

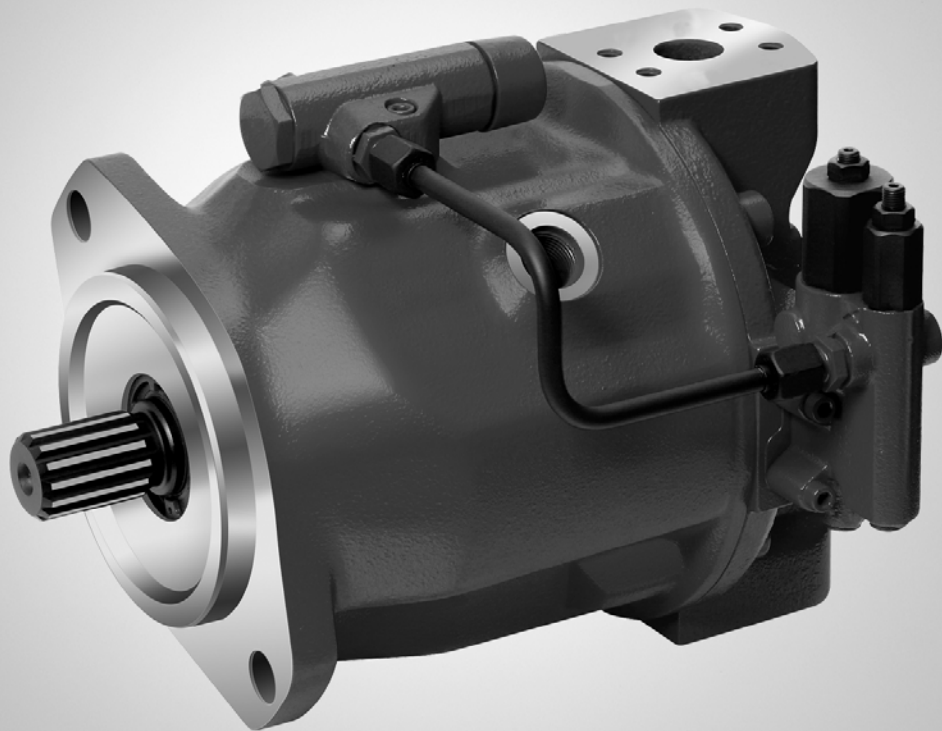
# Axial Piston Variable Pumps A10VO, A10VSO

Series 31

**RE 92701-01-B/01.2012**

Replaces: 11.08  
English

**Instruction manual**



The data specified above serve to describe the product. Should information be provided on use, these are only examples of applications and suggestions.

Information from the catalog are not assured properties. The information given does not release the user from the obligation of own judgment and verification. Our products are subject to a natural wear and aging process.

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The cover shows an example application. The product delivered may differ from the image on the cover.

The original instruction manual was created in the German language.

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# 1 About this manual

## 1.1 Validity of the documentation

This documentation applies to the following products:


- Axial piston variable pump A10VO (series 31)
- Axial piston variable pump A10VSO (series 31)

This documentation is intended for machine/system manufacturers, fitters and service technicians.








This documentation contains important information on the safe and appropriate transport, installation, commissioning, operation, maintenance, removal and simple troubleshooting of the axial piston unit.

- ▶ Read this documentation completely and in particular chapter 2 "Safety instructions" and chapter 3 "General instructions on damage to equipment and the product", before working with the axial piston unit.

## 1.2 Required and supplementary documentation

- ▶ Only commission the axial piston unit if the documentation marked with the book symbol  is available to you and you have understood and observed it.

**Table 1: Required and supplementary documentation**

	<b>Title</b>	<b>Document number</b>	<b>Document type</b>
	<b>Order confirmation</b> Contains the order-related technical data of your axial piston variable pump A10VO or A10VSO.	–	Order confirmation
	<b>Installation drawing</b> Contains the outer dimensions, all connections and the hydraulic circuit diagram for your axial piston variable pump A10VO or A10VSO.	Please request the installation drawing via your contact person at Bosch Rexroth.	Installation drawing
	<b>Axial piston variable pump A10V(S)O, Size 18 (A10VSO), Size 28 to 140 (A10VO)</b> Contains the permissible technical data.	RE 92701	Data sheet
	<b>Axial piston variable pump A10VSO, size 18 to 140</b> Contains the permissible technical data.	RE 92711	Data sheet
	<b>Mineral-oil based hydraulic fluid and related hydrocarbons</b> Describes the requirements on a mineral-oil based hydraulic fluid and related hydrocarbons for the operation with Rexroth hydraulic components, and assists you in selecting a hydraulic fluid for your hydraulic system.	RE 90220	Data sheet
	<b>Environmentally acceptable hydraulic fluids</b> Describes the requirements on an environmentally acceptable hydraulic fluid for operation with Rexroth hydraulic components and assists you in selecting a hydraulic fluid for your hydraulic system.	RE 90221	Data sheet
	<b>Axial piston units for operation with HF hydraulic fluids</b> Contains additional information on the use of Rexroth axial piston units with HF hydraulic fluids.	RE 90223	Data sheet

## About this manual

**Table 1: Required and supplementary documentation**

Title	Document number	Document type
<b>Information of the use of hydrostatic drives at low temperatures</b> Contains additional information on the use of Rexroth axial piston units at low temperatures.	RE 90300-03-B	Manual
<b>Storage and preservation of axial piston units</b> Contains additional information on storage and preservation.	RE 90312	Data sheet
<b>Axial piston pump A10V(S)O with electro-hydraulic pressure control ED../ER..</b>	RE 92707	Data sheet
<b>Differential pressure control, electrically variable</b>	RE 92709	Data sheet
<b>Pressure relief valve, direct controlled</b>	RE 25402	Data sheet
<b>Proportional pressure relief valve</b>	RE 29166	Data sheet
<b>Pump safety block</b>	RE 25880	Data sheet
<b>Pump safety block</b>	RE 25891	Data sheet
<b>Pressure and flow control system</b>	RE 30030	Data sheet


## 1.3 Display of information

Standardized safety instructions, symbols, terms and abbreviations are used so that you can use this documentation to work quickly and safely with your axial piston unit. To give you a better understanding they are explained in the sections below.

### 1.3.1 Safety instructions




Safety instructions are contained in this documentation in chapter 2.6 "Product-specific safety instructions" and chapter 3 "General instructions on damage to equipment and the product" as well as before a sequence or instruction whenever there is a risk of injury to persons or damage to equipment. The described danger prevention measures must be observed.

Safety instructions are set out as follows:

 <b>SIGNAL WORD</b>
<p><b>Type and source of danger</b></p> <p>Consequences in case of noncompliance</p> <ul style="list-style-type: none"> <li>▶ Measure for danger prevention</li> <li>▶ &lt;List&gt;</li> </ul>

- **Safety sign:** draws attention to the danger
- **Signal word:** identifies the degree of the danger
- **Type and source of danger:** identifies the type and source of the danger
- **Consequences:** describes what occurs if the safety instructions are not complied with
- **Precautions:** states how the danger can be avoided



Table 2: Danger classes in accordance with ANSI Z535.6-2006

Safety sign, signal word	Meaning
 <b>DANGER</b>	Identifies a dangerous situation that will result in death or serious injuries if it is not avoided.
 <b>WARNING</b>	Identifies a dangerous situation that may result in death or serious injuries if it is not avoided.
 <b>CAUTION</b>	Identifies a dangerous situation that may result in minor to moderate injuries if it is not avoided.
<b>NOTE</b>	Damage to equipment: the product or the environment may be damaged.

### 1.3.2 Symbols

The following symbols mark notes that are not safety-relevant but which increase the understanding of the documentation.

Table 3: Meaning of the symbols

Symbol	Meaning
	If this information is disregarded, the product can not be used and/or operated to the optimum extent.
	Single, independent step
1. 2. 3.	Numbered instruction: The numbers specify that the steps are completed one after the other.

### 1.3.3 Designations

This documentation uses the following designations:

Table 4: Designations

Designation	Meaning
A10VO	Axial piston variable pump, open circuit, maximum pressure 350 bar, for mobile applications
A10VSO	Axial piston variable pump, open circuit, maximum pressure 350 bar, for stationary applications
Screw plug	Metal screw, pressure-resistant
Protective plug	Made out of plastic, not pressure-resistant, only for transportation

As umbrella term for the "Axial Piston Variable Pump A10VO" or "A10VSO" the designation "axial piston unit" is used in the following.

## About this manual

### 1.3.4 Abbreviations

This documentation uses the following abbreviations:

**Table 5: Abbreviations**

Abbreviation	Meaning
DG	Two-point control, direct controlled
DIN	Deutsche Industrie Norm (German Institute for Standardization)
DFLR	Pressure flow power control
DFR/DFR1	Pressure flow control
DRG	Pressure controller, remotely controlled
ED	Electro-hydraulic pressure control
EF	Differential pressure control, electrically variable
ISO	International Organization for Standardization
RE	Rexroth document in the English language
VDI 2230	Directive for the systematic calculation of high duty bolted joints and joints with one cylindrical bolt from the VDI (Verein Deutscher Ingenieure – Association of German Engineers)



## 2 Safety instructions

### 2.1 About this chapter

The axial piston unit has been manufactured according to the generally accepted rules of current technology. There is, however, still a danger of personal injury or damage to equipment if this chapter and the safety instructions in this documentation are not complied with.

- ▶ Read this documentation completely and thoroughly before working with the axial piston unit.
- ▶ Keep this documentation in a location where it is accessible to all users at all times.
- ▶ Always include the required documentation when you pass the axial piston unit on to third parties.

### 2.2 Intended use

Axial piston units are hydraulic components, meaning that in their application they are classified neither as complete nor as incomplete machines in the sense of the EU machine directive 2006/42/EC. A component is exclusively intended to form an incomplete or a complete machine together with other components. The component may only be commissioned after it has been installed in the machine/system for which it is intended and the safety of the entire system has been established in accordance with the machine directive.

The product is intended for the following use:

The axial piston unit is only approved as a pump for hydrostatic drives in open circuit.

- ▶ Observe the technical data, application and operating conditions and performance limits as specified in data sheet RE 92701 and RE 92711 and in the order confirmation. Information about approved hydraulic fluids can be found in data sheet RE 92701 and RE 92711.

The axial piston unit is only intended for professional use and not for private use. Intended use includes having completely read and understood this documentation, especially chapter 2 "Safety instructions".

### 2.3 Improper use

Any use other than that described as intended use shall be considered as improper and is therefore impermissible.

Bosch Rexroth AG shall accept no liability whatsoever for damage resulting from improper use. The user shall bear all risks arising from improper use.

Similarly, the following foreseeable faulty usages are also considered to be improper:

- Using outside the operating parameters approved in the data sheet (unless customer-specific approval has been granted)
- Use for non-approved fluids, e.g. water or polyurethane components

## Safety instructions

- Modification of factory settings by non-authorized persons
- Use of add/on parts (e.g. mountable filter, control unit, valves) that are not specified Rexroth components
- Using the axial piston unit under water at a depth of more than 10 meters without necessary additional measures, e.g. pressure equalization
- Using the axial piston unit when the exterior pressure is greater than the interior pressure (case pressure)
- Using the axial piston unit in explosive environments unless the component or machine/system has been certified as compliant with the ATEX directive 94/9/EC
- Using the axial piston unit in an aggressive atmosphere
- Using the axial piston unit in aircraft or space craft

## 2.4 Personnel qualifications

The activities described in this documentation require basic mechanical, electrical and hydraulic knowledge, as well as knowledge of the associated technical terms. For transporting and handling the product, additional knowledge is necessary with regard to working with a lifting device and the corresponding attachment equipment. In order to ensure safe use, these activities may therefore only be carried out by appropriate qualified personnel or an instructed person under the direction and supervision of qualified personnel.

