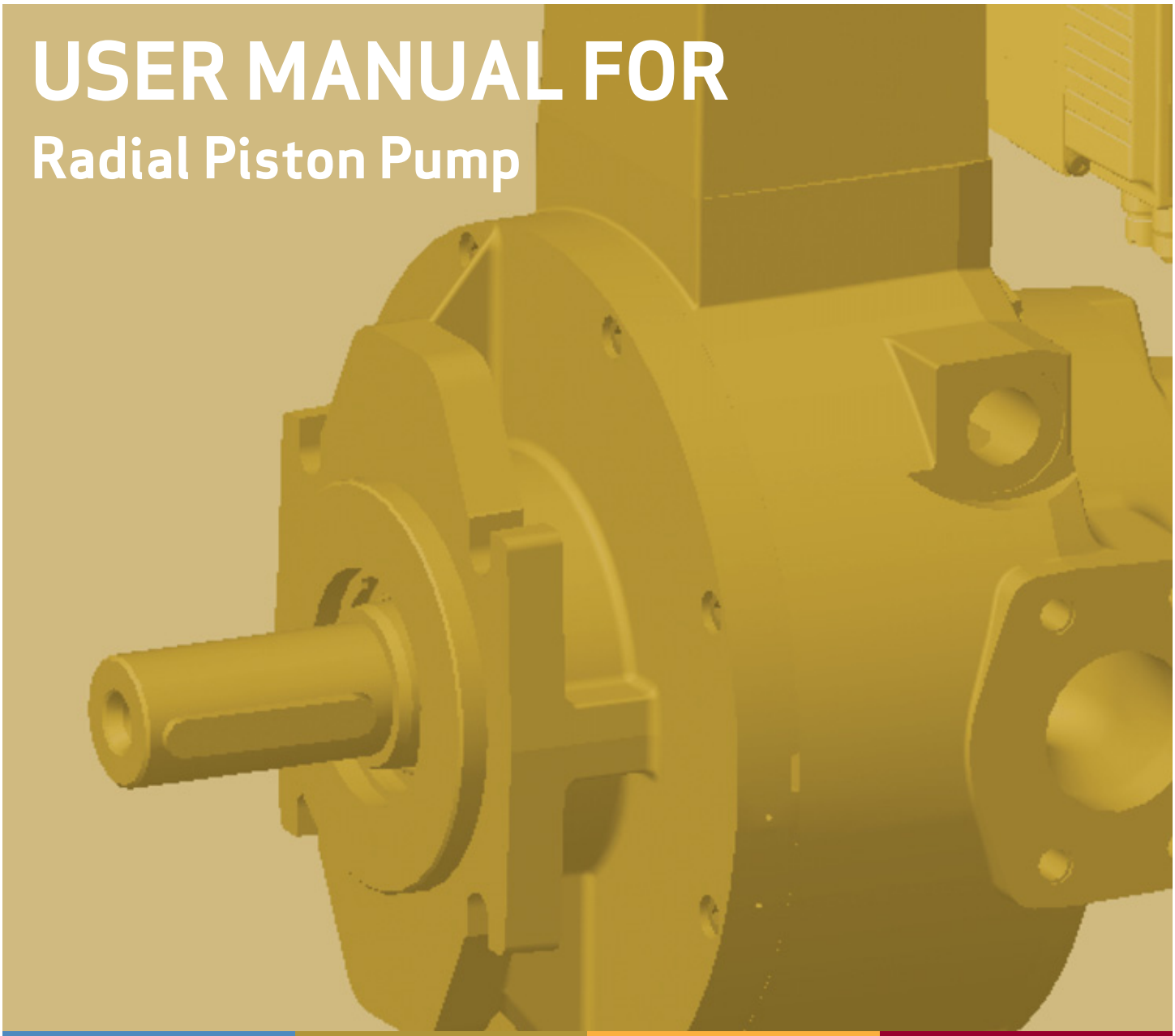
# USER MANUAL FOR

## Radial Piston Pump



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Subject to change without notice.

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# 1 General information

## 1.1 Information on the User Manual

**Information on the User Manual**

This User Manual refers solely to the radial piston pumps in the RKP series and is an integral part of the product. It describes the intended use and safe application of the product in all phases of operation.

### 1.1.1 Target Groups

#### 1.1.1.1 Operator

**Target Group: Operator**

Among other things, the operator must ensure that the trained staff working with the radial piston pump have read the User Manual and its supplemental documentation, and that it is observed accordingly, especially the relative safety and warning instructions.
⇨ Chap. "1.4 Responsibilities", Page 12

#### 1.1.1.2 Trained Staff

**Target Group: Trained Staff**

The trained staff must read the User Manual and its important supplemental documentation and must observe and follow the instructions, especially the respective safety and warning instructions.

### 1.1.2 Subject to Change and Validity

**Subject to Change and Validity of User Manual**

The information in this User Manual is valid as of the date this version of the User Manual is released. Version number and release date of this User Manual are noted in the footer.
This User Manual is subject to change at any time and such changes may be made without justification.

### 1.1.3 Completeness

**Completeness of User Manual**

The User Manual is only complete along with the supplemental documentation relevant for each particular application.
⇨ Chap. "1.2 Supplemental Documentation", Page 10

### 1.1.4 Storage Location

**Storage Location for User Manual**

This User Manual and any and all relevant supplemental documentation for each respective application must always be kept safely in an easily accessible location and be available at all times in the vicinity of the radial piston pump or close to the higher-level machinery with which the pump is associated.

## 1.1.5 Warning Labels

**Warning Labels**

**DANGER**

Warns about an imminent danger to health and life. Failure to observe this warning can result in severe injuries or even death.

- Make absolutely sure to heed the measures described to prevent this danger.

**WARNING**

Warns about a possible situation dangerous to health. Failure to observe this warning can result in severe injuries or even death.

- Make absolutely sure to heed the measures described to prevent this danger.

**CAUTION**

Warns about a possible situation dangerous to health. Failure to observe this warning can cause slight injuries.

- Make absolutely sure to heed the measures described to prevent this danger.

**NOTICE**

Failure to observe this safety notice can result in property damage!

**Important**

Identifies important notes that contain usage tips and special useful information, but no warnings.

## 1.1.6 Symbols

**Symbols**

| | |
|---|---|
| • or - | Identifies listings |
| ⇨ | Identifies references to another chapter, another table or figure as well as supplemental documentation |
| 1., 2., … | Identifies steps in a procedure that must be performed in consecutive order |

# 1.2 Supplemental Documentation

**Supplemental Documentation**

The supplemental documentation listed here is an integral part of the scope of delivery.

| Supplemental Documentation | Description |
|---|---|
| Application Instruction RKP-D with CAN Bus Interface, CA58548-002 | Application Instruction for radial piston pumps with digital onboard electronics (if required, included in the scope of delivery) |
| Order Data Sheet/Bill of Delivery | Includes item numbers, item names, quantities |
| Electrical connections user manual, CA63420-002 | Safe electrical connection of valves/pumps in accordance with regulations |
| User Manual RKP Explosion-Proof, CA57626 | ATEX supplemental instructions in the event that the radial piston pump is suitable for operation in explosive areas (included in the scope of delivery of RKP Explosion-proof) |
| RKP for Fire-Resistant Fluids Catalog | Supplemental instructions for operation with low-flammability fluids (if required, included in the scope of delivery) |
| RKP Catalog | Ordering information, technical data and additional information relating to the RKP radial piston pump |
| RKP-D Catalog, CDL28622-de | Ordering information, technical data and additional information relating to the RKP radial piston pump with digital control |
| Mounting and Start Up Instructions RKP, CA57130 | Quick reference guide for the RKP radial piston pump, technical data (included in the scope of delivery) |
| RKP Firmware User Manual, B99224 | Description of the configurable parameters of the RKP-D with a CANopen interface |

Table 1: Supplemental Documentation

# 1.3 Environmental Protection

## 1.3.1 Emissions

**Environmental Protection: Emissions**

If operated properly according to instructions, no dangerous emissions will normally emanate from the radial piston pump.

## 1.3.2 Disposal

**Environmental Protection: Disposal**

When disposing of the radial piston pump, its spare parts or accessories, superfluous packaging material, hydraulic fluid or additives and substances needed for cleaning purposes, the respective country-specific waste disposal regulations as amended must be observed!
In some cases, the items to be disposed of must be disassembled professionally and be separated according to their materials and then be disposed of in the respective waste stream or recycling location accordingly.
⇨ Chap. "1.2 Supplemental Documentation", Page 10

Incorporated in the radial piston pumps are, among other things, the following substances or materials:

- Electronic components ⇨ Application Instruction RKP-D with CAN Bus Interface
  ⇨ Table 1, Page 10
- Adhesive and potting compounds
- Parts with galvanized surfaces
- Hydraulic fluid
- Various metals and plastics

# 1.4 Responsibilities

**Responsibility of the manufacturer and the operator of the machinery**

The manufacturer and the operator of the machinery are both responsible for ensuring that the planning and execution of the work performed with and to the radial piston pump as well as all interactions with the radial piston pump are carried out in accordance with the instructions given in this User Manual and in the relevant supplemental documentation for each respective application.
The manufacturer and the operator of the machinery are responsible in particular for the following:

- Staff selection and training
  ⇨ Chap. "2.2.2 Selecting and Qualifying -Staff", Page 18
- Intended use
  ⇨ Chap. "2.1 Intended Use", Page 15
- Safe operation
  ⇨ Chap. "2.2.1 Safe Operation", Page 17
- Taking the required work safety measures for the respective application and monitoring their implementation
  ⇨ Chap. "2.2.4 Work Safety", Page 19
- Observing the relevant manufacturer's safety standards and those of the operator of the machinery for each respective application
- Observing the relevant national and international regulations as well as the applicable standards and directives (e. g. EU Machinery Directive and the regulations by the Employer's Liability Association, TÜV or VDE) as amended in their current version when designing, assembling and operating the machinery with all the installed components.
- Installing a suitable safety system for limiting the pressure in the hydraulic connections
  ⇨ Chap. "2.3.2.1 Safety Devices for Limiting Pressure", Page 20
- Using only radial piston pumps that are in a technically flawless condition and safe for operation
- Preventing unauthorized or unprofessional structural modifications, repairs and maintenance work to be carried out
  ⇨ Chap. "2.2.3 Structural Modifications", Page 18
  ⇨ Chap. "10 Spare Parts, Accessories, Repairs", Page 78
- Defining and adhering to application specific inspection and servicing instructions
- Adhering to all technical data during storage, transport, assembly, disassembly, connecting, start-up, configuring, operating, cleaning, repairing or performing any troubleshooting, especially the ambient conditions as well as to the data of the hydraulic fluid in use.
- Proper storage, transport, assembly, disassembly, connection, start-up, configuration, operation, cleaning, repairing, performing any troubleshooting or disposal
- Providing ready access to this Manual and its storage location as well as the relevant supplemental documentation for each respective application.
  ⇨ Chap. "1.1.4 Storage Location", Page 8
- This User Manual and the relevant supplemental documentation for each respective application are to be added to the User Manual of the machinery.

# 1.5 Warranty and Liability

In principle, our general terms and conditions for delivery and payment apply. These shall be made available to the buyer no later than the time at which the sales contract is concluded.

