaft and the coupling flange.
- ▶ The socket-head screw should be secured in a suitable manner (e.g. gluing with Loctite 276) and tightened with a tightening torque of 130 Nm.
- ▶ Sudden axial impact upon the drive shaft will lead to rotary group damage and therefore must 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 long standstill as the axial piston unit can empty via the hydraulic lines.

The pump housing is internally connected to the suction chamber. A separate drain line from the housing to the reservoir is not needed.

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

In all operating conditions, the suction line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not 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.

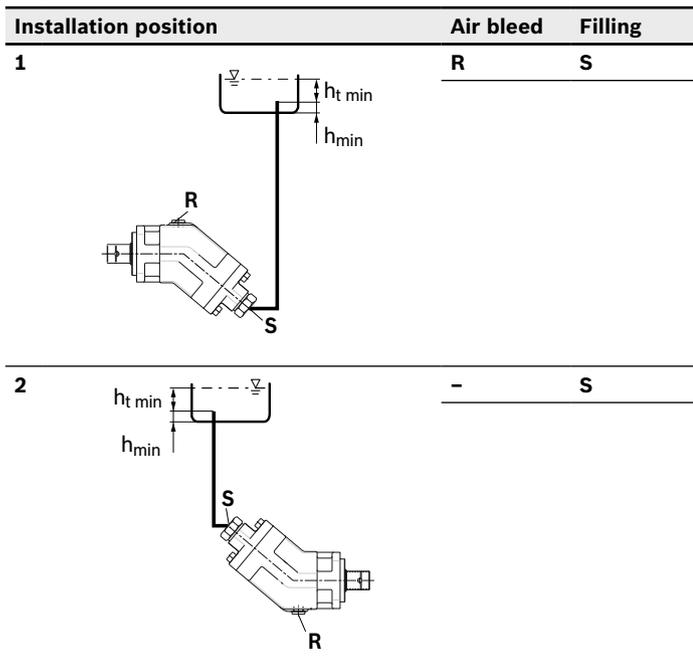
Installation position

See the following examples **1** to **4**.

Further installation positions are available upon request.
Recommended installation position: **1** and **2**.

Below-reservoir installation (standard)

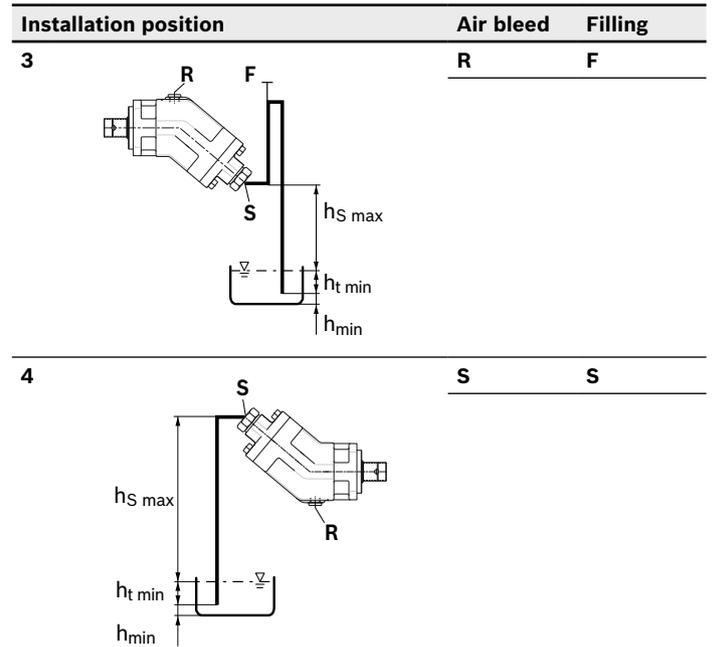
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



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.



Key

F Filling/air bleed

R Air bleed port

S Suction port

$h_{t \min}$ Minimum required immersion depth (200 mm)

h_{\min} Minimum required distance to reservoir bottom (100 mm)

$h_{S \max}$ Maximum permissible suction height (800 mm)

Note

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

Other related documents

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

- ▶ 91510: Fixed pump A17FNO, 250/300 bar
- ▶ 92270: Variable pump, A18VO 350/400 bar
- ▶ 92280: Variable pump, A18VLO 350/400 bar

Project planning notes

- ▶ The A17FO pump 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.
- ▶ Before finalizing your design, please request a binding installation drawing.
- ▶ The specified data and notes must be observed.
- ▶ Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- ▶ Preservation: Our axial piston units are supplied as standard with protection to preserve for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- ▶ Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- ▶ Be sure to add a pressure relief valve to the hydraulic system.
- ▶ Please note the details regarding the tightening torques of port threads and other threaded joints.

- ▶ Working 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.

Safety instructions

- ▶ 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).

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