Qualified personnel are those who can recognize possible hazards and institute the appropriate safety measures due to their professional training, knowledge, and experience, as well as their understanding of the relevant regulations pertaining to the work to be done. Qualified personnel must observe the rules relevant to the subject area and have the necessary hydraulic knowledge.

Hydraulic knowledge means, for instance:

- reading and fully understanding hydraulic plans,
- fully understanding in particular the interrelationships regarding safety devices, and
- having knowledge on the function and assembly of hydraulic components.



Bosch Rexroth offers training support for special fields. You can find an overview of the training contents on the internet at: <http://www.boschrexroth.de/didactic>.

## 2.5 General safety instructions

- Observe the applicable accident prevention and environmental protection regulations.
- Observe the safety regulations and provisions of the country in which the product is used/operated.
- Use Rexroth products only when they are in good technical order and condition.
- Observe all notes on the product.
- Persons who install, operate, remove or maintain Rexroth products must not consume any alcohol, drugs or pharmaceuticals that may affect their ability to respond.
- Only use Rexroth original accessories and spare parts to ensure there is no risk to persons from unsuitable spare parts.
- Conform to the technical data and ambient conditions specified in the product documentation.

**Safety instructions**

- If unsuitable products are installed or used in applications that are of relevance to safety, unexpected operating conditions may occur in the application which could result in injury to persons or property damage. For this reason, only use the product in a safety-relevant application if this use is expressly specified and permitted in the product documentation, for example in ex-protection applications or in safety-related parts of a control system (functional safety).
- You may only commission the product if it has been determined that the end product (e.g. machinery or a system) into which the Rexroth products are installed complies with the country-specific provisions, safety regulations and standards of the application.
- Pressure cut-off and pressure control do not provide security against pressure overload.
- A separate pressure relief valve is to be provided in the hydraulic system.

## 2.6 Product-specific safety instructions

The following safety instructions apply for chapters 6 to 14.

### **WARNING**

#### **Danger from suspended loads!**

Danger to life or risk of injury, damage to equipment!

Improper transportation may cause the axial piston unit to fall down lead to injuries e.g. crushing or broken bones or damage to the product.

- ▶ Make sure that the forklift truck or lifting device has adequate lifting capacity.
- ▶ Never stand under or put you hands under suspended loads.
- ▶ Ensure your position is stable during transportation.
- ▶ Use your personal protective equipment (e.g. safety glasses, safety gloves, suitable working clothes, safety shoes).
- ▶ Use suitable lifting devices for transportation.
- ▶ Observe the prescribed position of the lifting strap.
- ▶ Observe the national laws and regulations on work and health protection and transportation.

#### **Pressurized machine/system!**

Danger to life or risk of injury, serious injuries when working on machines/systems not shutdown! Damage to equipment!

- ▶ Protect the complete system against being energized.
- ▶ Make sure that the machine/system is depressurized. Please follow the machine/system manufacturer's instructions.
- ▶ Do not disconnect any line connections, ports and components when the machine/system is pressurized.
- ▶ Switch off all power-transmitting components and connections (electric, pneumatic, hydraulic) in accordance with the manufacturer's instruction and secure them against being switched back on.

#### **Escaping oil mist!**

Danger of explosion, danger of fire, allergic reactions, environmental pollution!

- ▶ Depressurize the machine/system and repair the leak.
- ▶ Only perform welding work then the machine/system is depressurized.
- ▶ Keep open flames and ignition sources away from the axial piston unit.
- ▶ If axial piston units are to be situated in the vicinity of ignition sources or powerful thermal radiators, a shield must be erected to ensure that any escaped hydraulic fluid can not ignite, and to protect hose lines from premature aging.

#### **Electrical voltage!**

Risk of injury due to electric shock or damage to equipment!

- ▶ Always set up the relevant part of the machine/system so that it is free of electrical voltage before you install the product or when connecting and disconnecting plugs. Protect the machine/system against being energized.

 **CAUTION****High noise development in operation!**

Danger of hearing damage, deafness!

The noise emission of axial piston units depends on speed, operating pressure and installation conditions. The sound pressure level may rise above 70 dBA during normal application conditions.

- ▶ Always wear hearing protection when in the vicinity of the operating axial piston unit.

**Hot surfaces on the axial piston unit!**

Risk of burns!

- ▶ Allow the axial piston unit to cool down sufficiently before touching it.
- ▶ Wear heat-resistant protective clothing, e.g. gloves.

**Improper routing of cables and lines!**

Tripping hazard and damage to equipment!

- ▶ Lay cables and lines so that they can not be damaged and nobody can trip over them.

**Contact with hydraulic fluid!**

Hazard to health/health impairment e.g. eye injuries, skin damage, toxication during inhalation!

- ▶ Avoid contact with hydraulic fluids.
- ▶ When working with hydraulic fluids, strictly observe the safety instructions provided by the lubricant manufacturer.
- ▶ Use your personal protective equipment (e.g. safety glasses, safety gloves, suitable working clothes, safety shoes).
- ▶ If hydraulic fluid should, nevertheless, come into contact with your eyes or bloodstream or is swallowed, consult a doctor immediately.

**Escaping hydraulic fluid due to machine/system leakage!**

Risk of burns and risk of injury due to escaping oil jet!

- ▶ Depressurize the machine/system and repair the leak.
- ▶ Never attempt to block or seal the leak or oil jet with a cloth.

## 2.7 Personal protective equipment

The personal protective equipment is the responsibility of the user of the axial piston unit. Observe the safety regulations and provisions of your country. All components of the personal protective equipment must be intact.

### 3 General instructions on damage to equipment and the product

The following notes apply for chapters 6 to 14.

#### **NOTE**

##### **Danger from improper handling!**

Product can be damaged!

- ▶ Do not expose the product to an impermissible mechanical load.
- ▶ Never use the product as a handle or step.
- ▶ Do not place/lay any objects on the product.
- ▶ Do not strike the drive shaft of the axial piston unit.
- ▶ Do not set/place the axial piston unit on the drive shaft.
- ▶ Do not strike sensitive fittings (e.g. sensors or valves).
- ▶ Do not strike sealing surfaces (e.g. service line ports).
- ▶ Leave the protective covers on the axial piston unit until shortly before the lines are connected.

##### **Damage to equipment due to improper lubrication!**

Product can be damaged or destroyed!

- ▶ Never operate the axial piston unit with insufficient hydraulic fluid. Make sure in particular that the rotary group has sufficient lubrication.
- ▶ When commissioning a machine/system, make sure that the case interior and the service lines of the axial piston unit are filled with hydraulic fluid and remain filled during operation. Air intrusions in the forward drive shaft bearing are to be prevented, especially with the installation position "drive shaft upwards".
- ▶ Check the hydraulic fluid level in the case interior regularly; if necessary, recommission. With above-reservoir installation, the case interior may drain via the reservoir line after longer standstill periods (air enters via the shaft seal) or via the service line (gap leakage). The bearings are thus insufficiently lubricated at switch on.
- ▶ Make sure that the suction line is always filled with hydraulic fluid during commissioning and operation.
- ▶ With above-reservoir installation, an axial piston unit must be moved to full swivel angle after no more than three seconds during commissioning and recommissioning. Make sure that the axial piston unit really does suck in hydraulic fluid and build up pressure.

##### **Mixing of hydraulic fluids!**

Product can be damaged!

- ▶ Before installation, remove all fluids from the axial piston unit to prevent mixing with the hydraulic fluid used in the machine/system.
- ▶ Any mixing of hydraulic fluids of different manufacturers or different types of the same manufacturer is not permissible in general.

## NOTE

### Contamination of the hydraulic fluid!

The cleanliness of the hydraulic fluid has a considerable impact on the cleanliness and service life of the hydraulic system. Premature wear and malfunctions!

- ▶ Make sure that the working environment at the installation site is fully free of dust and foreign substances in order to prevent contaminants, such as welding beads or metal cuttings, from getting into the hydraulic lines and causing product wear or malfunctions. The axial piston unit must be installed in a clean condition.
- ▶ Use only clean connections, hydraulic lines and attachments (e.g. measuring equipment).
- ▶ No contaminants may enter the connections when they are plugged.
- ▶ Before commissioning, make sure that all hydraulic connections are tight and that all of the connection seals and plugs are installed correctly to ensure that they are leakproof and fluids and contaminants are prevented from penetrating the product.
- ▶ Use a suitable filter system to filter hydraulic fluids during filling to minimize solid impurities and water in the hydraulic system.

### Improper cleaning!

Product can be damaged!

- ▶ Plug all openings with the appropriate protective equipment in order to prevent detergents from entering the hydraulic system.
- ▶ Never use solvents or aggressive detergents. Use only water and, if necessary, a mild detergent to clean the axial piston unit.
- ▶ Do not point the power washer at sensitive components, e.g. shaft seal, electrical connections and components.
- ▶ Use lint-free cloths for cleaning.

### Environmental pollution due to incorrect disposal!

Careless disposal of the axial piston unit, the hydraulic fluid and the packaging material could lead to pollution of the environment!

- ▶ Dispose of the axial piston unit, hydraulic fluid and packaging in accordance with the national regulations in your country.
- ▶ Dispose of the hydraulic fluid in accordance with the applicable safety data sheet for the hydraulic fluid.

### Escaping or spilling hydraulic fluid!

Environmental pollution and contamination of the ground water!

- ▶ Always place a drip tray under the axial piston unit when filling and draining the hydraulic fluid.
- ▶ Use an oil binding agent if hydraulic fluid is spilled.
- ▶ Observe the information in the safety data sheet for the hydraulic fluid and the specifications provided by the system manufacturer.

- The warranty applies only to the delivered configuration.
- The entitlement under warranty is rendered void if the product is incorrectly installed, commissioned or operated, as well as in the case of improper use and/or handling.

## 4 Delivery contents

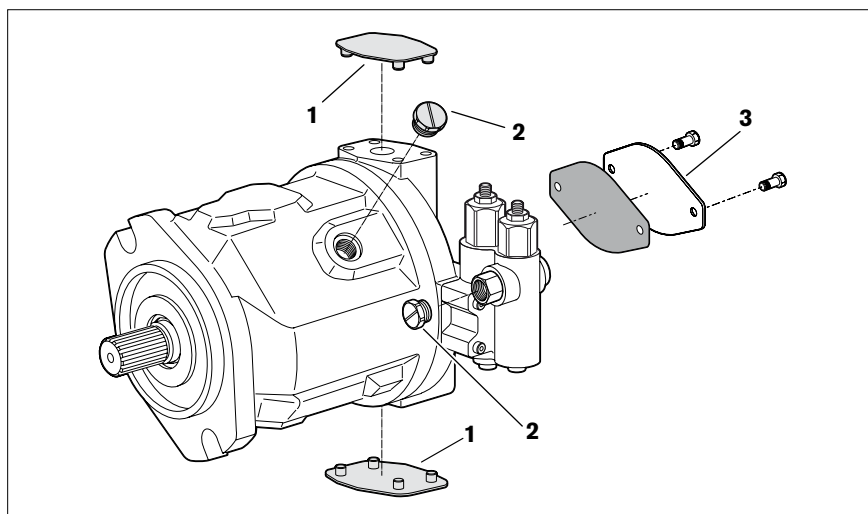


Fig. 1: Axial piston unit A10VSO

Included in the delivery contents are:

- Axial piston unit as per order confirmation

The following parts are also installed on delivery:

- Protective covers made of plastic (1) (metal protective covers are used for painted axial piston units)
- Protective plug/threaded plug (2)
- On version with through drive, metallic protective cover and fixing screws (3) at the through drive



## 5 Product description

### 5.1 Performance description

The Axial piston variable pump generates, controls and regulates a hydraulic fluid flow. The A10VO is designed for mobile applications such as construction machinery. The A10VSO is designed for stationary applications such as tooling machines.