**Limits to Warranty and Liability**

Among other things, warranty and liability claims for personal injury and damage to property are excluded if they are caused by one or more of the following:

- Work performed with and to the radial piston pump or handling the radial piston pump by users not qualified for the job
  ⇨ Chap. "2.2.2 Selecting and Qualifying -Staff", Page 18
- Improper use
  ⇨ Chap. "2.1 Intended Use", Page 15
- Unsafe operation
  ⇨ Chap. "2.2.1 Safe Operation", Page 17
- Failing to take the required work safety measures for the respective application
  ⇨ Chap. "2.2.4 Work Safety", Page 19
- Not adhering to the instructions in this User Manual or to the relevant supplemental documentation relevant for the respective application.
- Non-observance of the relevant manufacturer's safety standards and those of the operator of the machinery for each respective application
- Non-observance of the relevant national and international regulations as well as the applicable standards and directives (e. g. EU Machinery Directive and the regulations by the Employer's Liability Association, TÜV or VDE) as amended in their current version when designing, assembling and operating the machinery with all the installed components.
- Failure to install a suitable safety system for limiting the pressure in the hydraulic connections
  ⇨ Chap. "2.3.2.1 Safety Devices for Limiting Pressure", Page 20
- Using radial piston pumps that are not in a technically flawless condition or are not safe for operation
- Unauthorized or unprofessional design modifications, repairs or maintenance work
  ⇨ Chap. "2.2.3 Structural Modifications", Page 18
  ⇨ Chap. "8 Maintenance and Repairs", Page 72
- Not adhering to the inspection and maintenance instructions from the manufacturer and the operator of the machinery.
- Not adhering to all technical data during storage, transport, assembly, disassembly, connecting, start-up, configuring, operating, cleaning, repairing or troubleshooting, especially to the ambient conditions as well as to the data of the hydraulic fluid in use.
  ⇨ Chap. "4 Technical Data", Page 38
- Improper storage, transport, assembly, disassembly, connection, start-up, configuration, operation, cleaning, repairing, troubleshooting or disposal
- Use of unsuitable or defective accessories or rather unsuitable or defective spare parts
  ⇨ Chap. "10 Spare Parts, Accessories, Repairs", Page 78
- Catastrophes caused by foreign objects or force majeure

# 1.6 Trademarks

**Trademarks**

Moog™ and Moog Authentic Repair Service™ are registered trademarks of Moog Inc. and its subsidiaries.

All product and company names listed in the User Manual may be protected trademarks of their respective manufacturer, the use of which by third parties for their own purposes may be in violation of the manufacturer's rights.
A missing ® or ™ symbol must not be interpreted to mean that the name is a brand name that can be used without restriction.

# 2 Safety

## 2.1 Intended Use

**Intended Use**

The RKP Radial Piston Pump is a work machine used to produce hydraulic displacement. Certain versions of the radial piston pumps are fitted with an additional safety function for locking (not a hermetic sealing function) the hydraulic displacement.

**Usage Environment:**

The radial piston pump is designed to control and regulate pressures and displacements in commercial applications.

**Obvious Misuse:**

Operating the unit outside of the specifically defined application and environmental conditions
in respect of:

- Operating pressure
- Temperature
- Speed and direction of rotation
- Operating ambient pressure
- Shock/vibration
- Resistance to electromagnetic interference
- Operating fluids (viscosity, cleanliness class, chemical ingredients)
- Protection class
- Electrical and electromagnetic connections
- Operation in explosion hazardous areas, if not permitted for such use

**The following applies in respect of higher-level machinery/equipment:**

- The Radial Piston Pump must only be operated as a component of a complete superordinate system, e.g. in a machine.
- The radial piston pump is designed to be used with the specified operating fluids. Use with any other operating fluids requires our express approval.
- The efficient, reliable and safe operation of the radial piston pump demands high-quality project planning as well as professional application, transport, storage, mounting, demounting, electrical and hydraulic connections, start-up, configuration, operation, cleaning and servicing.

**The radial piston pump must not be put into operation until the following has been assured:**

- The higher-level machine/equipment and all its installed components adhere to the relevant national and international regulations as well as the applicable standards and directives (e.g. EU Machinery Directive and the regulations of the Employer's Liability Association, TÜV or VDE) as amended in their current version.
- The radial piston pump and all other installed components are in a technically sound and operationally safe condition.

**The following also applies in respect of "Intended Use":**

- Observance of this User Manual
- Safe handling of the radial piston pump ⇨ Chap. "2.2.1 Safe Operation", Page 17
- Adhering to the inspection and maintenance instructions from the manufacturer and the operator of the machinery.
- Following all the supplemental documentation relating to the application
- Observing the relevant manufacturer's safety standards and those of the operator of the machinery for each respective application
- Observing the relevant national and international regulations, as well as the applicable standards and directives (e.g. the EU Machinery Directive and the applicable regulations of the Employer's Liability Insurance Association, TÜV or VDE) as amended

# 2.2 Organizational Measures

## 2.2.1 Safe Operation

**CAUTION**

**Danger of personal injury and damage to property due to unexpected operation!**
As in any control system, the failure of certain components in radial piston pumps as well might lead to an uncontrolled and/or unpredictable operational sequence.

- If automatic control technology is to be used, the user should, in addition to all the potentially available standards or guidelines on safety-engineering installations, consult the manufacturers of the components used in great depth.

It is the responsibility of the manufacturer and the operator of the machine/equipment to ensure the safe operation of the radial piston pump.

**Safe Operation**

The basic requirement for safe handling and trouble free operation of the radial piston pump involves observing the following:

- All safety instructions and user manuals
- All safety instructions contained in the supplemental documentation relating to the application in question
- All safety instructions pertaining to the relevant manufacturer's safety standards and those of the operator of the machinery for each respective application
- All relevant national and international safety and accident prevention regulations, standards and directives, such as the safety instructions of the Employer's Liability Insurance Association, TÜV or VDE, in particular the following standards for the safe operation of machinery:
  - EN ISO 12100
  - EN ISO 4413

Following the safety instructions and the safety and accident prevention regulations, standards and directives helps to prevent accidents, machine failure and property damage!

## 2.2.2 Selecting and Qualifying -Staff

**Selecting and Qualifying -Staff**

**WARNING**

**Incorrect handling of the radial piston pump!**
May result in severe personal injury and property damage.
- Any and all work on the Radial Piston Pump may only be performed by qualified and authorized users.

**Qualified Users**

Qualified users are skilled professionals who have been trained to carry out these tasks and who have the required knowledge and experience. In particular, such skilled professionals must be licensed to operate, ground and label machines, systems and electric circuits in accordance with applicable safety standards. Project planners must be familiar with the safety concepts associated with automation technology.

## 2.2.3 Structural Modifications

**Structural Modifications**

To prevent damage to the radial piston pump or any of its accessories, structural modifications to the equipment may only be performed by us or by an authorized service center.
⇨ Chap. "8.3 Moog Service Addresses", Page 75

Warranty and liability claims for personal injury or property damage are excluded if they are the result of unauthorized or improperly carried out structural modifications or tampering with the equipment in any way.
⇨ Chap. "1.5 Warranty and Liability", Page 13

## 2.2.4 Work Safety

Work Safety

**WARNING**

**Risk of poisoning and injury!**
Contact with hydraulic fluids can damage your health (e.g. eye injuries, skin and tissue damage, poisoning in case of inhaling).

- Always wear safety gloves and safety glasses.
- Seek medical advice immediately should hydraulic fluid nevertheless splash into your eyes or come into contact with your skin.
- Always observe the safety instructions of the manufacturer when handling hydraulic fluids.

**CAUTION**

**Danger of injury due to falling objects!**
Falling tools or accessories can cause personal injury.

- Wear suitable safety equipment, e.g. safety shoes.

**CAUTION**

**Risk of burns!**
The radial piston pump and the hydraulic port lines can become very hot during operation and may burn your skin if you touch them.

- Wear suitable safety equipment, e.g. work gloves.
- Wear suitable safety equipment if you have to touch the pump while it is in operation or shortly afterwards.

**CAUTION**

**Damage to hearing!**
Depending on the application, significant levels of noise may be generated when the radial piston pumps are operated, which can lead to hearing damage.

- The operator/manufacturer must take suitable measures to protect against noise, e.g. stipulating that ear protection is worn. Always protect yourself with hearing protection when working on radial piston pumps.

**CAUTION**

**Hazardous operating fluids!**
When working with hazardous operating fluids, any skin contact or inhalation may cause personal injury.

- Wear suitable safety equipment, e.g. work gloves.

# 2.3 General Safety Instructions

**General Safety Instructions**

- Any and all work on the Radial Piston Pump may only be performed by qualified and authorized users.
  ⇨ Chap. "2.2.2 Selecting and Qualifying -Staff", Page 18
- The technical data and especially the information shown on the Radial Piston Pump's nameplate must be observed and adhered to at all times.
  ⇨ Chap. "4 Technical Data", Page 38

## 2.3.1 Specific Phases of Operation

### 2.3.1.1 Mounting

**General Safety Instructions for specific phases of operation**

- During mounting, ensure that all connections, plugs and sockets are tightly sealed to prevent the ingress of substances into the radial piston pump.
- The radial piston pump must be completely filled with operating fluid.
- Before mounting, the radial piston pump must have adapted to room temperature and must not contain any condensation.

### 2.3.1.2 Start Up

- All hydraulic and electric connections must be in use or closed off.
- Never start up the radial piston pump until all mounting steps have been completed.

### 2.3.1.3 Maintenance and Repairs

- Maintenance and repair work as well as servicing work is to be carried out according to schedule and regularly at the specified times.
- Secure the machine/equipment to prevent it from being started up during maintenance and repair.
- Ensure that the machine/equipment is depressurized before commencing any maintenance work.

## 2.3.2 Operating Hydraulic Equipment

### 2.3.2.1 Safety Devices for Limiting Pressure

**General Safety Instructions When operating hydraulic equipment**

**DANGER**

**Excess pressure may cause personal injury and property damage!**

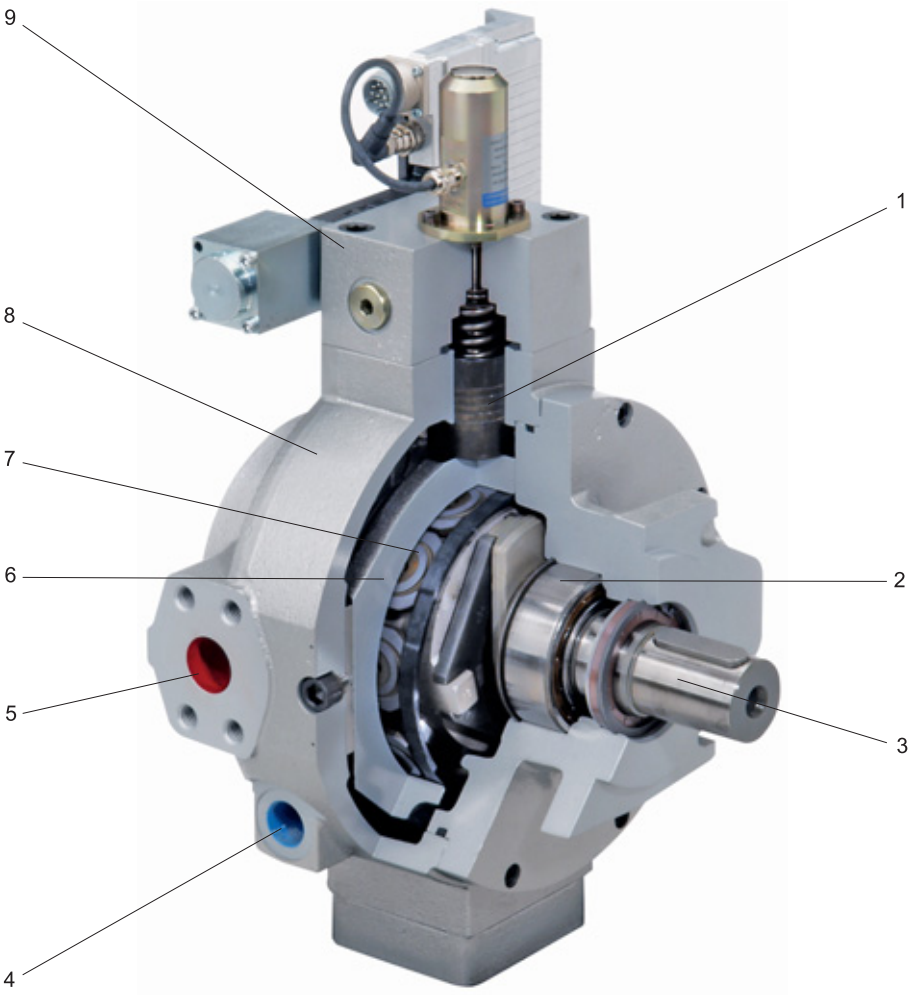
Excess pressure in the machine/equipment may damage parts of the machine/system and as a result cause severe personal injury.

- To limit the machine/system to the maximum permissible operating pressure, a pressure limitation valve or a comparable safety device must be installed directly at the pump output.

# 3 Product Description

## 3.1 Design



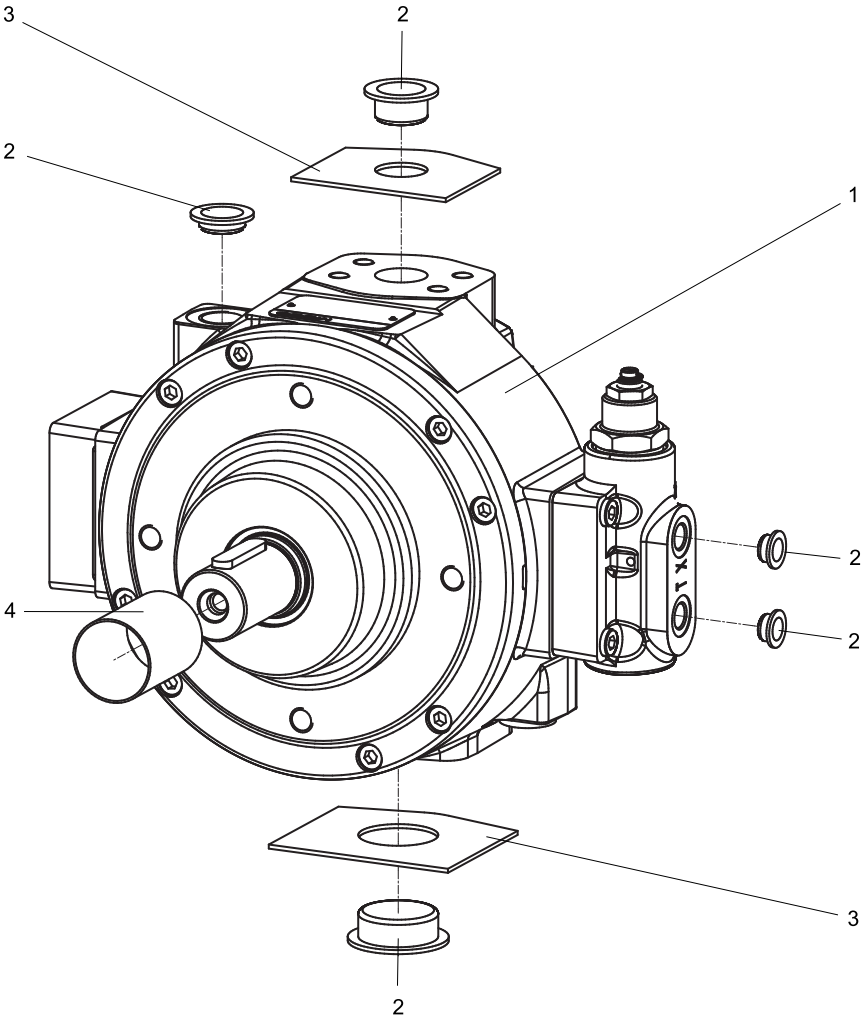



| Item | Description |
|---|---|
| 1 | Control piston |
| 2 | Roller bearing |
| 3 | Drive shaft |
| 4 | Drain port |
| 5 | SAE piping connection |
| 6 | Sliding stroke ring |
| 7 | Slipper pad with working piston |
| 8 | Housing |
| 9 | Compensator |

Fig. 1: Radial Piston Pump Design

# 3.2 Scope of Delivery

**Scope of Delivery**




| Item | Description |
|---|---|
| 1 | RKP radial piston pump |
| 2 | Cap |
| 3 | Flange cover |
| 4 | Transport protection for shaft ends |

Fig. 2: Scope of Delivery

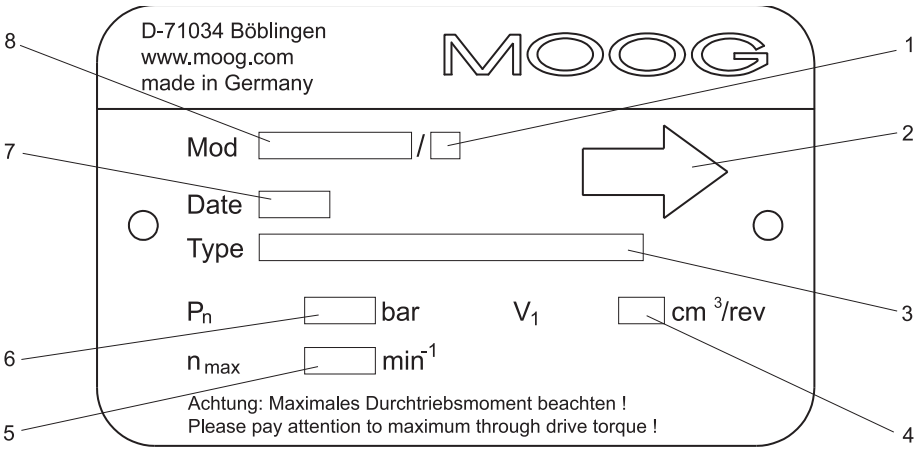
When pump stages are delivered, the through-drive is closed with a cap. The caps are not suitable for operational purposes.

**Included in the scope of delivery:**

- RKP radial piston pump with flange covers, caps and transport protection for the shaft ends, preserved
- User manual with additional documentation

# 3.3 Nameplate

**Nameplate**




| Item | Marking | Additional information |
|---|---|---|
| 1 | Revision status | |
| 2 | Rotation direction | |
| 3 | Type key | ⇨ Radial Piston Pumps RKP Catalog |
| 4 | Displacement | |
| 5 | Maximum revolutions for low noise operation | |
| 6 | Maximum operating pressure | |
| 7 | Date of manufacture in the format MM/YY | |
| 8 | Model number | |

Fig. 3: Nameplate for RKP Radial Piston Pump

In the case of multiple pumps, each individual pump has its own nameplate.

# 3.4 Functional Description

**Functional Description**

The shaft (5) transfers the drive torque to the star-shaped cylinder block (3), free of any transverse forces via a crossdisc coupling (4). The cylinder block is supported on the control journal (1). The radial pistons (9) in the cylinder block run against the stroke ring (7) through hydrostatically balanced slipper pads (8). Piston and slipper pads are joined by ball and socket joints which are each locked by a ring. The slipper pads are guided in the stroke ring by two retaining rings (2) and, when running, are held against the stroke ring by centrifugal force and oil pressure. As the cylinder block rotates, the pistons perform a reciprocating motion due to the eccentric positioning of the stroke ring, the piston stroke being twice the eccentricity. The eccentric position of the stroke ring is controlled by two diametrically opposed control pistons (6, 10) and the compensator (11). The oil flow to and from the pump passes through the pump ports and into and out of the pistons through the porting in the control journal. The rolling bearing, supporting the drive shaft, is only subjected to external forces. The compensator setting limits the system pressure and adjusts the pump flow between zero and full flow to maintain the set pressure.

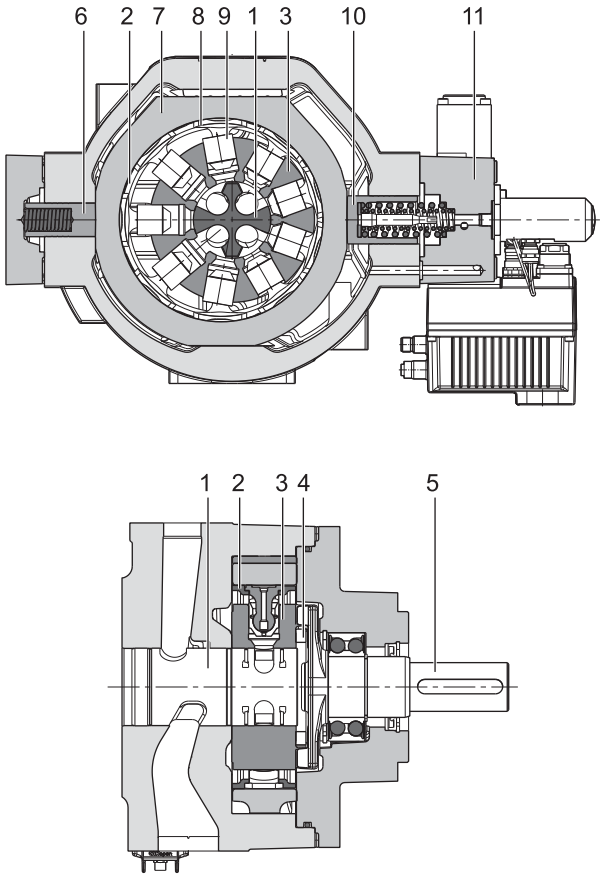



Fig. 4: Cross Section of RKP Radial Piston Pump

# 3.5 Compensator Operation

**Compensator Operation**

The RKP Radial Piston Pump enables a variety of compensator options to be used. This ensures maximum flexibility.