Refer to data sheets RE 92701 and RE 92711 and the order confirmation for the technical data, operating conditions and operating limits of the axial piston unit.

### 5.2 Product description

The A10VO and A10VSO are variable pumps with axial piston rotary group in swashplate design for hydrostatic drive in an open circuit. Flow is proportional to drive speed and displacement. The flow can be steplessly changed by adjusting the swashplate. For axial piston units with swashplate design, the pistons are arranged axially with respect to the drive shaft.

**Open circuit** In an open circuit, the hydraulic fluid flows from the reservoir to the hydraulic pump from where it is fed to the consumer, e.g. hydraulic motor. From the consumer, the hydraulic fluid flows directly back to the reservoir.

#### 5.2.1 Assembly of the axial piston unit

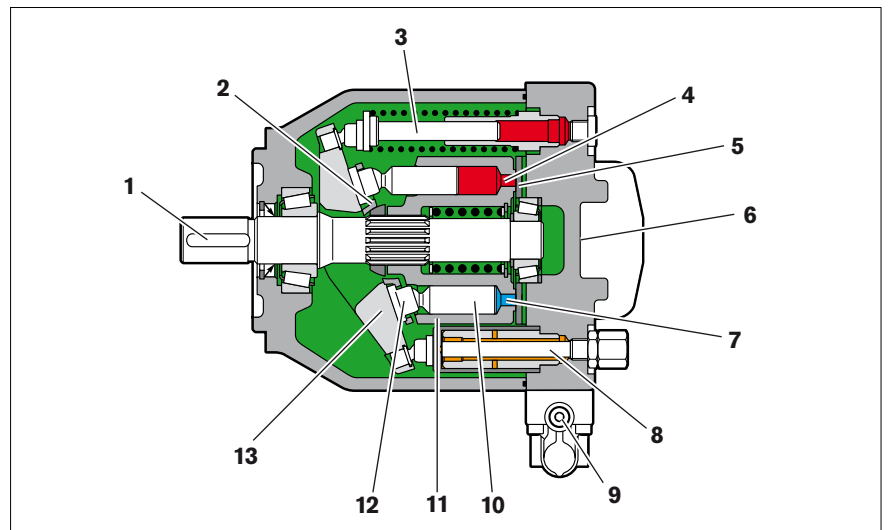


Fig. 2: Assembly of the A10VO/A10VSO

1 Drive shaft	6 Port plate	11 Cylinder
2 Retaining plate	7 Suction side	12 Slipper pad
3 Opposing piston	8 Stroke piston	13 Swashplate
4 High-pressure side	9 Control valve	
5 Control plate	10 Piston	

**Product description****5.2.2 Functional description**

**Pump** Torque and rotational speed are applied to the drive shaft (1) by an engine. The drive shaft is connected by splines to the cylinder (11) to set this in motion. With every revolution, the pistons (10) in the cylinder bores execute one stroke whose magnitude depends on the setting of the swashplate (13). The pistons hold the slipper pads (12) onto the glide surface of the swashplate with the retaining plate (2) and guide them along. The swashplate setting during a rotation causes each piston to move over the bottom and top dead centers and back to its initial position. Here, hydraulic fluid is fed in and drained out through the two control slots in the control plate (5) according to the stroke displacement. On the suction side (7) hydraulic fluid flows into the piston chamber as the piston recedes. At the same time, on the high-pressure side (4) the hydraulic fluid is pushed out of the cylinder chamber into the hydraulic system by the pistons.

**Control** The swivel angle of the swashplate (13) is steplessly variable. Controlling the swivel angle of the swashplate changes the piston stroke and therefore the displacement. The swivel angle is changed hydraulically by means of the stroke piston. The swashplate is mounted for easy motion in swivel bearings and it is kept in balance by the opposing piston (3). Increasing the swivel angle increases the displacement; reducing the angle results in a corresponding reduction in displacement.



Various control devices are available depending on requirements. Information about this can be found in data sheets RE 92701 and RE 92711.

### 5.3 Product identification

The axial piston unit can be identified from the name plate. The following example shows an A10VSO name plate:

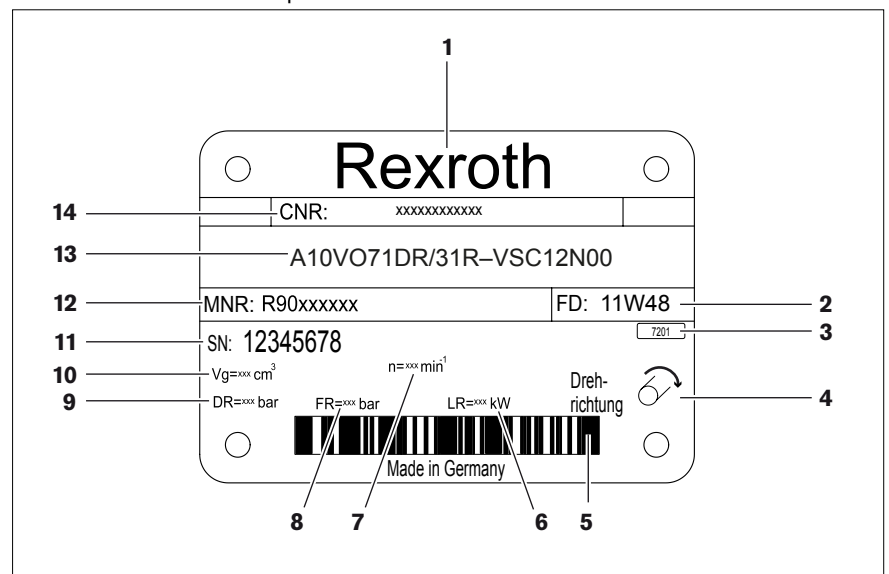


Fig. 3: Name plate A10VSO

- |   |   |    |  |
|---|---|----|--|
| 1 | Manufacturer  | 8  | Flow setting (optional)                  |
| 2 | Production date   | 9  | Pressure controller setting (optional)   |
| 3 | Internal plant designation                                      | 10 | Minimum displacement                     |
| 4 | Direction of rotation (viewed on drive shaft) – here: clockwise | 11 | Serial number                            |
| 5 | Bar code  | 12 | Material number of the axial piston unit |
| 6 | Power setting (optional)  | 13 | Ordering code                            |
| 7 | Speed   | 14 | Customer material number                 |

## 6 Transport and storage

- ▶ Make sure you conform to the required ambient conditions during transportation and storage, see chapter 6.2 "Storing the axial piston unit".



You can find unpacking notes in chapter 7.1 "Unpacking".

### 6.1 Transporting the axial piston unit

The transportation options below exist depending on the weight and duration of the transport:

- Transporting by hand
- Transporting with lifting device (ring screw or lifting strap)

#### Dimensions and weights

Table 6: Dimensions and weights

Size		18	28	45	71	100	140
Weight	kg	12	15	21	33	45	60
Width	mm	The dimensions vary with the unit type. The values applicable for your axial piston unit can be found in the installation drawing (request if necessary).					
Height	mm						
Depth	mm						

The weight specifications may vary depending on the unit type.

#### 6.1.1 Transporting by hand

Axial piston units with a weight of up to 15 kg can be transported manually for a short time if necessary.

**CAUTION!** Danger from heavy loads!

There is a danger of health damage when carrying axial piston units.

- ▶ Use suitable lifting, placement and relocation equipment.
- ▶ Use your personal protective equipment (e.g. safety glasses, safety gloves, suitable working clothes, safety shoes).
- ▶ Do not transport the axial piston unit at sensitive attachment parts (e.g. sensors or valves).
- ▶ Carefully place the axial piston unit on the seating to prevent it from being damaged.

#### 6.1.2 Transporting with lifting device

For transporting, the axial piston unit can be connected to a lifting device via a ring screw or a lifting strap.

#### Transport with ring screw

The axial piston unit can be transported suspended from a ring screw screwed into the drive shaft as long as only outward (pulling) axial forces are applied.

- ▶ For all female threads, use a threaded plug from the same system of units and of the correct size.
- ▶ To do this, screw a ring screw completely into the thread on the drive shaft. The thread sizes is stated in the installation drawing.
- ▶ Make sure that the ring screw can bear the total weight of the axial piston unit plus 20%.

## Transport and storage

You can hoist the axial piston unit as shown in Fig. 4 with the ring screw screwed into the drive shaft.

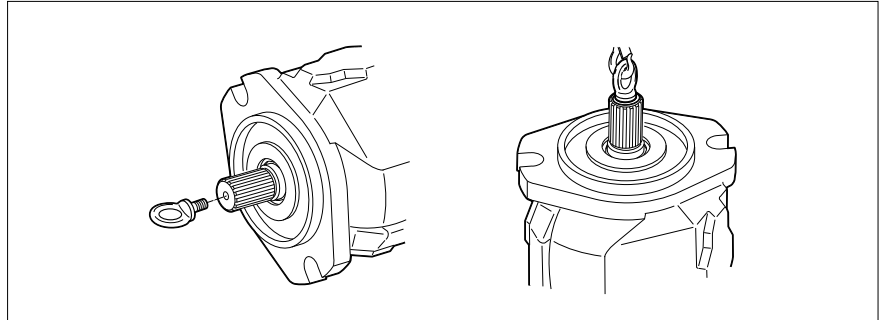


Fig. 4: Fixing the ring screw

**Transport with lifting strap**

**WARNING!** Danger from suspended loads!

During transport with a lifting device, the axial piston unit can fall out of the lifting strap and cause injuries.

- ▶ Use the widest possible lifting strap.
- ▶ Make sure that the axial piston unit is securely fixated with the lifting strap.
- ▶ Only guide the axial piston unit by hand for fine positioning and to avoid oscillations.
- ▶ Never stand under or put your hands under suspended loads.
  
- ▶ Place the lifting strap around the axial piston unit in such a way that it passes over neither the attachment parts (e.g. valves) nor such that the axial piston unit is hung from attachment parts (see Fig. 5).