The following options are described in more detail later on:

| No. | Compensator Option | Description/Characteristics/Application |
|---|---|---|
| 1 | **Adjustable pressure compensator, F1, F2** | For constant pressure systems with a fixed pressure setting<br>⇨ Chap. "3.5.1 Adjustable Pressure Compensator, F1, F2", Page 26 |
| 2 | **Remote pressure compensator, H1** | For constant or variable pressure systems with remote pressure setting<br>⇨ Chap. "3.5.2 Remote Pressure Compensator, H1", Page 27 |
| 3 | **Pressure compensator with mooring control, H2**<br>Hydraulically adjustable | For constant pressure systems with variable pressure setting for mooring control<br>⇨ Chap. "3.5.3 Remote Pressure Compensator with Mooring Control, H2", Page 28 |
| 4 | **Load-sensing compensator, J1**<br>Combined pressure and flow compensator | For displacement systems with variable volume flow and load sensing pressure control (hydro-mechanical compensator concept)<br>⇨ Chap. "3.5.4 Load-Sensing Compensator, J1", Page 29 |
| 5 | **Load sensing compensator with P-T control notch, R1**<br>Combined pressure and flow compensator with p-T control notch | As described in 4 plus: active reduction of pressure peaks during dynamic control processes<br>⇨ Chap. "3.5.5 Combined Pressure and Flow Compensator with P-T Control Notch, R1", Page 30 |
| 6 | **Mechanical stroke adjustment, B1** | For displacement systems with fixed displacement settings, which can be changed manually if needed<br>⇨ Chap. "3.5.6 Mechanical Stroke Adjustment, B1", Page 31 |
| 7 | **Servo control, C1** | The displacement can be adjusted with a hand lever or an actuator<br>⇨ Chap. "3.5.7 Servo Control, C1", Page 32 |
| 8 | **Constant horse power control, S1**<br>(force comparison system) | Automatic reduction of displacement in the event of an increasing load so that the capacity of the drive motor is not exceeded<br>⇨ Chap. "3.5.8 Power Control, S1", Page 33 |
| 9 | **Constant horse power control, S2**<br>with superimposed pressure and displacement limitation, controlled hydraulically | As described in 8 plus: an adjustable maximum limit setting for pressure and displacement<br>⇨ Chap. "3.5.9 Power Control, S2", Page 36 |
| | **RKP-D** | Radial piston pump with digital on-board electronics<br>⇨Application Instruction RKP-D with CAN Bus Interface<br>⇨ Tab. 1, Seite 10 |
| 11 | **Dual displacement, type N1** | Switching of displacement between two defined stroke ring positions.<br>⇨ Chap. "3.5.10 Dual Displacement, N1", Page 37 |

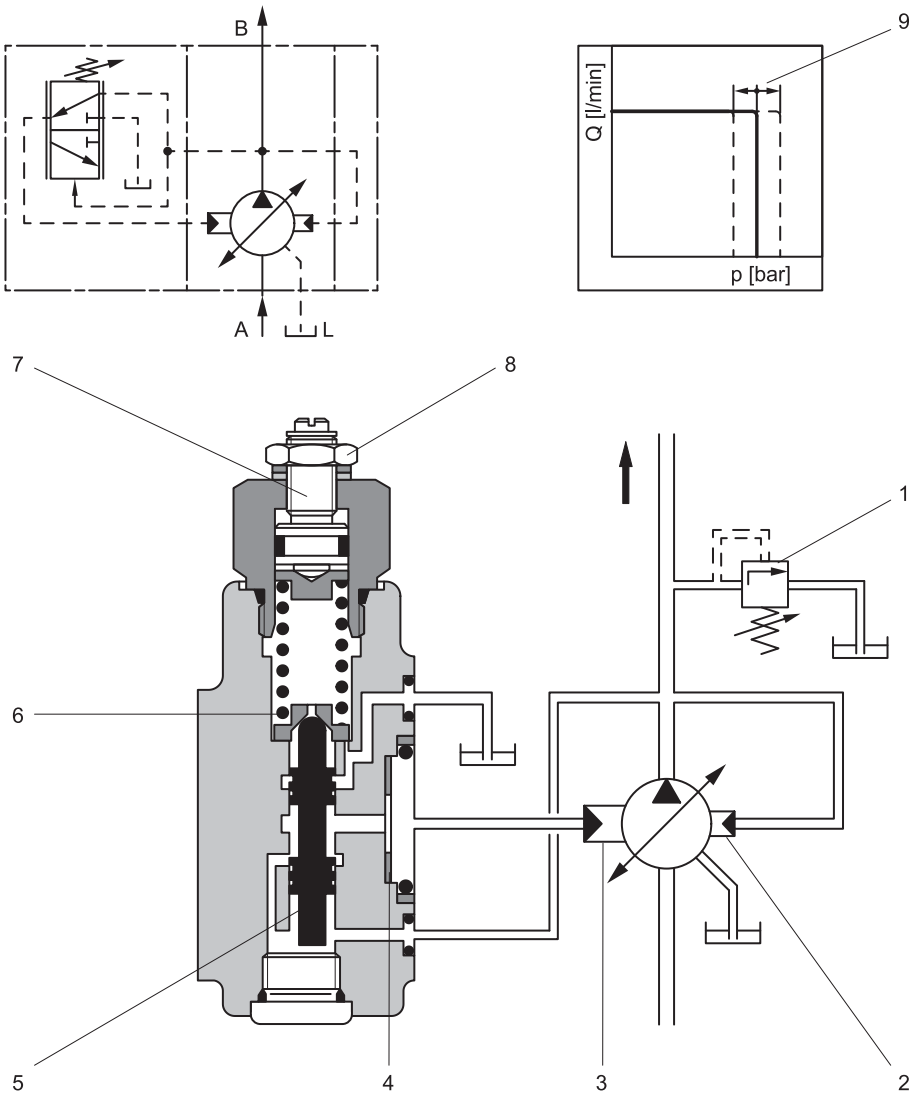
Table 2: Description of the Compensator Options

All compensators are pre-set at the factory.
Information on adjusting the compensators:
⇨ Chap. "7.1.2 Adjusting the Compensator", Page 58

## 3.5.1 Adjustable Pressure Compensator, F1, F2

**Pressure range:**
F1: 30–150 bar
F2: 80–350 bar

**Adjustable Pressure Compensator, F1, F2**



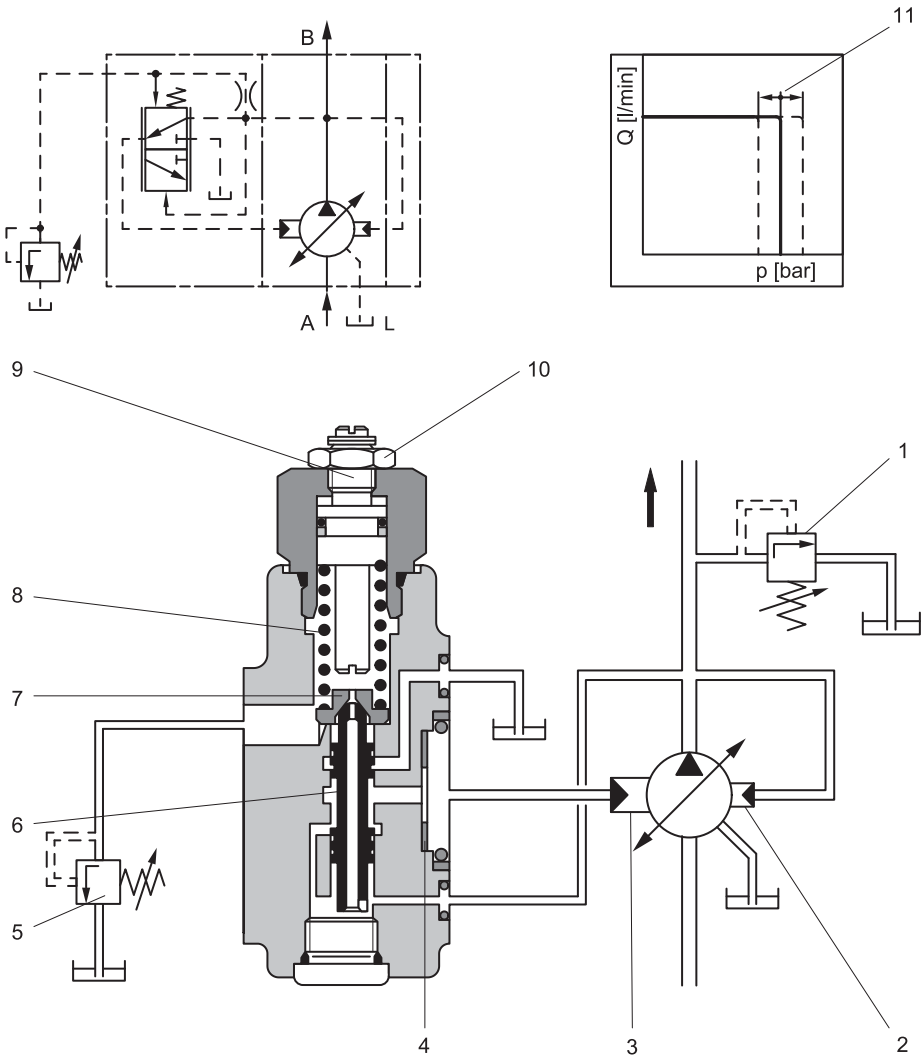

| Item | Description |
|---|---|
| 1 | Safety valve p = $p_{max.}$ + 30 bar |
| 2 | Control piston 2 |
| 3 | Control piston 1 |
| 4 | Adjustment of zero stroke |
| 5 | Valve spool |
| 6 | Valve spring |
| 7 | Adjusting screw |
| 8 | Locknut for adjusting screw |
| 9 | Setting on adjusting screw |

Fig. 5: Adjustable Pressure Compensator, F1, F2

## 3.5.2 Remote Pressure Compensator, H1

**Pressure pilot valve:**
Manually adjustable or proportional pressure valve Q = 1–1.5 l/min.

**Remote Pressure Compensator, H1**



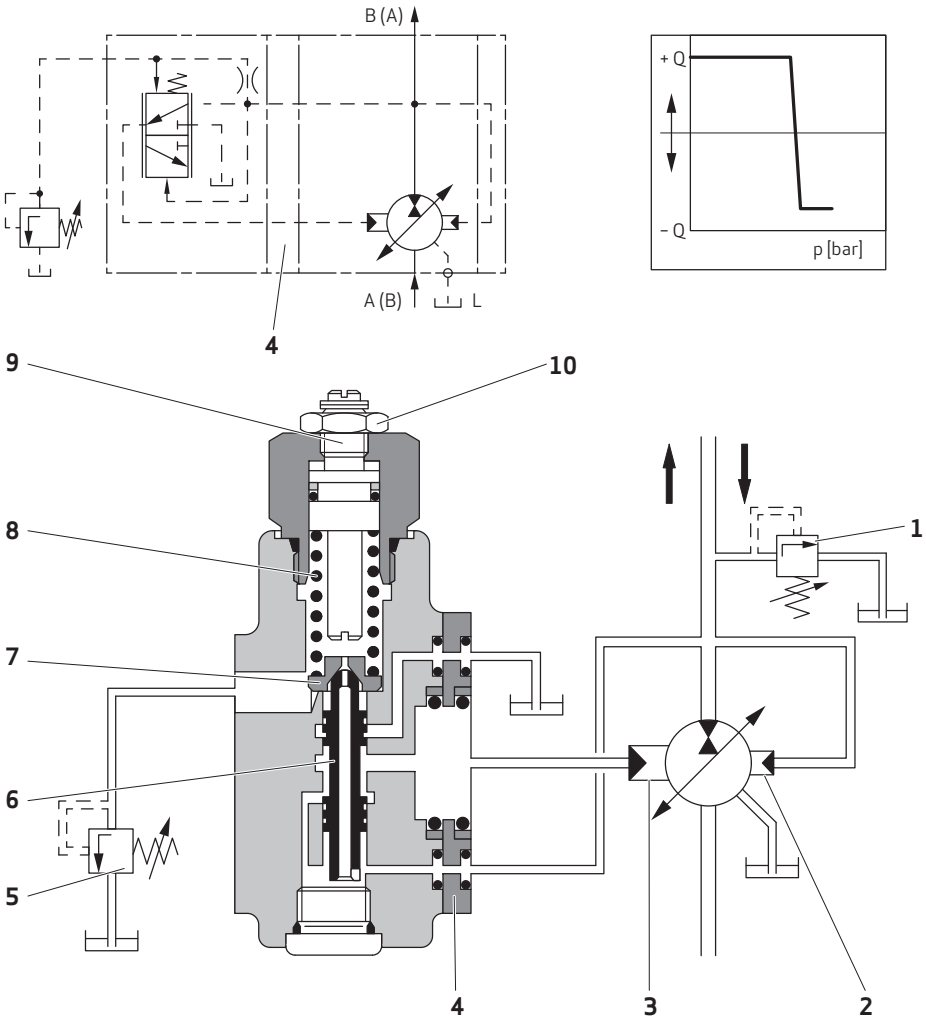

| Item | **Description** |
|---|---|
| 1 | Safety valve p = $p_{max.}$ + 30 bar |
| 2 | Control piston 2 |
| 3 | Control piston 1 |
| 4 | Adjustment of zero stroke |
| 5 | Pressure pilot valve |
| 6 | Valve spool |
| 7 | Orifice |
| 8 | $p_{min.}$ spring |
| 9 | Locked adjusting screw |
| 10 | Locknut for adjusting screw |
| 11 | Setting on pressure pilot valve |