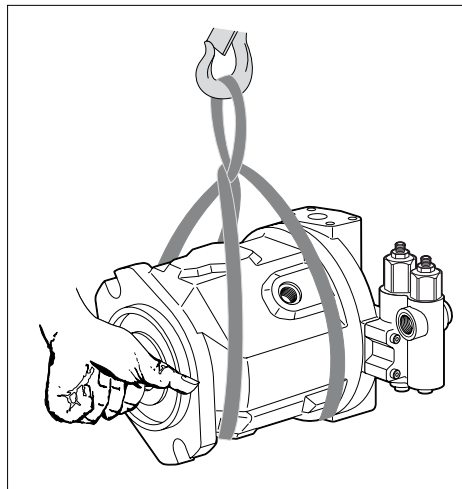


Fig. 5: Transport with lifting strap

## 6.2 Storing the axial piston unit

- Requirement**
- The storage areas must be free from corrosive materials and gases.
  - To prevent damage to the seals, ozone-forming equipment (e.g. mercury-vapor lamps, high voltage equipment, electric motors, sources of electrical sparks or electrical discharges) must not be operated in storage areas.
  - The storage areas must be dry.
  - Ideal storage temperature: +5 °C to +20 °C.
  - Minimum storage temperature: -50 °C.
  - Maximum storage temperature: +60 °C.
  - Avoid high light irradiation (e.g. bright windows or direct fluorescent lighting).
  - Do not stack axial piston units and store them shock-proof.
  - Do not store the axial piston unit on sensitive attachment parts, e.g. speed sensors.
  - For other storage conditions, see table 7.
- Check the axial piston unit monthly to ensure proper storage.

**After delivery** The axial piston units are provided ex-works with corrosion protection packaging (corrosion protection film).  
 The following table lists the maximum permissible storage times for an originally packed axial piston unit as per data sheet RE 90312.

**Table 7: Storage time with factory corrosion protection**

Storage conditions	Standard corrosion protection	Long-term corrosion protection
Closed, dry room, uniform temperature between +5 °C and +20 °C. Undamaged and closed corrosion protection film.	Maximum 12 months	Maximum 24 months



Entitlement to warranty will be rendered void if the requirements and storage conditions are not adhered to or after expiration of the maximum storage time (see table 7).

Procedure after expiry of the maximum storage time:

1. Check the entire axial piston unit for damage and corrosion prior to installation.
2. Check the axial piston unit for proper function and leaks during a test run.
3. If the storage time exceeds 24 months, the shaft seal ring must be replaced.



After expiry of the maximum storage time, we recommend that you have the axial piston unit inspected by your responsible Bosch Rexroth Service partner.

In the event of questions regarding repair and spare parts, contact your responsible Bosch Rexroth Service partner or the service department of the manufacturer's plant for the axial piston unit, see chapter 10.5 "Spare parts" for further information.

**After removal**

If a removed axial piston unit is to be stored, it must be preserved against corrosion for the duration of storage.



The following instructions only refer to axial piston units which are operated with a mineral-oil based hydraulic fluid. Other hydraulic fluids require preservation methods that are specifically designed for them. In such a case, consult with Bosch Rexroth Service, see chapter 10.5 "Spare parts" for address.

Bosch Rexroth recommends the following procedure:

1. Clean the axial piston unit, see chapter 10.1 "Cleaning and care".
2. Empty the axial piston unit.
3. For storage time up to 12 months: Moisten the inside of the axial piston unit with mineral oil and fill with approx. 100 ml mineral oil.  
For storage time up to 24 months: Fill the axial piston unit with corrosion protection medium VCI 329 (20 ml).  
Fill via the reservoir port **L** or **L<sub>1</sub>**, see chapter 7.4 "Installing the axial piston unit", Fig. 12 and 13.
4. Seal all ports airproof.
5. Moisten the unpainted surfaces of the axial piston unit with mineral oil or a suitable, easily removed corrosion protection agent, e.g. acid-free grease.
6. Package the axial piston unit airproof together with desiccant in corrosion protection film.
7. Store the axial piston unit so that it is protected against jolts, see "Requirement" in this chapter.

## 7 Installation

Prior to installation, the following documents must be available:

- Installation drawing for axial piston unit (can be obtained from your responsible contact person at Bosch Rexroth)
- Hydraulic circuit diagram for the axial piston unit (in the installation drawing)
- Hydraulic circuit diagram for the machine/system (available from the machine/system manufacturer)
- Order confirmation (contains the order-related technical data for your axial piston unit)
- Data sheet of the axial piston unit (contains the permissible values of technical data)

### 7.1 Unpacking

The axial piston unit is delivered in a corrosion protection film made of polyethylene material (PE).

**CAUTION!** Danger from parts falling out!

If the packaging is not opened correctly, parts may fall out and damage the parts or even cause injuries!

- ▶ Place the packaging on a flat and solid surface.
- ▶ Only open the packaging from the top.
  
- ▶ Remove the packaging from the axial piston unit.
- ▶ Check the axial piston unit for transport damage and completeness, see chapter 4 "Delivery contents".
- ▶ Dispose of the packaging according to the environmental regulations of your country.

### 7.2 Installation conditions

The installation location and position of the axial piston unit essentially determine the procedures during installation and commissioning (such as when filling and air bleeding the axial piston unit).

- ▶ Fix the axial piston unit so that the expected forces and torques can be transferred without any danger. The machine/system manufacturer is responsible for dimensioning the fasteners.
- ▶ Observe the permissible radial forces on the drive shaft when transferring output drive with radial loading (belt drives). If necessary, the belt pulley must be separately mounted.
- ▶ Make sure that the axial piston unit is air bled and filled with hydraulic fluid during commissioning and operation. This is also to be observed following relatively long standstill periods as the axial piston unit may empty via the hydraulic lines.
- ▶ The case drain fluid in the case interior must be directed to the reservoir via the highest case drain port. Use the line size which is appropriate for the port.
- ▶ A check valve in the reservoir line is not permissible.
- ▶ To achieve favorable noise values, decouple all connecting lines from all vibration-capable components (e.g. reservoir) using elastic elements.



- ▶ Make sure that the suction, reservoir and return lines lead into the reservoir below the minimum fluid level in all operating conditions. This will prevent air from being drawn in and foam from being formed.

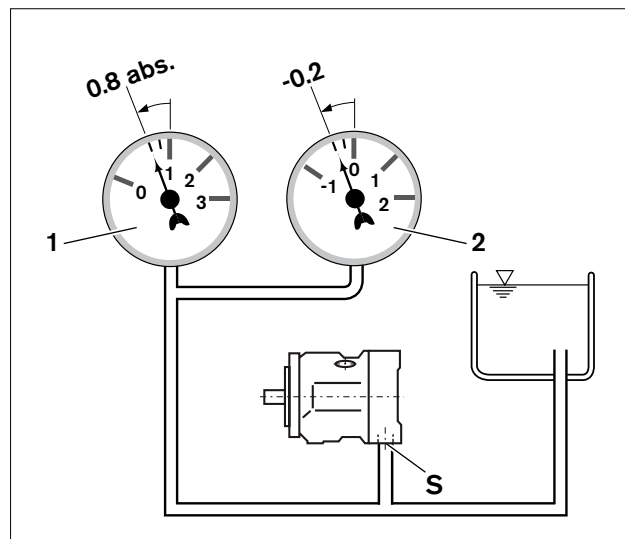


Fig. 6: Suction pressure

- 1 Absolute pressure gage
- 2 Standard pressure gage

- ▶ Make sure that a minimum suction pressure of 0.8 bar absolute is present at port **S** during operation for all installation positions and installation locations of the axial piston pump; see Fig. 6. See data sheet for pressure values.



The suction conditions improve with below- and inside-reservoir installation.

- ▶ Make sure that the working environment at the installation site is fully free of dust and foreign substances. The axial piston unit must be installed in a clean condition. Dirt contamination in the hydraulic fluid can seriously impair the function and service life of the axial piston unit.
- ▶ Use lint-free cloths for cleaning.
- ▶ Use suitable mild detergents to remove lubricants and other difficult-to-remove contamination. Cleaning agents must not enter the hydraulic system.

### 7.3 Installation position

The following installation positions are permissible. The shown piping layout illustrates the basic layout.

## Installation

## 7.3.1 Below-reservoir installation (standard)

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



Recommended installation positions: 1 and 3.

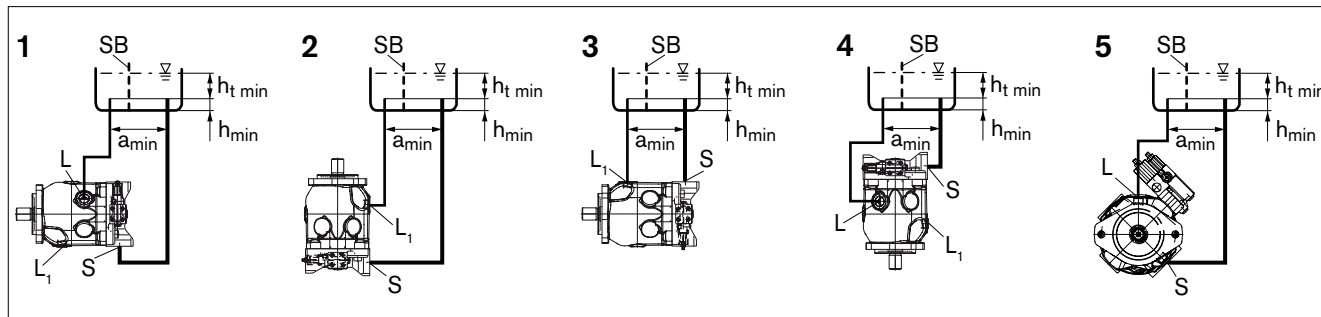


Fig. 7: Below-reservoir installation A10VO/A10VSO with installation position 1–5

<b>L, L<sub>1</sub></b>	Highest case drain port	<b>h<sub>min</sub></b>	Minimum required spacing to reservoir bottom (100 mm)
<b>S</b>	Suction port	<b>a<sub>min</sub></b>	When designing the reservoir, ensure adequate space between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.
<b>SB</b>	Baffle (baffle plate)		
<b>h<sub>t min</sub></b>	Minimum required immersion depth (200 mm)		

Table 8: Below-reservoir installation

Installation Position	Air bleed	Filling
1 (drive shaft, horizontal)	L	S + L
2 (drive shaft vertically upward)	L <sub>1</sub>	S + L <sub>1</sub>
3 (drive shaft, horizontal)	L <sub>1</sub>	S + L <sub>1</sub>
4 (drive shaft, vertically downward)	L	S + L
5 (drive shaft, horizontal) <sup>1)</sup>	L	S + L

<sup>1)</sup> Equivalent to installation position 1, but with mounting flange turned through 45° (2-hole mounting flange horizontal)

## 7.3.2 Inside-reservoir installation

## ! CAUTION

### Risk of damage with inside-reservoir installation!

To prevent damage to the axial piston unit, all plastic parts (e.g. protective plugs, covers) must be removed prior to installation in the reservoir.

- ▶ Remove all plastic parts before installing the axial piston unit in the reservoir. Make sure that no pieces of these parts remain in the reservoir.
- ▶ Remove the protective plug from the suction port **S** and open at least one **L** port.

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.

If the minimum fluid level is equal to or below the upper edge of the pump, see chapter 7.3.3 "Above-reservoir installation".



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



Our advice is to fit a suction pipe to the suction port **S** and to fit a pipe to case drain port **L** or **L<sub>1</sub>**. In such cases, the other case drain port must be plugged. The axial piston unit case must be filled before fitting the piping and filling the reservoir with hydraulic fluid.

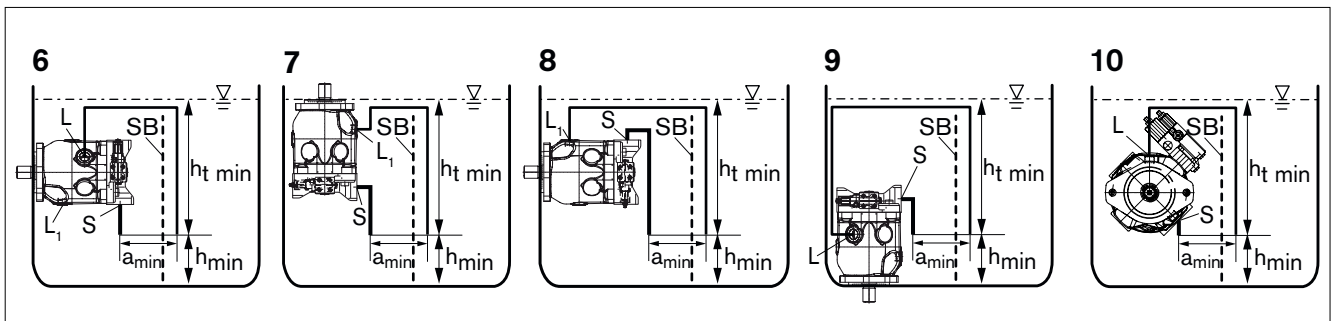


Fig. 8: Inside-reservoir installation A10VO/A10VSO with installation position 6–10

- |                          |   |                        |  |
|--------------------------|---|------------------------|--|
| <b>L, L<sub>1</sub></b>  | Highest case drain port                   | <b>h<sub>min</sub></b> | Minimum required spacing to reservoir bottom (100 mm)  |
| <b>S</b>                 | Suction port                              | <b>a<sub>min</sub></b> | When designing the reservoir, ensure adequate space between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line. |
| <b>SB</b>                | Baffle (baffle plate)                     |                        |  |
| <b>h<sub>t min</sub></b> | Minimum required immersion depth (200 mm) |                        |  |

Table 9: Inside-reservoir installation

Installation position	Air bleed	Filling
6 (drive shaft, horizontal)	L	L
7 (drive shaft vertically upward)	L <sub>1</sub>	L <sub>1</sub> + S
8 (drive shaft, horizontal)	L <sub>1</sub>	L <sub>1</sub> + S
9 (drive shaft, vertically downward)	L	L + S
10 (drive shaft, horizontal) <sup>1)</sup>	L	L

<sup>1)</sup>Equivalent to installation position 6, but with mounting flange turned through 45° (2-hole mounting flange horizontal)

Installation

7.3.3 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. The permissible suction height  $h_s$  is derived from the total pressure loss.

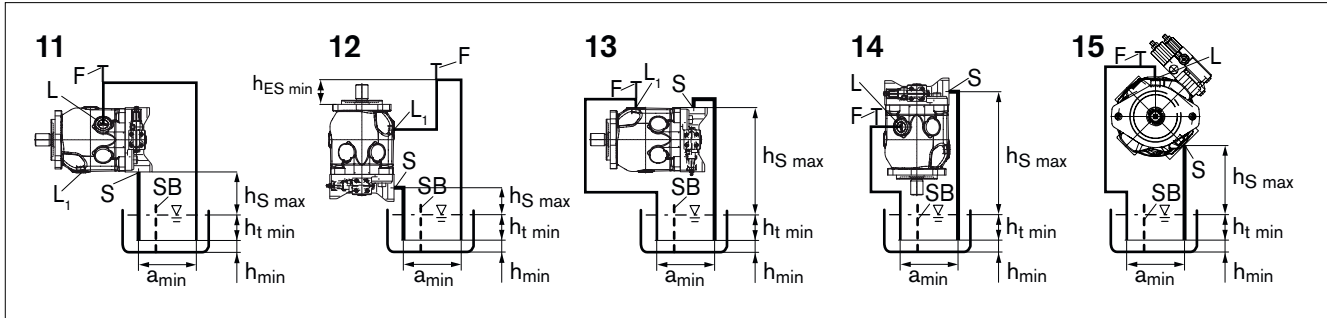


Fig. 9: Above-reservoir installation A10VO/A10VSO with installation position 11–15

<b>L, L<sub>1</sub></b>	Highest case drain port	<b>h<sub>min</sub></b>	Minimum required spacing to reservoir bottom (100 mm)
<b>F</b>	Air bleed and filling port	<b>h<sub>ES min</sub></b>	Minimum necessary height to provide protection against the axial piston unit running dry (25 mm)
<b>S</b>	Suction port	<b>a<sub>min</sub></b>	When designing the reservoir, ensure adequate space between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.
<b>SB</b>	Baffle (baffle plate)		
<b>h<sub>S max</sub></b>	Maximum permissible suction height		
<b>h<sub>t min</sub></b>	Minimum required immersion depth (200 mm)		

Table 10: Above-reservoir installation

Installation position	Air bleed	Filling
11 (drive shaft, horizontal)	F	L (F)
12 (drive shaft vertically upward)	F	L <sub>1</sub> (F)
13 (drive shaft, horizontal)	F	L <sub>1</sub> (F)
14 (drive shaft, vertically downward)	F	L (F)
15 (drive shaft, horizontal) <sup>1)</sup>	F	L (F)

<sup>1)</sup> Equivalent to installation position 11, but with mounting flange turned through 45° (2-hole mounting flange horizontal)

7.4 Installing the axial piston unit

7.4.1 Preparation

1. Compare the material number and designation (ordering code) with the details in the order confirmation.



If the material number for the axial piston unit does not correspond to the one in the order confirmation, contact Bosch Rexroth Service for clarification, see chapter 10.5 "Spare parts" for address.

2. Before installation, completely empty the axial piston unit to prevent mixing with the hydraulic fluid used in the machine/system.

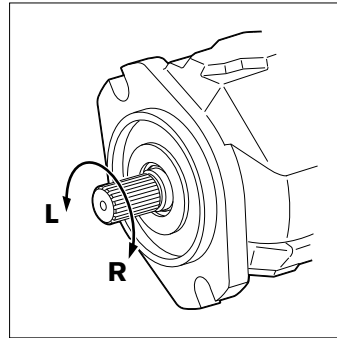


Fig. 10: Direction of rotation

- L Counter-clockwise  
R Clockwise

3. Check the direction of rotation of the axial piston unit (on the name plate) and make sure that this corresponds to the direction of rotation of the engine.



The direction of rotation as specified on the name plate, see chapter 5.3 "Identification of the product", is the direction of rotation of the axial piston unit as viewed to the drive shaft. For information on the direction of rotation of the engine, please refer to the engine manufacturer's operating instructions.

#### 7.4.2 Dimensions

The installation drawing contains the dimensions for all connections and ports on the axial piston unit. Also observe the manuals provided by the manufacturers of the other hydraulic components when selecting the required tools.

#### 7.4.3 General instructions

Please keep in mind the following general instructions for installation of the axial piston unit:

- Note that you can expect certain installation positions to affect the control device. Gravity, unit weight and case pressure can cause minor shifts in control characteristics and changes in response time.
- After a short operating time, toothed belts lose a major portion of their pre-tension and thus cause speed variations and torsional vibrations. Torsional vibrations may cause leakages on the shaft seal or increased rotary angle accelerations of the rotary group of the axial piston unit. Particularly at risk are diesel drives with a small number of cylinders and low flywheel mass.
- V-belt drives without automatic clamber are also critical with regard to speed variations and torsional vibrations. These can also lead to leakages on the shaft seal ring.  
An automatic clamber can lessen the speed variations and vibrations and thus avoid consequential damage.
  - Always use an automatic tensioning device when using toothed belts or V-belts to transfer the input or output drive.

## Installation

- On the input or output drive of an axial piston unit, a cardan shaft may cause vibrations and impermissible rotary angle accelerations. Depending on the frequency and temperature, they may result in leakage on the shaft seal and damage to the rotary group.
- For combinations of multiple units, make sure that the respective case pressure in each unit 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.

How to install the axial piston unit depends on the connecting elements to the drive side. The following descriptions explain the installation of the axial piston unit:

- with a coupling
- on a gearbox

### 7.4.4 Installation with coupling

The method for installing the axial piston unit with a coupling is described below:

**NOTE!** Danger from improper handling!

Product can be damaged!

- ▶ Do not install the coupling hub onto the drive shaft of the axial piston unit by striking it.
1. Install the specified coupling half onto the drive shaft of the axial piston unit according to the instructions of the coupling manufacturer.



The drive shaft of the axial piston unit is equipped with a threaded bore. Use this threaded bore to pull the coupling element onto the drive shaft. The size of the threaded bore can be seen in the installation drawing.

2. Remove dirt and contaminants from the installation location.
3. Clamp the coupling hub onto the drive shaft or ensure permanent lubrication of the drive shaft. This prevents the formation of frictional corrosion and the associated wear.
4. Transport the axial piston unit to the installation location.
5. Install the coupling on the drive shaft of the machine/system in accordance with the specifications provided by the coupling manufacturer.



The axial piston unit may not be bolted down until the coupling has been correctly installed.

6. Fix the axial piston unit at the installation location.
7. Align the drive shaft of the axial piston unit and the drive shaft of the machine or system so that there is no angular deviation.
8. Make sure that no impermissible axial and radial forces act on the drive shaft.
9. For bell housing installation, check the coupling axial play through the bell window according to the manufacturer's instructions.

10. Details on the required tools and tightening torques for the fixing screws are available from the machine/system manufacturer.
11. When using flexible couplings, check that the output drive is free of resonance after completing the installation.

#### 7.4.5 Installation on a gearbox

The installation layout for the axial piston unit on a gearbox is described below. After installing on a gearbox, the axial piston unit is covered and is difficult to access:

- ▶ Therefore, before installing, make sure that the centering spigot centers the axial piston unit (observe tolerances) and that no impermissible axial or radial forces act on the drive shaft of the axial piston unit (installation length).
- ▶ Protect the drive shaft against frictional corrosion by providing permanent lubrication.
- ▶ Fix the axial piston unit at the installation location.

#### For attachment via gear wheel or helically-toothed shaft

No gearing forces higher than the permissible axial and radial forces are to act on the shaft, if necessary the gear wheel must be supported separately at the gearbox output.

#### 7.4.6 Installation with cardan shaft

To connect the axial piston unit to the engine via a cardan shaft:

1. Position the axial piston unit close to the specified installation location. It should allow enough space for the cardan shaft to fit through on both sides.
2. Position the cardan shaft on the output shaft of the engine.
3. Push the axial piston unit to the cardan shaft and join the cardan shaft to the drive shaft of the axial piston unit.
4. Bring the axial piston unit to the installation position and secure. Details on the required tools and breakaway torques for the fixing screws can be obtained from the system manufacturer if required.

#### 7.4.7 Completing installation

1. Remove any mounted transport screws.

#### **CAUTION!** Operation with protective plug!

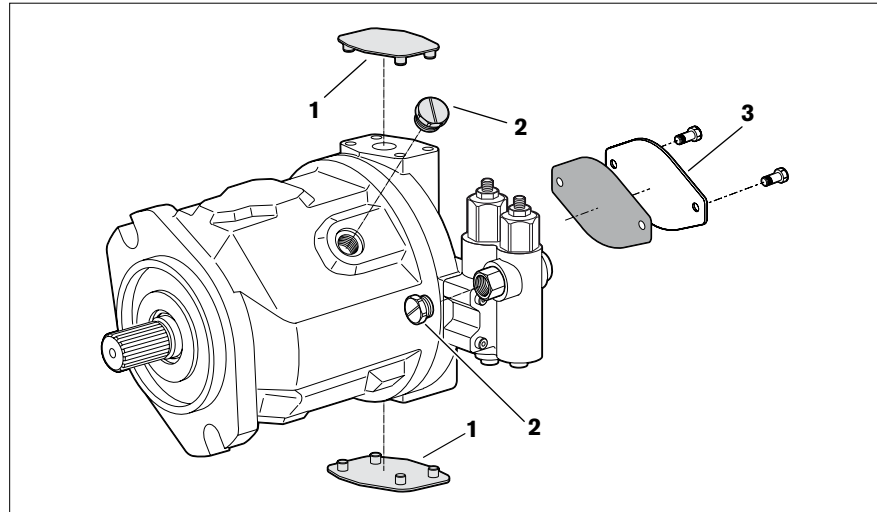
Operating the axial piston unit with protective plugs may result in injuries or damage to the axial piston unit.