Fig. 6: Hydraulically Driven Remote Pressure Compensator, H1

# 3.5.3 Remote Pressure Compensator with Mooring Control, H2

**Pressure Compensator with Mooring Control, H2**

The pressure compensator with mooring control has an intermediate plate inserted between the pump body and the pressure compensator. The intermediate plate enables the pump's sucktion mode (motor mode) operation.




| Item | Description |
|---|---|
| 1 | Safety valve p = $p_{max.}$ + 30 bar |
| 2 | Control piston 2 |
| 3 | Control piston 1 |
| 4 | Intermediate plate |
| 5 | Pressure pilot valve |
| 6 | Valve spool |
| 7 | Orifice |
| 8 | $p_{min.}$ spring |
| 9 | Locked adjusting screw |
| 10 | Locknut for adjusting screw |

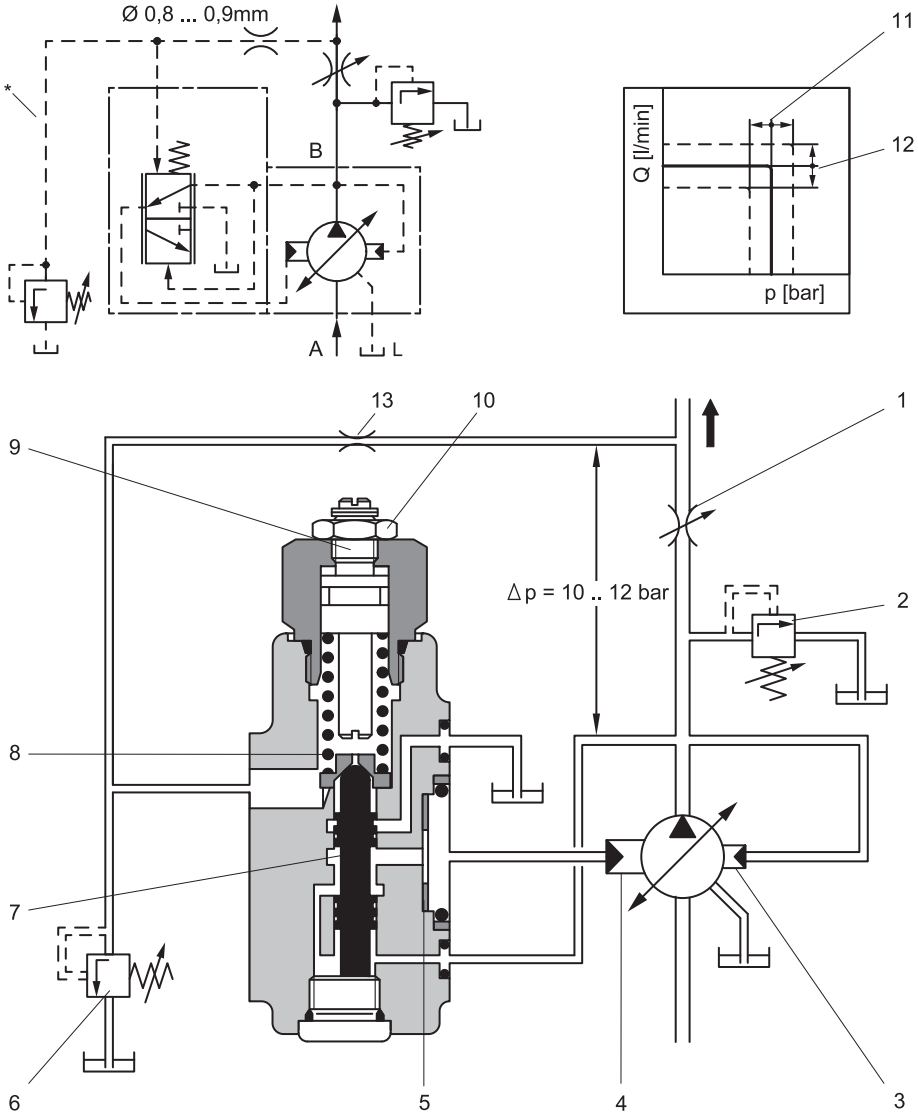
Fig. 7: Pressure Compensator with Mooring Control, H2

# 3.5.4 Load-Sensing Compensator, J1

**Load-Sensing Compensator, J1**

**Metering throttle:**
Manually adjustable throttle valve or proportional throttle valve.

**Pressure pilot valve:**
Manually adjustable or proportional pressure valve Q = 1–1.5 l/min.




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Metering throttle for flow control | 8 | Δp spring |
| 2 | Safety valve p = $p_{max.}$ + 30 bar | 9 | Locked adjusting screw |
| 3 | Control piston 2 | 10 | Locknut for adjusting screw |
| 4 | Control piston 1 | 11 | Setting on pilot valve |
| 5 | Adjustment of zero stroke | 12 | Setting on metering throttle |
| 6 | Pressure pilot valve | 13 | Orifice Ø 0.8 to 0.9 mm |
| 7 | Valve spool | | |

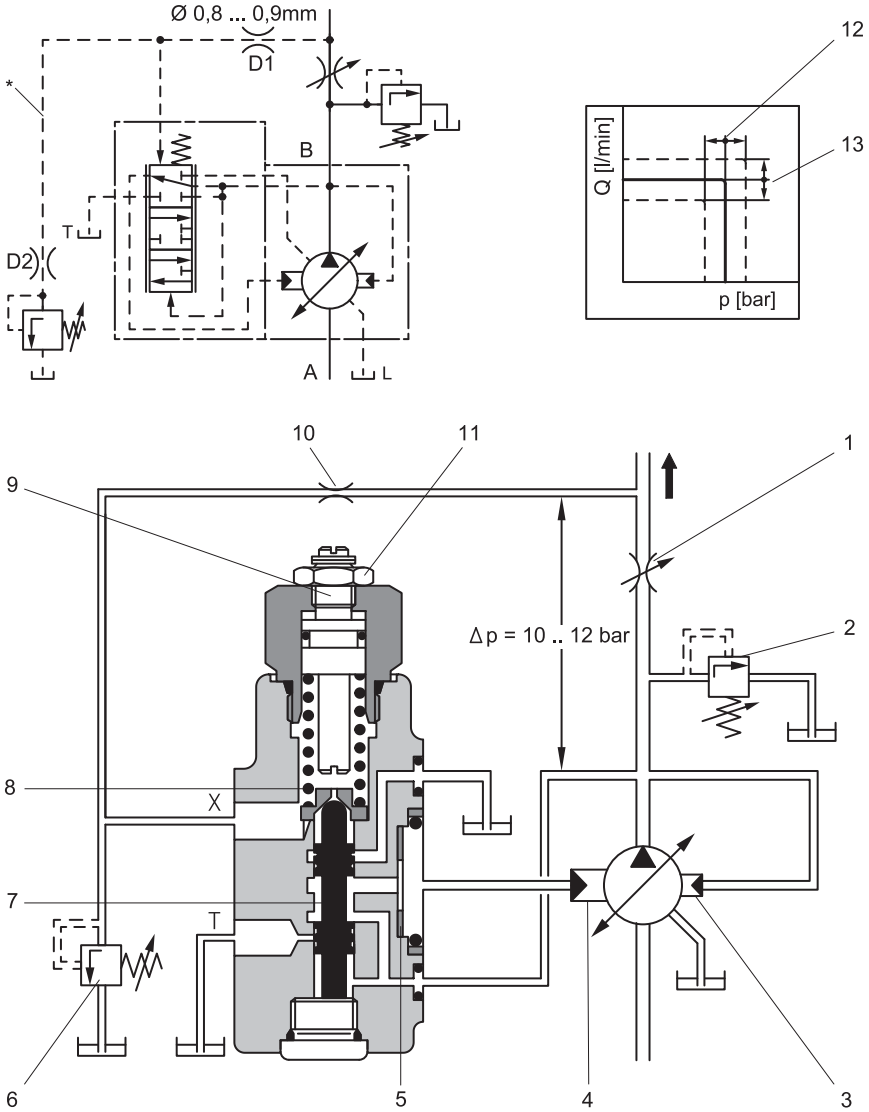
Fig. 8: Load-Sensing Compensator, J1

# 3.5.5 Combined Pressure and Flow Compensator with P-T Control Notch, R1

**Load-Sensing Compensator with P-T Control Notch, R1**

**Metering throttle:**
Manually adjustable throttle valve or proportional throttle valve.

**Pressure pilot valve:**
Manually adjustable or proportional pressure valve Q = 1 to 1.5 l/min.
For multiple pumps feeding in one common line, only one compensator with a p-T control notch may be used. This compensator must be set to the higher ∆p value.

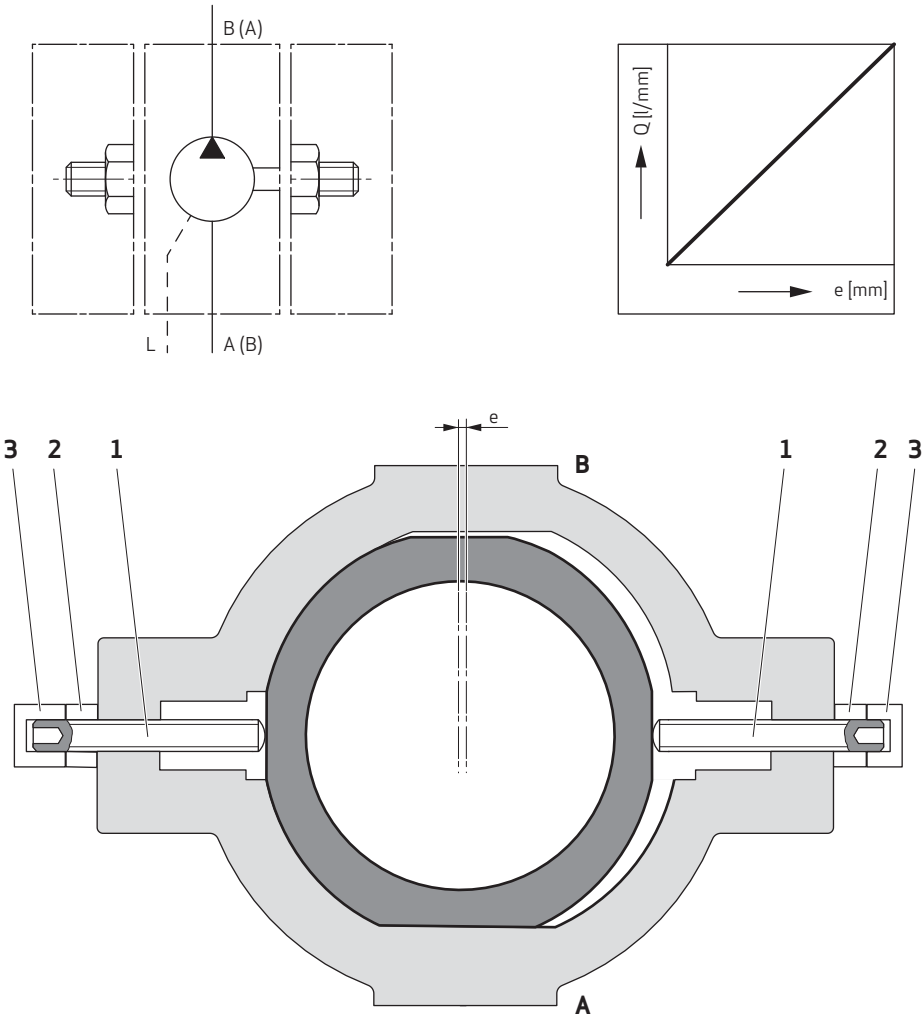



| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Metering throttle for flow control | 8 | ∆p spring |
| 2 | Safety valve p = $p_{max.}$ + 30 bar | 9 | Locked adjusting screw |
| 3 | Control piston 2 | 10 | Orifice Ø 0.8 to 0.9 mm |
| 4 | Control piston 1 | 11 | Locknut for adjusting screw |
| 5 | Adjustment of zero stroke | 12 | Setting on pilot valve |
| 6 | Pressure pilot valve | 13 | Setting on metering throttle |
| 7 | Valve spool | | |