- ▶ Before commissioning, remove all protective plugs and replace them with suitable, pressure-proof, metal threaded plugs.

2. Remove the transport protection.

The axial piston unit is delivered with protective covers (1) and protective plug (2). They are not pressure-resistant, therefore they have to be removed prior to connection. Use a suitable tool for this to prevent damage to the sealing and functional surfaces. If sealing or functional surfaces are damaged, contact your responsible Bosch Rexroth Service partner or the service department of the manufacturer's plant for the axial piston unit.

## Installation



**Fig. 11: Removing transport protection**

- |  |   |
|--|---|
| <p><b>1</b> Protective covers made of plastic (metallic protective covers are used for painted axial piston units)</p> | <p><b>2</b> Protective plug/threaded plug</p>   |
|  | <p><b>3</b> On version with through drive, metallic protective cover and fixing screws at the through drive</p> |



Ports intended for connecting lines are covered by protective plugs or threaded plugs, which serve as transport protection. All ports required for functional operation must be connected (see table 11 "Ports A10VO/A10VSO Series 31"). If this requirement is disregarded, malfunction or damage may result. If a port is not connected, it must be plugged with a threaded plug because protective plugs are not pressure-resistant.

Changing the setting of the adjusting screw will void the warranty. If you need to change the setting, please contact your responsible Bosch Rexroth Service partner (address as to chapter 10.5 "Spare parts").

- 3.** For versions with through drive, install the auxiliary pump according to the pump manufacturer's instructions. The metallic protective cover (**3**) is not pressure-resistant and thus not permissible in operation.



### 7.4.8 Hydraulically connecting the axial piston unit

## NOTE

### Insufficient suction pressure!

Generally, a minimum permissible suction pressure at port **S** is specified for axial piston pumps in all installation positions. If the pressure at port **S** drops below the specified values, damage may occur which may lead to the axial piston pump being damaged beyond repair!

- ▶ Make sure that the necessary suction pressure is not undercut. This is influenced by:
  - the piping (e.g. suction cross-section, pipe diameter, length of suction line)
  - the position of the reservoir
  - the viscosity of the hydraulic fluid
  - if fitted, a filter cartridge or check valve in the suction line (regularly check the level of soiling of the filter cartridge)

The machine/system manufacturer is responsible for dimensioning the lines. The axial piston unit must be connected to the rest of the hydraulic system in accordance with the hydraulic circuit diagram of the machine/system manufacturer.

The ports and fixing threads are designed for the maximum pressure specified in the data sheet. The machine/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.



Connect only hydraulic lines that are appropriate for the axial piston unit port (pressure level, size, system of units).

### Notes on routing the lines

Observe the following notes when routing the suction, pressure and reservoir lines.

- Lines and hoses must be installed without pre-charge pressure, so that no further mechanical forces are applied during operation that will reduce the service life of the axial piston unit and, if applicable, the entire machine/system.
- Use suitable seals as sealing material.
- Suction line (pipe or hose)
  - The suction line should be as short and straight as possible.
  - Measure the line cross section of the suction line so that the pressure at the suction port does not drop below the minimum permissible pressure. Make sure that the maximum suction pressure is not exceeded (e.g. when pre-filling).
  - Make sure the connections and connecting elements are air-tight.
  - The hose must be pressure-resistant, also for external air pressure.
- Pressure line
  - For the pressure lines, use only pipes, hoses and connecting elements rated for the operating pressure range specified in data sheets RE 92701 and RE 92711 (see Table 11).

## Installation

- Drain line
  - Always route the reservoir lines so that the case is constantly filled with hydraulic fluid and to ensure that no air gets through the shaft seal even during extended standstill periods.
  - The case internal pressure must not exceed the limit values listed for the axial piston unit in the data sheet under any operating conditions.
  - The reservoir line joint in the reservoir must always be below the minimum fluid level under all conditions (see chapter 7.3 "Installation position").

### Risk of mix-ups with threaded connections

The axial piston units are used in application areas with both metric and Anglo-American (inch) systems of units.

The system of units and the size of the female thread and threaded plug (e.g. locking screw) must match.

Due to the limited options for visually detecting differences, there is a risk of mix-ups.

#### **WARNING!** Leaking or popped-out threaded plugs!

If a threaded plug which is of a different measurement system and size with respect to the female thread is pressurized, the threaded plug may loosen itself or even be ejected from the hole in a projectile-like manner. This can result in serious injury and damage to equipment. Hydraulic fluid can be discharged from this leakage point.

- ▶ Use the drawings (installation drawing/data sheet) to determine the required threaded plug for each fitting.
- ▶ Make sure that there are no mix-ups when installing fittings, fixing screws and threaded plugs.
- ▶ For all female threads, use a threaded plug from the same system of units and of the correct size.

### Port overview

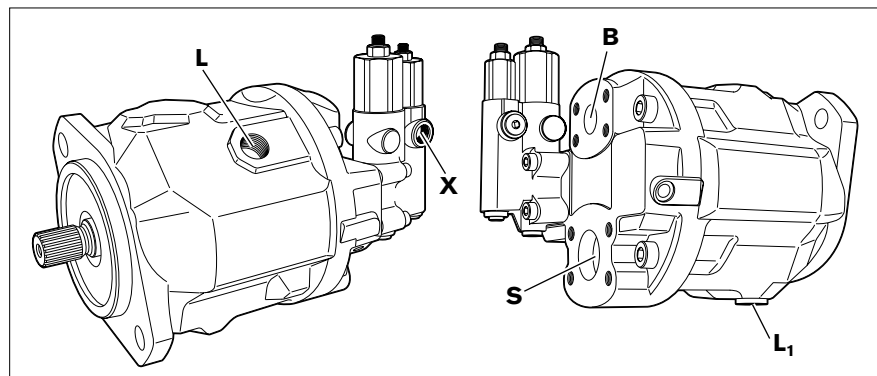


Fig. 12: Port overview A10VO Series 31, SAE flange ports at rear

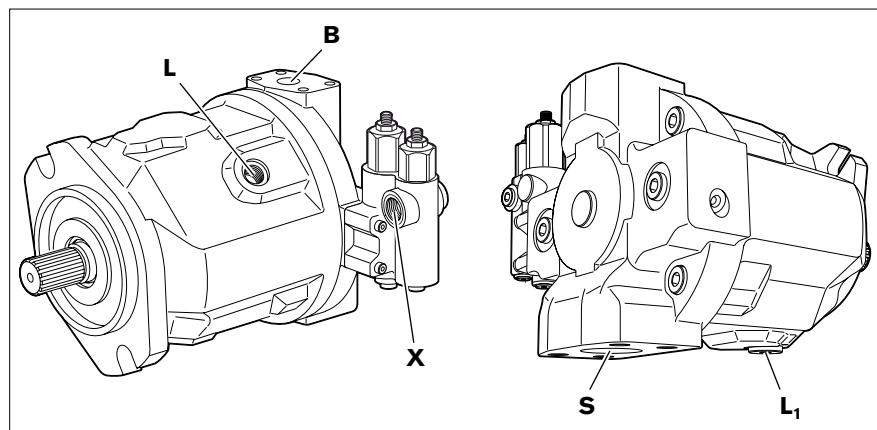


Fig. 13: Port overview A10VO/A10VSO Series 31, SAE flange ports at top, opposite at bottom

Table 11: Ports A10VO/A10VSO Series 31

Designation	Port for	Standard	Maximum pressure [bar] <sup>1)</sup>	State
<b>B</b>	Service line Fixing threads	SAE J518 <sup>2)</sup> DIN 13	350	O
<b>S</b>	Suction line Fixing threads	SAE J518 <sup>2)</sup> DIN 13	10	O
<b>L</b>	Reservoir line (case drain fluid)	DIN 3852 <sup>3)</sup>	2	O <sup>4)</sup>
<b>L<sub>1</sub></b> <sup>5)</sup>	Reservoir line (case drain fluid)	DIN 3852 <sup>3)</sup>	2	X <sup>4)</sup>
<b>L<sub>1</sub></b> <sup>6)</sup>	Reservoir line (case drain fluid)	ISO 11926 <sup>3)</sup>	2	X <sup>4)</sup>
<b>X</b>	Pilot pressure DRG, DFR/ DFR1, DFLR	DIN 3852 <sup>3)</sup>	350	O
<b>X</b>	Pilot pressure at DG control	DIN 3852 <sup>3)</sup>	350	O

<sup>1)</sup> Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings. Pressure data in bar absolute.

<sup>2)</sup> Metric fixing thread, deviating from standard.

<sup>3)</sup> The countersink may be deeper than specified in the standard.

<sup>4)</sup> Depending on the installation position, L or L<sub>1</sub> must be connected.

<sup>5)</sup> Valid for A10VSO.

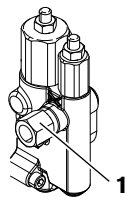
<sup>6)</sup> Valid for A10VO.

O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

### Connect line to pilot pressure port with adapter

Please comply with the following information for the version with adapter (concerns controller DRG, DFR/DFR1, DFLR).



- ▶ When connecting and tightening the connection line to the pilot pressure port **X**, the adapter (**1**) must be secured with a tightening torque of 20 Nm (WAF 19). The maximum permissible tightening torque of 45 Nm in the female thread of the adapter (M14 x 1.5, 12 deep) must not be exceeded.

If the adapter (**1**) is unscrewed from the pilot pressure port **X** and then screwed back in again, it must be tightened with a tightening torque of 23+2.5 Nm.



For the version without adapter, the pilot pressure port **X** has an ISO 11926 thread of size 7/16-20 UNF-2B; 11.5 deep.

### Tightening torques

The following tightening torques apply:

- Threaded hole of 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.
- Fittings:  
Observe the manufacturer's instructions regarding the tightening torques of the fittings used.
- Fixing screws:  
For fixing screws with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque in individual cases as per VDI 2230.
- 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.

Installation

Table 12: Tightening torques for the female threads and threaded plugs

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 for the threaded plugs
ISO 11926	7/16-20 UNF-2B	40 Nm	18 Nm	3/6 in
	7/8-14 UNF-2B	240 Nm	110 Nm	3/8 in
	1 1/16-12 UN-2B	360 Nm	170 Nm	9/16 in
DIN 3852 <sup>1)</sup>	M14 x 1.5	80 Nm	35 Nm	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M27 x 2	330 Nm	135 Nm	12 mm
DIN ISO 228	G 1/4 in	70 Nm	-	-

<sup>1)</sup> The tightening torques of the threaded plugs MV are valid for the delivery condition "dry" and for installation related screw condition "lightly oiled".