Fig. 9: Load-Sensing Compensator with P-T Control Notch, R1

# 3.5.6 Mechanical Stroke Adjustment, B1

**Mechanical Stroke Adjustment, B1**

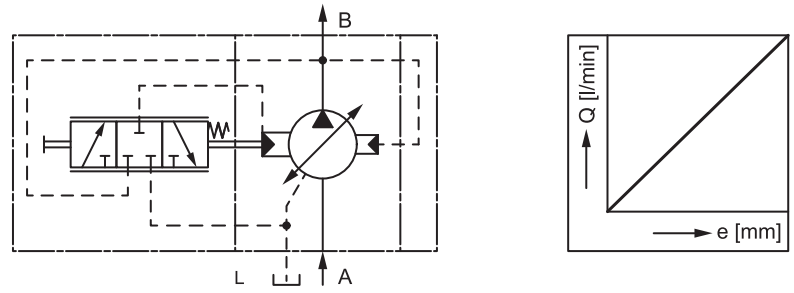


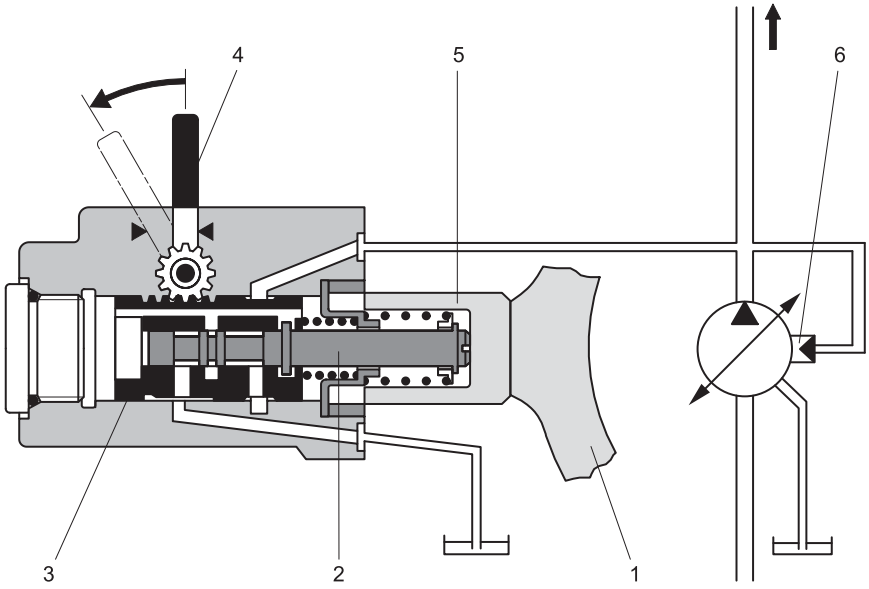

| Item | Description |
|---|---|
| 1 | Adjusting screw |
| 2 | Seal nut |
| 3 | Cap nut (for RKP250 only) |

Fig. 10: Mechanical Stroke Adjustment, B1

# 3.5.7 Servo Control, C1

**Servo Control, C1**



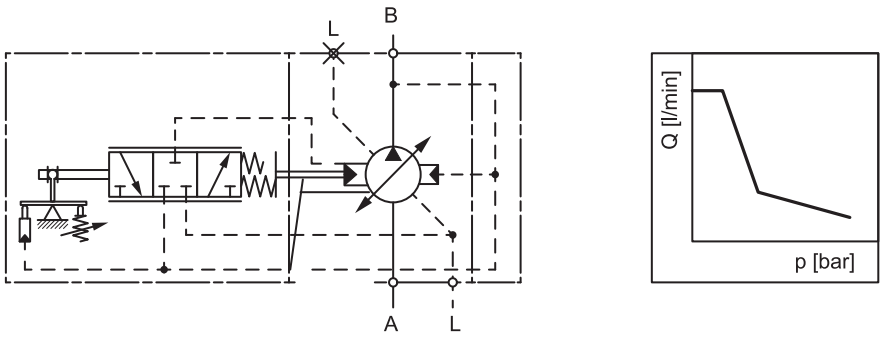



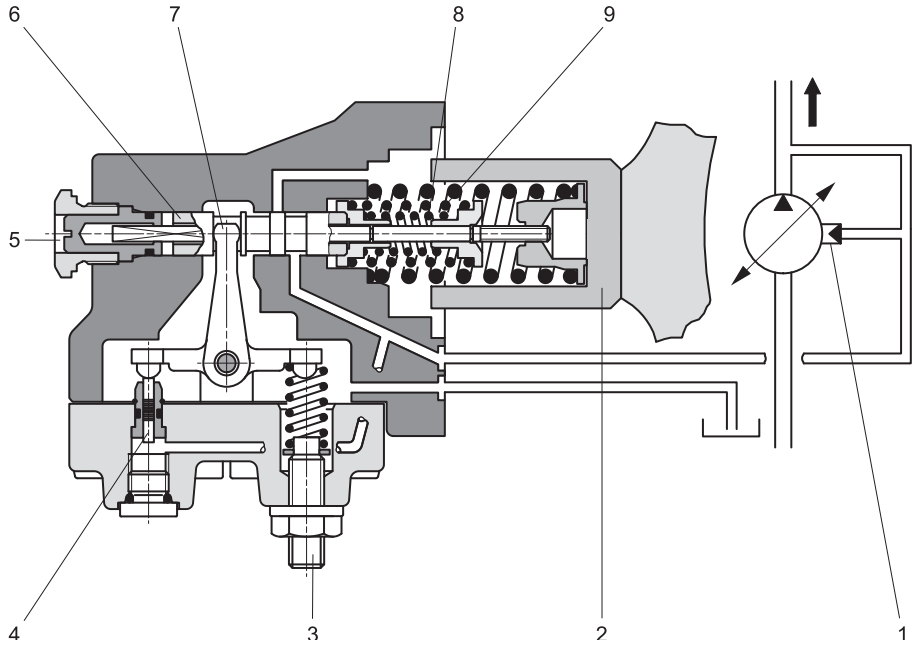

| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Stroke ring | 4 | Adjustment lever for control shaft |
| 2 | Pilot spool | 5 | Control piston 1 |
| 3 | Spool sleeve | 6 | Control piston 2 |

Fig. 11: Servo Control, C1

## 3.5.8 Power Control, S1

**Power Control, S1**




| Item | Description | Item | Description |
|---|---|---|---|
| 1 | Control piston 2 | 6 | Pilot spool |
| 2 | Control piston 1 | 7 | Rocker |
| 3 | Adjusting screw (**fixed setting, do not modify**) | 8 | Spring 1 |
| 4 | Sensing piston | 9 | Spring 2 |
| 5 | Adjusting screw (**fixed setting, do not modify**) | | |

Fig. 12: Power Control, S1

## Characteristics for Power Control, S1

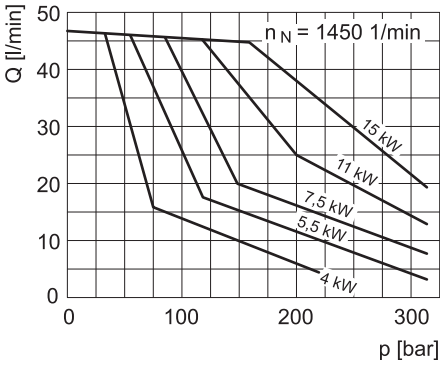



Fig. 13: Characteristic V = 32 $cm^3$/U

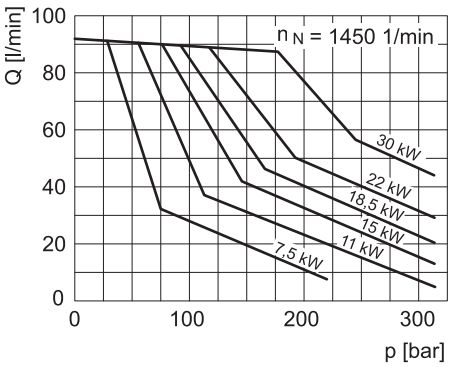



Fig. 14: Characteristic V = 63 $cm^3$/U

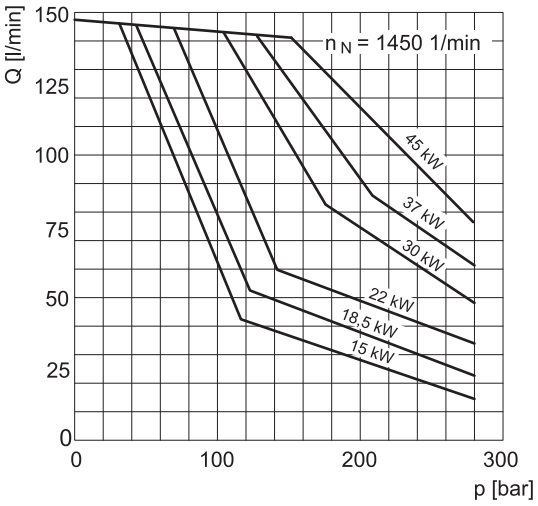



Fig. 15: Characteristic V = 100 $cm^3$/U

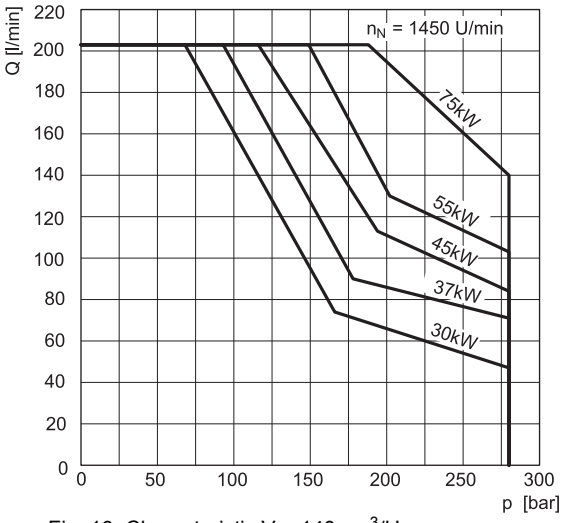



Fig. 16: Characteristic V = 140 $cm^3$/U

Approximation to the power hyperbola by means of two springs.
Referenced on n = 1450 rpm

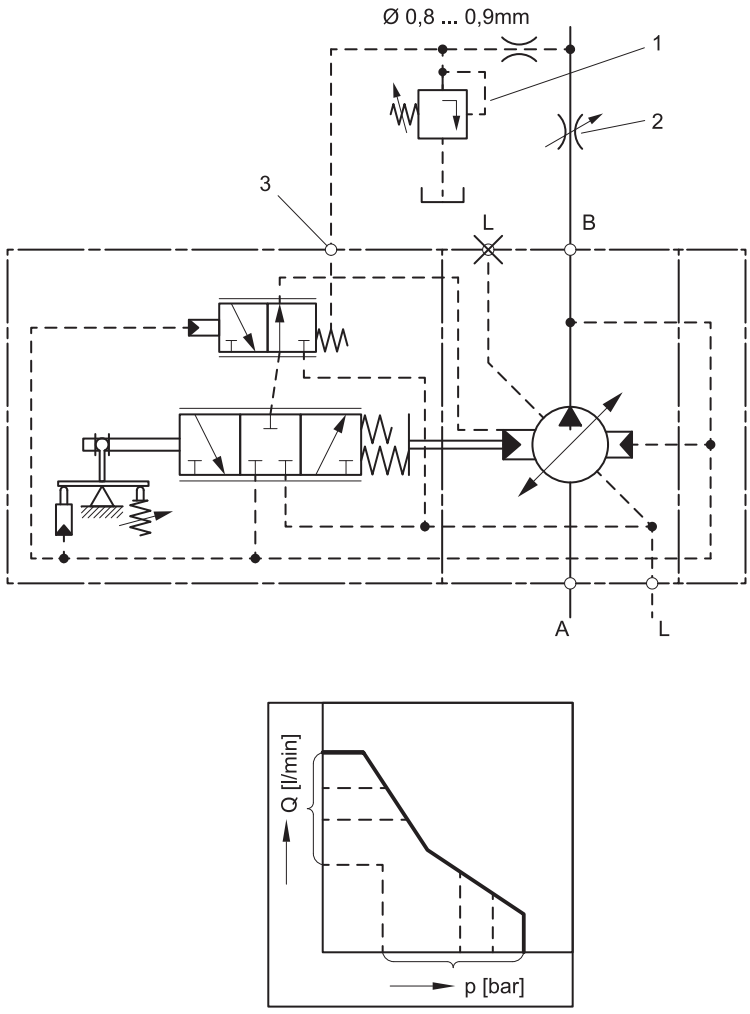
For other revolutions,the following applies:

$$P = \frac{P_N \cdot n}{1450}$$

## 3.5.9 Power Control, S2

Hydraulically operated power control with superimposed pressure and displacement limitation.

**Power Control, S2**




| Item | Description |
|---|---|
| 1 | Setting the pressure p |
| 2 | Flow control Q setting |
| 3 | Control port |

Fig. 17: Power Control, S2

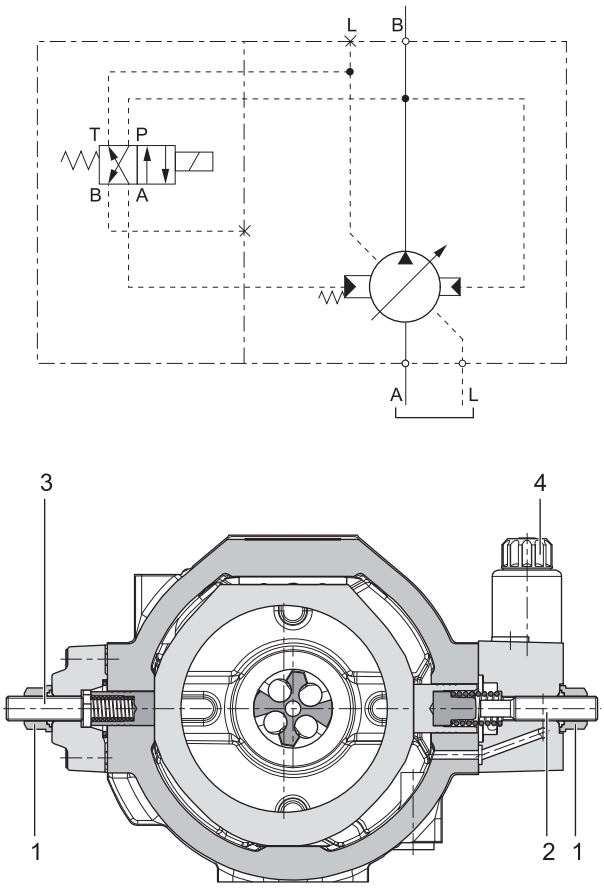
## 3.5.10 Dual Displacement, N1

To switch displacement volume from one defined stroke ring position to another, a switching valve is used. The required minimum displacement volume ($V_{minimum}$) and maximum displacement volume ($V_{maximum}$) values can be mechanically set using an adjusting screw.

Factory setting: $V_{minimum} = 0.5 \cdot V_{maximum}$

This control option is suitable for both variable speed operation as well as displacement control with two displacement stages and a constant speed. When used as a variable speed pump, the displacement volume can be adjusted to the respective point in the cycle by switching between $V_{minimum}$ and $V_{maximum}$. As the pump drive torque is reduced with $V_{minimum}$, both the motor and frequency inverter may be smaller, depending on the machine cycle.

**Dual Displacement, N1**




| Item | Description |
|---|---|
| 1 | Seal nut |
| 2 | Adjusting screw for $V_{min.}$ |
| 3 | Adjusting screw for $V_{max.}$ |
| 4 | Switching valve |

Fig. 18: Dual Displacement, N1

# 4 Technical Data

## 4.1 General Technical Data

**General Technical Data**

| **Displacement [$cm^3$/R]** | **19** | **32** | **45** | **63** | **80** | **100** | **140** | **250** |
|---|---|---|---|---|---|---|---|---|
| Type of construction | Radial Piston Pump for open circuits with various control devices | | | | | | | |
| Type of mounting | End mounting, centering and hole-circle diameter as per ISO 3019/2 (metric)<br>Attachment flange as per ISO 3019/1 (dimensions in inches)<br>Attachment flange as per ISO 3019/2 (metric) | | | | | | | |
| Mounting position | optional | | | | | | | |
| Weight [kg] | 22 | 33 | 33 | 71 | 71 | 71 | 103 | 236 |
| Mass moment of inertia [$kg/cm^2$] | 17.7 | 61 | 61 | 186.3 | 186.3 | 186.3 | 380 | 1555 |
| Line connections | | | | | | | | |
| Pressure port | | | | | | | | |
| Medium pressure version | 3/4" 3000 psi | 1" 3000 psi | 1" 3000 psi | 1 1/4" 3000 psi | 1 1/4" 3000 psi | 1 1/4" 6000 psi | 1 1/2" 6000 psi | – |
| High pressure version | 3/4" 6000 psi | 1" 6000 psi | – | 1 1/4" 6000 psi | 1 1/4" 6000 psi | – | – | SAE1 1/2" 6000 psi |
| Suction port | | | | | | | | |
| Medium pressure version | 3/4" 3000 psi | 1 1/2" 3000 psi | 1 1/2" 3000 psi | 2" 3000 psi | 2" 3000 psi | 2" 3000 psi | 2 1/2" 3000 psi | SAE3" 3000 psi |
| High pressure version | 3/4" 6000 psi | 1 1/2" 3000 psi | – | 2" 3000 psi | 2" 3000 psi | – | – | – |
| Recommended pipe OD for drain pipes (lightweight version) [mm] | 15 (5/8") | 18 (3/4") | 18 (3/4") | 22 (7/8") | 22 (7/8") | 22 (7/8") | 22 (7/8") | 35 (1 1/4") |

Table 3: General Technical Data

# 4.2 Operating Conditions

**Operating Conditions**

| Displacement [$cm^3$/R] | 19 | 32 | 45 | 63 | 80 | 100 | 140 | 250 |
|---|---|---|---|---|---|---|---|---|
| Drive type | Direct drive with coupling (for other drive types, please contact us) | | | | | | | |
| Ambient temperature range | -15 °C to 60 °C | | | | | | | |
| Max. speed at inlet pressure 0.8 bar abs. [$min^{-1}$] | 2700 | 2500 | 2000 | 2400 | 2000 | 1800 | 1800 | 1800 |
| Max. speed at inlet pressure 1 bar abs. [$min^{-1}$] | 2800 | 2600 | 2100 | 2500 | 2050 | 1850 | 1900 | 1850 |
| Max. speed for low noise operation [$min^{-1}$] | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 | 1800 |
| Min. suction port inlet pressure | 0.8 bar absolute at pump inlet | | | | | | | |
| Max. housing pressure | 2 bar (1 bar above atmosphere) | | | | | | | |
| Standard version: | | | | | | | | |
| Continuous pressure [bar] | 280 | 280 | 280 | 280 | 280 | 280 | 280 | 280 |
| Maximum pressure[1] [bar] | 315 | 315 | 315 | 315 | 315 | 315 | 315 | 315 |
| Peak pressure [bar] | 350 | 350 | 350 | 350 | 350 | 350 | 350 | 350 |
| High pressure version: | | | | | | | | |
| Continuous pressure [bar] | 350 | 350 | – | 350 | 350 | – | – | 350 |
| Maximum pressure[1] [bar] | 385 | 385 | – | 385 | 385 | – | – | 385 |
| Peak pressure [bar] | 420 | 420 | – | 420 | 420 | – | – | 420 |
| Hydraulic fluid | Mineral oil as per DIN 51 524 | | | | | | | |
| Hydraulic fluid temperature range | -15 °C to 80 °C | | | | | | | |
| Viscosity | Permissible operating range 12 to 100 $mm^2/s$<br>Recommended operating range 16 to 46 $mm^2/s$<br>Hydraulic fluid for viscosity class ISO VG 46 or VG 32<br>Max. viscosity 500 $mm^2/s$ during start-up using electric motor 1800 $min^{-1}$ | | | | | | | |
| Filtering | NAS 1638, Class 9;<br>ISO 4406, Class 20/18/15<br>Achievable using filter fineness $\beta_{20} = 75$[2]<br><br>NAS 1638, Class 7;<br>ISO 4406, Class 18/16/13; with electro-hydraulic control (RKP -D) | | | | | | | |

Table 4: Operating Conditions

[1] Maximum pressure as per ISO 5598:2008 Fluid power systems and components

[2] Dirt particles retention rate > 20 µm is 1:75, meaning 98.67 %

For special fluids, such as HFA, HFC and emulsions, other values apply in part with regard to pressure, viscosity, temperature and filtering. Information on these values can be found in the following supplemental documentation:
⇨ RKP for Fire-Resistant Fluids Catalog
⇨ Tab. 1, Page 10

# 5 Transport and Storage

**Transport and Storage**

For pumps in explosive areas, also refer to the supplementary documentation:
⇨ User Manual RKP Explosion-Proof
⇨ Tab. 1, Page 10

Always wear appropriate personal protective equipment when working on the pump.
⇨ Chap. "2.2.4 Work Safety", Page 19

## 5.1 Unpacking the Pump

**Unpacking the Pump**

**CAUTION**

**Individual parts may fall out!**
If the original packaging is opened improperly, individual parts may fall out and be damaged or lead to injuries of a worker.
- Place the pump in its original packaging on a stable surface.
- Only open the original packaging from the top.
- Dispose of the packaging material in accordance with locally applicable regulations.

**Procedure:**

1. Remove original packaging.
2. Inspect product and contents according to the purchase order.
3. Check that the packing slip and delivered product match.
4. In the event of transport damage of defects, inform the manufacturer or the supplier.
5. Store original packaging for later use or dispose of it in accordance with locally applicable regulations.

# 5.2 Transporting the Pump

**Transporting the Pump**

**WARNING**

**Danger of crushing!**
The pump may topple over during transport and lead to crushing injuries.
- Select lifting tackle to correspond with the overall weight of the pump.
- Attach the lifting tackle to the pump in the approved manner.
- Do not stand under a suspended load.

**NOTICE**

**Damage to the drive shaft!**
During transport, impact and blows to the drive shaft may damage the pump.
- Do not bang objects against the drive shaft.
- Do not place or set objects onto the drive shaft.
- Do not exceed permissible axial and radial forces to the drive shaft.