**Procedure** To connect the axial piston unit to the hydraulic system:

1. Remove the threaded plugs at the ports at which the connections are to be made according to the hydraulic circuit diagram.
2. Make sure that the sealing surfaces of the hydraulic ports and functional surfaces are not damaged.
3. Use only clean hydraulic lines or flush them before installation. (Observe chapter 7.5 "Performing flushing cycle" when you flush the entire system.)
4. Connect the lines in accordance with the installation drawing and the machine or system circuit diagram. Check whether all ports are piped up or plugged with threaded plugs. With inside-reservoir installation, the axial piston unit case must be filled before fitting the piping and filling the reservoir with hydraulic fluid.
5. Correctly tighten the union nuts for the fittings and flanges (observe tightening torques). Mark all correctly tightened fittings, e.g. with a permanent marker.
6. Check all pipes and hose lines and every combination of connecting pieces, couplings or connecting points with hoses or pipes to ensure they are in condition for safe working.

7.4.9 Electrically connecting the axial piston unit

<b>NOTE</b>
<p><b>Short circuit in event of penetrating hydraulic fluid!</b>                  Fluid can penetrate the product and cause a short circuit!</p> <ul style="list-style-type: none"> <li>▶ Do not install axial piston units with electric components (e.g. electric controls, sensors) in a reservoir below the fluid level (inside-reservoir installation).</li> </ul>

The machine/system manufacturer is responsible for the layout of the electric control.

Electrically controlled axial piston units must be connected in accordance with the electrical circuit diagram for the machine/system.

For axial piston units with electrical control and/or mounted sensors, please comply with the details given in data sheets RE 92701 and RE 92711, e.g.:

- the permissible voltage range
- the permissible current
- correct connection
- the recommended electrical control units

Exact details on the connector, type of protection and matching mating connector can also be found in data sheets RE 92701 and RE 92711. The mating connector is not included in the delivery contents.

1. Switch off power supply to the relevant system component.
2. Electrically connect the axial piston unit (12 or 24V). Before connection, check that the connector including all seals are intact.

## 7.5 Performing flushing cycle

In order to remove foreign particles from the system, Bosch Rexroth recommends a flushing cycle for the entire system. To avoid internal contamination, the axial piston unit must not be included in the flushing cycle.



The flushing cycle must be performed with an additional flushing unit. Follow the instructions of the flushing unit's manufacturer for the exact procedure during the flushing cycle.

## 8 Commissioning

### WARNING

#### **Danger while working in the danger zone of a machine/system!**

Danger to life, risk of injury or serious injuries!

- ▶ Pay attention to and rectify potential danger sources before operating the axial piston unit.
- ▶ Nobody may stand in the danger zone of the machine/system.
- ▶ The emergency stop button for the machine/system must be within the operator's reach.
- ▶ Always follow the instructions of the machine/system manufacturer during commissioning.

### CAUTION

#### **Commissioning of an incorrectly installed product!**

Risk of injury and damage to equipment!

You can injure yourself on incorrectly installed products or damage the product.

- ▶ Make sure that all electrical and hydraulic ports are connected or plugged.
- ▶ Only commission a completely installed product.

### 8.1 First commissioning



During all work for commissioning the axial piston unit, observe the general safety instructions and intended use in chapter 2 "Safety instructions".

- ▶ Connect the gage for the operating pressure, case pressure and suction pressure to the specified measuring points on the axial piston unit or in the hydraulic system, to check the technical data at first operation.
- ▶ During the commissioning process, monitor the temperature of the hydraulic fluid in the reservoir to ensure that it lies within the permissible viscosity limits.

#### 8.1.1 Filling the axial piston unit

Professional filling and air bleeding is necessary to prevent damage to the axial piston unit and to maintain correct function.



The axial piston unit should be filled with a filling unit (10  $\mu\text{m}$  filter grade). The axial piston unit must not be operated while it is being filled by the filling unit.

Use only a hydraulic fluid that conforms to the following requirements:

You can find details of the minimum requirements on hydraulic fluids in Bosch Rexroth data sheets RE 90220, RE 90221 and RE 90223. You can find the title of the data sheets in table 1 "Required and supplementary documentation". You can find details of permissible and optimal viscosity in data sheets RE 92701 and RE 92711.

To ensure the functional reliability of the axial piston unit, cleanliness level 20/18/15 according to at least ISO 4406 is necessary for the hydraulic fluid. 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. For permissible temperatures, see data sheets RE 92701 and RE 92711.

1. Place a drip tray under the axial piston unit to collect any hydraulic fluid that may escape.

**NOTE!** Contaminated hydraulic fluid!

The cleanliness levels of hydraulic fluids on delivery do not normally conform to the requirements for our components.

- ▶ Use a suitable filter system to filter hydraulic fluids during filling to minimize solid impurities and water in the hydraulic system.

2. Fill and air bleed the axial piston unit via the appropriate ports, see chapter 7.3 "Installation position". The hydraulic lines of the system must also be filled.

**NOTE!** Damage to equipment due to improper lubrication!

Product can be damaged or destroyed!

- ▶ When using a shut-off valve in the suction and/or reservoir line, make sure that the input of the axial piston unit can only be started when the shut-off valves are open.

3. When using a shut-off valve in the suction and/or reservoir line, only operate the axial piston unit when the shut-off valves are open.
4. Test the direction of rotation of the engine. To do this, rotate the engine briefly at the lowest rotational speed (inching). Make sure that direction of rotation of the axial piston unit matches the details on the name plate, see also chapter 5.3 "Product identification", Fig. 3: Name plate.
5. Operate the axial piston pump at a lower speed (starter speed for internal combustion engines or inching operation for electric motors) until the hydraulic system is completely filled and bled. To inspect, drain the hydraulic fluid at the reservoir port and wait until it drains without bubbles.

### 8.1.2 Testing the hydraulic fluid supply

The axial piston unit must always have a sufficient supply of hydraulic fluid. For this reason, the supply of hydraulic fluid must be ensured at the start of the commissioning process.

When you test the hydraulic fluid supply, constantly monitor the noise development and check the hydraulic fluid level in the reservoir. If the axial piston unit becomes louder (cavitation) or the case drain fluid is discharged with bubbles, this is an indication that the axial piston unit is not being sufficiently supplied with hydraulic fluid.

Notes on troubleshooting can be found in chapter 14 "Troubleshooting".

To test the hydraulic fluid supply:

1. Allow the engine to run at the lowest speed. The axial piston unit must be operated without load. Pay attention to leakage and noise.
2. Check the axial piston unit's reservoir line during the test. The case drain fluid should not contain any bubbles.
3. Increase the load and check whether the operating pressure rises as expected.
4. Carry out a leak test to ensure that the hydraulic system is sealed and can withstand the maximum pressure.

## Commissioning

5. Check the suction pressure at port **S** of the axial piston pump at nominal speed and maximum swivel angle. Refer to data sheet RE 92701 and RE 92711 for the permissible value.
6. At maximum pressure, check the case drain pressure at port **L** or **L<sub>1</sub>**. Refer to data sheet RE 92701 and RE 92711 for the permissible value.

### 8.1.3 Performing functional test

#### **WARNING**

##### **Incorrectly connected axial piston unit!**

Mixing up the ports will lead to malfunctions (e.g. lift instead of lower) and thus to corresponding danger to persons and equipment!

- ▶ Before the functional test, check whether the piping specified in the hydraulic circuit diagram has been installed.

Once you have tested the hydraulic fluid supply, you must perform a functional test on the machine/system. The functional test should be performed according to the instructions of the machine/system manufacturer.

The axial piston unit is checked for functional capability before delivery according to the technical data. During commissioning, it must be ensured that the axial piston unit was installed properly in the machine/system.

- ▶ After starting the engine, check in particular the specified pressures, e.g. system pressure and case pressure.
- ▶ If necessary, disconnect the gage and plug the ports with threaded plugs.

## 8.2 Running-in phase

#### **NOTE**

##### **Damage to equipment by insufficient viscosity!**

An increased hydraulic fluid temperature may reduce the viscosity values by too much and damage the product!

- ▶ Monitor the operating temperature during the running-in phase, e.g. by measuring the case drain temperature.
- ▶ Reduce the loading (pressure, rpm) of the axial piston unit if impermissible operating temperatures and/or viscosities occur.
- ▶ Operating temperatures that are too high indicate faults that have to be analyzed and cleared.

The bearings and sliding surfaces are subject to a running-in phase. The increased friction at the start of the running-in phase results in increased heat development which decreases with increasing operating hours. The volumetric and mechanical-hydraulic efficiency increases as well through the conclusion of the running-in phase of approx. 10 operating hours.



To ensure that contamination in the hydraulic system does not damage the axial piston unit, Bosch Rexroth recommends the following procedure after the running-in phase:

- ▶ After the running-in phase, have a hydraulic fluid specimen analyzed for the required cleanliness level.
- ▶ Change the hydraulic fluid if the required cleanliness level is not reached. If a laboratory test is not carried out after the running-in phase, Bosch Rexroth recommends the hydraulic fluid be changed.

### 8.3 Recommissioning after standstill

Depending on the installation conditions and ambient conditions, changes may occur in the hydraulic system which make recommissioning necessary.

Among others, the following criteria may make recommissioning necessary:

- Air and/or water in the hydraulic system
  - Old hydraulic fluid
  - Other contamination
- ▶ Before recommissioning, proceed as described in chapter 8.1 "First commissioning".

## 9 Operation

The product is a component which requires no settings or changes during operation. For this reason, this chapter of the manual does not contain any information on adjustment options. Use the product only within the performance range provided in the technical data. The machine/system manufacturer is responsible for the proper project planning of the hydraulic system and its control.

## 10 Maintenance and repair

### ***NOTE***

**Inspection and maintenance work carried out too late!**

Damage to equipment!

- ▶ Carry out the specified inspection and maintenance work at the intervals described in this manual.

### 10.1 Cleaning and care

### ***NOTE***

**Damage to seals and electrical system by mechanical effects!**

The water jet of a power washer may damage the seals and electrical system of the axial piston unit!

- ▶ Do not point the power washer at sensitive components, e.g. shaft seal, electrical connections and components.

For cleaning and care of the axial piston unit, observe the following:

- ▶ Check whether all seals and fittings on the connections are securely seated to ensure that no moisture can penetrate into the axial piston unit during cleaning.
- ▶ Use only water and, if necessary, a mild detergent to clean the axial piston unit. Never use solvents or aggressive detergents.
- ▶ Remove coarse external dirt and keep sensitive and important components, such as solenoids, valves, indicators and sensors, clean.

## 10.2 Inspection

In order to enable long and reliable operation of the axial piston unit, Bosch Rexroth recommends testing the hydraulic system and axial piston unit on a regular basis, and documenting and archiving the following operating conditions:

**Table 13: Inspection schedule**

Task to be carried out		Interval
Hydraulic system	Check level of hydraulic fluid in the reservoir.	Daily
	Check the operating temperature at a comparable load condition at the reservoir port and in the reservoir.	Weekly
	Conduct analysis of hydraulic fluid: viscosity, aging and dirt contamination	Yearly or every 2000 operating hours (whichever occurs first)
Axial piston unit	Check axial piston unit for leakage. Early detection of hydraulic fluid loss can help to find errors on the machine/system and to rectify them. For this reason, Bosch Rexroth recommends that the axial piston unit and system are always kept in a clean condition.	Daily
	Check axial piston unit for unusual noise development.	Daily
	Check fasteners for tight seating. All fasteners have to be checked when the hydraulic system is switched off, depressurized and cooled down.	Monthly

## 10.3 Maintenance

The axial piston unit is low maintenance when used properly.

The service life of the axial piston unit is heavily dependent on the quality of the hydraulic fluid. For this reason, we recommend changing the hydraulic fluid at least once per year or every 2000 operating hours (whichever occurs first) or having it analyzed by the hydraulic fluid manufacturer or a laboratory to determine its suitability for further use.

The service life of the axial piston unit is limited by the service life of the bearings fitted. The service life based on the load cycle can be requested from the responsible Bosch Rexroth Service partner, see chapter 10.5 "Spare parts" for address. Based on these details, a maintenance period is to be determined by the system manufacturer for the replacement of the bearings and included in the maintenance schedule of the hydraulic system.

## 10.4 Repair

Bosch Rexroth offers a comprehensive range of services for the repair of Rexroth axial piston units.

Repairs on the axial piston unit may only be performed by service centers certified by Bosch Rexroth.

- Use exclusively original spare parts from Rexroth to repair the Rexroth axial piston units, otherwise the functional reliability of the axial piston unit can not be assured and you lose your entitlement under warranty.

In the event of questions regarding repair, contact your responsible Bosch Rexroth Service partner or the service department of the manufacturer's plant for the axial piston unit, see chapter 10.5 "Spare parts" for further information.

## 10.5 Spare parts

### CAUTION

#### **Use of unsuitable spare parts!**

Spare parts that do not meet the technical requirements specified by Bosch Rexroth may cause personal injury or property damage!

- ▶ Use exclusively original spare parts from Rexroth to repair the Rexroth axial piston units, otherwise the functional reliability of the axial piston unit can not be assured and you lose your entitlement under warranty.

The spare parts lists for axial piston units are order specific. When ordering spare parts, quote the material and serial number of the axial piston unit as well as the material numbers of the spare parts.

Address all questions regarding spare parts to your responsible Bosch Rexroth Service partner or the service department of the manufacturer's plant for the axial piston unit.

Bosch Rexroth AG  
An den Kelterwiesen 14  
72160 Horb a.N., Germany  
Tel. +49 (0) 74 51-92-0  
Fax +49 (0) 711-811-513-93 82  
svm.support@boschrexroth.de

For the addresses of foreign subsidiaries, please refer to  
[www.boschrexroth.com/addresses](http://www.boschrexroth.com/addresses)

# 11 Removal and replacement

## 11.1 Required tools

Removal can be performed using standard tools. No special tools are necessary.

## 11.2 Preparing for removal

1. Decommission the entire system as described in the instruction manual for the machine or system.
  - Relieve pressure in the hydraulic system according to the instructions of the machine or system manufacturer.
  - Make sure that the relevant system components are not under pressure or voltage.
2. Protect the complete system against being energized.

## 11.3 Removing the axial piston unit

Proceed as follows to remove the axial piston unit:

1. Check whether the hydraulic system is depressurized.
2. Allow the axial piston unit to cool down until it can be removed without danger.
3. For below-reservoir installation, before removing the axial piston unit from the complete system, seal the connection to the reservoir or drain the reservoir.
4. Place a drip tray under the axial piston unit to collect any hydraulic fluid that may escape.
5. Loosen the lines and collect the escaping hydraulic fluid in the drip tray.
6. Remove the axial piston unit. Use a suitable lifting device.
7. Completely empty the axial piston unit.
8. Plug all openings.

## 11.4 Preparing the components for storage or further use

- ▶ Proceed as described in chapter "6.2 Storing the axial piston unit".

## 12 Disposal

Careless disposal of the axial piston unit, the hydraulic fluid and the packaging material could lead to pollution of the environment.

Observe the following points when disposing of the axial piston unit:

1. Completely empty the axial piston unit.
2. Dispose of the axial piston unit and packaging material in accordance with the national regulations in your country.
3. Dispose of the hydraulic fluid according to the national regulations of your country. Also observe the applicable safety data sheet for the hydraulic fluid.
4. Remove the axial piston unit into its individual parts and properly recycle these parts.
5. Separate according to, for instance:
  - Cast parts
  - Steel
  - Aluminum
  - Non-ferrous metal
  - Electronic waste
  - Plastic
  - Seals

## 13 Extension and conversion

Do not modify the axial piston unit. This also includes a modification of the adjusting screws.



The Bosch Rexroth warranty only applies for the delivered configuration. In case of conversion or extension, the entitlement under warranty will be rendered void.



Changing the setting of the adjusting screw will void the warranty. If you need to change the setting, please contact your responsible Bosch Rexroth Service partner (address as to chapter 10.5 "Spare parts").

## 14 Troubleshooting

The following table may assist you in troubleshooting. The table makes no claim for completeness.

In practical use, problems which are not listed here may also occur.

### 14.1 How to proceed for troubleshooting

- ▶ Always act systematically and purposefully, even under pressure of time. Random and imprudent removal and changing of settings could result in the inability to ascertain the original failure cause.
- ▶ First obtain a general overview of how your product works in conjunction with the entire system.
- ▶ Try to determine whether the product worked properly in conjunction with the entire system before the error occurred.
- ▶ Try to determine any changes of the entire system in which the product is integrated
  - Were there any changes to the product's application conditions or operating range?
  - Has maintenance work recently been carried out? Is there an inspection or maintenance log?
  - Were changes (e.g. conversions) or repairs made to the complete system (machine/system, electrics, control) or on the product? If yes, which?
  - Has the hydraulic fluid been changed?
  - Was the product or machine operated as intended?
  - How did the malfunction appear?
- ▶ Try to get a clear idea of the error cause. Directly ask the (machine) operator.
- ▶ Document the work carried out.
- ▶ If you cannot rectify the error, contact one of the contact addresses which can be found under:  
[www.boschrexroth.com/addresses](http://www.boschrexroth.com/addresses).



## 14.2 Malfunction table

Table 14: Axial piston unit malfunction table

Fault	Possible cause	Remedy	
Unusual noises	Drive speed too high.	Machine/system manufacturer.	
	Wrong direction of rotation.	Ensure correct direction of rotation.	
	Insufficient suction conditions, e.g. air in the suction line, insufficient diameter of the suction line, viscosity of the hydraulic fluid too high, suction height too high, suction pressure too low, contaminants in the suction line.		Machine or system manufacturer (e.g. optimize inlet conditions, use suitable hydraulic fluid).
			Completely air bleed axial piston unit, fill suction line with hydraulic fluid.
			Remove contaminants from the suction line.
	Improper fixing of the axial piston unit.	Check the fixing of the axial piston unit according to the specifications of the machine/system manufacturer. Observe tightening torques.	
	Improper fixing of the attachment parts, e.g. coupling and hydraulic lines.	Fix attachment parts according to the information provided by the coupling or fitting manufacturer.	
	Pressure relief valves on axial piston unit	Contact Bosch Rexroth Service.	
Mechanical damage to the axial piston unit (e.g. bearing damage).	Exchange axial piston unit, contact Bosch Rexroth Service.		
No or insufficient flow	Faulty mechanical drive (e.g. defective coupling).	Machine/system manufacturer.	
	Drive speed too low.	Machine/system manufacturer.	
	Insufficient suction conditions, e.g. air in the suction line, insufficient diameter of the suction line, viscosity of the hydraulic fluid too high, suction height too high, suction pressure too low, contaminants in the suction line.		Machine or system manufacturer (e.g. optimize inlet conditions, use suitable hydraulic fluid).
			Completely air bleed axial piston unit, fill suction line with hydraulic fluid.
			Remove contaminants from the suction line.
	Hydraulic fluid not in optimum viscosity range.	Use suitable hydraulic fluid (machine/system manufacturer).	
	External control of the control device defective.	Check external control (machine/system manufacturer).	
	Insufficient pilot pressure or control pressure.	Check pilot pressure or control pressure, contact Bosch Rexroth Service.	
	Malfunction of the control device or controller of the axial piston unit.	Contact Bosch Rexroth Service.	
	Wear of axial piston unit.	Exchange axial piston unit, contact Bosch Rexroth Service.	
Mechanical damage to the axial piston unit.	Exchange axial piston unit, contact Bosch Rexroth Service.		

## Troubleshooting

Table 14: Axial piston unit malfunction table

Fault	Possible cause	Remedy
No or insufficient pressure	Faulty mechanical drive (e.g. defective coupling).	Machine/system manufacturer.
	Drive power too low.	Machine/system manufacturer.
	Insufficient suction conditions, e.g. air in the suction line, insufficient diameter of the suction line, viscosity of the hydraulic fluid too high, suction height too high, suction pressure too low, contaminants in the suction line.	Machine or system manufacturer (e.g. optimize inlet conditions, use suitable hydraulic fluid).
		Completely air bleed axial piston unit, fill suction line with hydraulic fluid.
		Remove contaminants from the suction line.
	Hydraulic fluid not in optimum viscosity range.	Use suitable hydraulic fluid (machine/system manufacturer).
	External control of the control device defective.	Check external control (machine/system manufacturer).
	Insufficient pilot pressure or control pressure.	Check pilot pressure or control pressure, contact Bosch Rexroth Service.
	Malfunction of the control device or controller of the axial piston unit.	Contact Bosch Rexroth Service.
	Wear of axial piston unit.	Exchange axial piston unit, contact Bosch Rexroth Service.
	Mechanical damage to the axial piston unit (e.g. bearing damage).	Exchange axial piston unit, contact Bosch Rexroth Service.
	Output unit defective (e.g. hydraulic motor or cylinder).	Machine/system manufacturer.
Pressure/flow fluctuations	Axial piston unit not or insufficiently air bled.	Completely air bleed axial piston unit.
	Insufficient suction conditions, e.g. air in the suction line, insufficient diameter of the suction line, viscosity of the hydraulic fluid too high, suction height too high, suction pressure too low, contaminants in the suction line.	Machine or system manufacturer (e.g. optimize inlet conditions, use suitable hydraulic fluid).
		Completely air bleed axial piston unit, fill suction line with hydraulic fluid.
		Remove contaminants from the suction line.
Excessive hydraulic fluid temperature and case temperature	Excessive inlet temperature at the axial piston unit.	Machine or system manufacturer: inspect system, e.g malfunction of the cooler, insufficient hydraulic fluid in the reservoir.
	Malfunction of the pressure control valves (e.g. high-pressure relief valve, pressure cut-off, pressure controller).	Contact Bosch Rexroth Service.
	Wear of axial piston unit.	Exchange axial piston unit, contact Bosch Rexroth Service.
Instability/vibrations	Target value not stable.	Machine/system manufacturer.
	Resonance in the reservoir line.	Machine/system manufacturer.
	Malfunction of the control devices or the controller.	Contact Bosch Rexroth Service.

## 15 Technical data

The permissible values of the technical data of your axial piston unit can be found in data sheets RE 92701 and RE 92711.

The data sheets can be found on the internet at

[www.boschrexroth.com/various/utilities/mediadirectory/index.jsp?&language=en-GB](http://www.boschrexroth.com/various/utilities/mediadirectory/index.jsp?&language=en-GB)

Further information can be found in the online product catalog:

Mobile Hydraulics: [www.boschrexroth.com/axial-piston-pumps](http://www.boschrexroth.com/axial-piston-pumps)

Industrial Hydraulics: [www.boschrexroth.com/ics](http://www.boschrexroth.com/ics)

The order-related technical data of your axial piston unit can be found in the order confirmation.

## 16 Appendix

### 16.1 Address directory

For the addresses of foreign subsidiaries, please refer to [www.boschrexroth.com/addresses](http://www.boschrexroth.com/addresses)

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