**NOTICE**

**Damage to the attached parts!**
Any heavy weight on the attached parts, for example the compensator, during transport may result in damage to such.
- Do not attach lifting tackle to the attached parts during transport.
- Make sure that the attached parts do not collide with other objects during transport.

For multiple pumps, add up the weights of the individual pumps.

**Procedure:**

1. Determine the weight and dimensions of the pump.
   ⇨ Radial Piston Pumps RKP Catalog
   ⇨ Chap. "4 Technical Data", Page 38
2. Attach suitable lifting tackle to the pump:
   - Mount the ring bolts into the attachment flange of the pressure side.
   - If the center of gravity is off-center (e.g. for multiple pumps with pump stages of the same weight): Attach the ring bolts to the exterior pumps.
3. Lift the pump carefully and transport it with supervision.

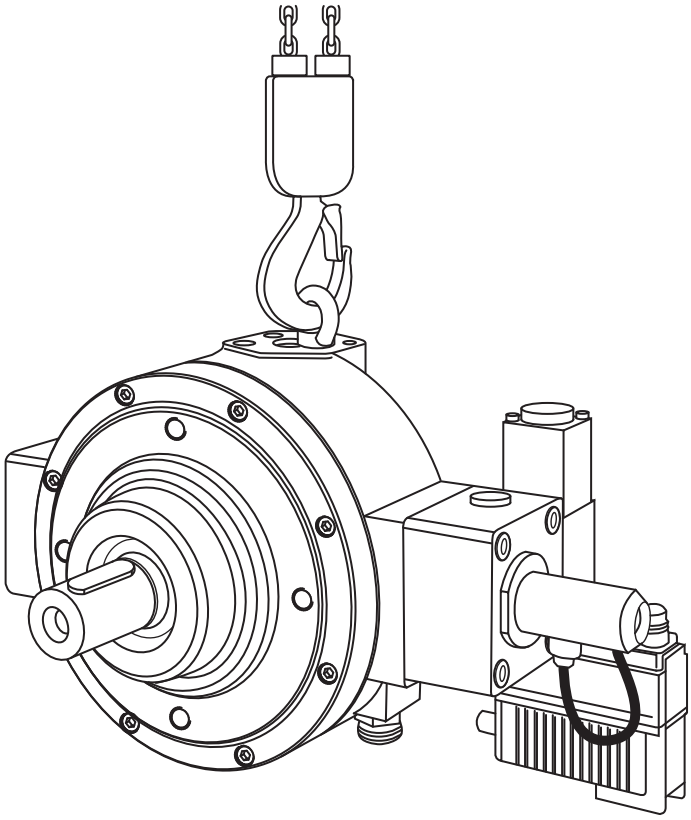


Fig. 19: Transporting Pump with Lifting Tackle

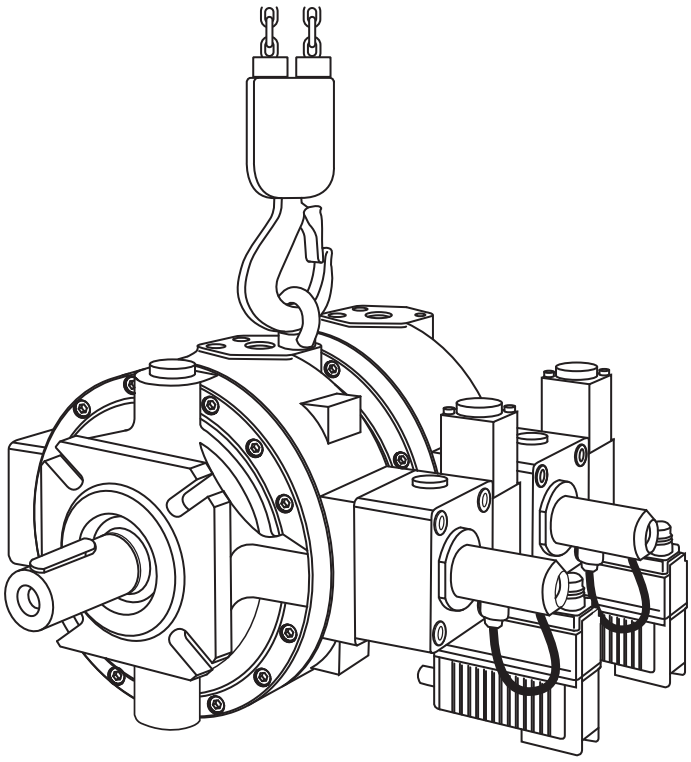


Fig. 20: Transporting Multiple Pumps with Lifting Tackle

# 5.3 Storing the Pump

**Storing the Pump**

**CAUTION**

**Property damage and personal injury due to improper storage!**
If stored improperly, the pump may topple over and be damaged or lead to injuries of a worker.
- Place the pump in its original packaging whenever possible on a stable surface.
- Secure the pump against slippage and toppling over.

**NOTICE**

**Warning of possible property and environmental damage!**
Storing the pump improperly may lead to property damage.
- Store the pump as instructed and if necessary, preserve it.

### Preservation Conditions

| Storage Duration | Preservation |
|---|---|
| up to 12 months | not required |
| > 1 year | required<br>⇨ Chap. "5.4 Preserving the Pump", Page 44 |

Table 5: Preservation Conditions

### Storage Conditions

| Storage Duration | Measures |
|---|---|
| > 1 year | Visual inspection |

Table 6: Storage Conditions

### Preconditions:

- Pump has been demounted. ⇨ Chap. "9.1 Demounting the Pump", Page 76

### Procedure:

1. Inspect to assure that all openings have been closed using flange covers or caps.
2. Check to assure that transportation protection means are attached to the pump's drive shaft.
3. Make certain that the storage space
   - is clean, dry, frost-protected and free of corrosives and vapors
   - has a consistent temperature (temperature difference < 10 °C).
4. Depending on the storage duration: Preserve the pump.
   ⇨ Tab. 5, Page 43
5. Check the storage conditions.
   ⇨ Tab. 6, Page 43
6. After delivery: No steps need to be taken.
7. After demounting: Pour a small amount of mineral oil into the pump's interior.

# 5.4 Preserving the Pump

**Preserving the Pump**

The pump should only be preserved on the exterior.

**NOTICE**

**Damage to property!**
Improper preservation or no preservation at all may cause corrosion to the pump.

- If required, properly preserve the pump
  ⇨ Chap. " Preservation Conditions", Page 43

**Preconditions:**

- Pump has been demounted. ⇨ Chap. "9.1 Demounting the Pump", Page 76
- Pump is clean and dry.
- All openings are closed using flange covers or caps.

**Procedure:**

1. Store in INTERCEPT® corrosion intercept bag or apply corrosion preventative (Castrol SafeCoat DW 18X) evenly to the pump's exterior surface.
2. Allow the pump to dry.

The pump does not need to be de-preserved before initial set-up.

# 6 Mounting

**Mounting**

For pumps in explosive areas, also refer to the supplementary documentation: ⇨ User Manual RKP Explosion-Proof
⇨ Tab. 1, Page 10

Always wear appropriate personal protective equipment when working on the pump. ⇨ Chap. "2.2.4 Work Safety", Page 19

**DANGER**

**Risk of injury and property damage as a result of leaking operating fluid or high pressure fluid ejection hazard!**
Any ejection of operating fluid under high pressure because of improper mounting may lead to serious injury or property damage.

- Only trained personnel should be allowed to mount the pump.
- Check the cleanliness of the mounting surface.
- Observe the tightening torques for the fasteners.
  ⇨ Chap. "12.2 Tightening torques", Page 84
- Use only specified fasteners (quantity/type).
- Ensure the proper flange and screws are being used as per standard (e.g. SAE).
- Check for the existence and correct position of the O-rings.
- Use the correct sealant based on the operating fluid.
- Mount all connections to be hydraulically sealed.
- Do not exceed the maximum operating pressure in the system.
- Do not exceed the maximum body pressure.

**DANGER**

**Serious personal injury!**
Starting-up the machine/equipment during the mounting process may lead to serious injuries or death.

- Ensure that the machine/equipment cannot be switched on.

## 6.1 Preparing for Mounting

**Preparing for Mounting**

The pump is pre-assembled in the factory.

**Procedure:**

1. Pump has been unpacked.
   ⇨ Chap. "5.1 Unpacking the Pump", Page 40
2. The required supplementary documentation is at hand.
3. The hydraulic plans from the machine/system manufacturer are available.
4. The required standard tools and mounting material are at hand.

# 6.2 Installing the Pump

**Installing the Pump**

**DANGER**

**Risk of death from electric shock!**
Touching any live parts can result in serious injury or death.
- Ensure that the machine/system is de-energized and is impossible to turn on again accidentally.

**WARNING**

**Danger of crushing!**
The pump can drop down as it is being mounted and crush body parts.
- Select lifting tackle that is capable of handling the total weight of the pump.
- Attach the lifting tackle to the pump in the approved manner.
  ⇨ Chap. "5.2 Transporting the Pump", Page 41
- Do not stand under a suspended load.

**WARNING**

**Risk of injury and poisoning from hazardous operating fluids!**
Any hazardous operating fluids that escape or leak can cause serious injuries.
- Check whether the operating fluids being used pose a risk.
- Ensure that the machine/system is depressurized and de-energized.
- Wear safety equipment such as work gloves.
  ⇨ Chap. "2.2.4 Work Safety", Page 19

**WARNING**

**Risk of injury and property damage as a result of vibration!**
Vibrations from machine/system parts may result in personal injury or property damage.
- Decouple the pump using suitable anti-vibration elements.

**NOTICE**

**Material damage as a result of contamination!**
Removing the caps on the pump connections can result in contamination and hence material damage.
- Do not remove the caps until just before the pipes are connected.

**NOTICE**

**Risk of damage!**
Electrical discharges can damage the internal components of the electro-hydraulic control unit of pumps (ESD).
- The pump, its accessories and spare parts must be protected from electrostatic discharges. In particular, touching the contacts of the connectors must be avoided.
- Wear ESD protective equipment.

**Preconditions:**
- The mounting area is freely accessible.
- The machine/system has been depressurized and de-energized.
- The operating fluid matches the information on the order data sheet.
- Standard tools and mounting material are at hand.
- Supplementary documentation is available.
- The specified direction of rotation of the pump corresponds to that of the drive motor.

The pump can be mounted in any position.

**Procedure:**
1. Mount the specified half of the coupling to the pump drive shaft in accordance with the instructions provided by the coupling manufacturer.

   The threaded bore on the pump drive shaft can be used to mount the coupling.

2. Ensure that the connection and mounting surfaces are clean.
   - If not, clean the connection and mounting surfaces using suitable cleaning agents.
   - Use suitable cleaning rags.
   - Do not allow the cleaning agent to enter the hydraulic circuit.
3. Ensure that the coupling hub is tightened to the drive shaft or that the drive shaft is lubricated continuously to prevent abrasion by vibration.
4. Transport the pump to the mounting location.
5. Mount the coupling to the drive according to the information provided by the coupling manufacturer.

   Only bolt the pump down after the coupling has been mounted correctly.

6. Fasten the pump with the coupling at the mounting location. Tighten the mounting screws crosswise to the appropriate tightening torque.
   ⇨ Chap. "12.2 Tightening torques", Page 84
7. For bell housing mounting: check the axial clearance of the coupling as per the information provided by the coupling manufacturer.
8. For flange mounting: align the pump supports with the drive.
9. For elastic couplings: after completing the mounting, check the drive to ensure it does not vibrate.

# 6.3 Planning Lines

**Planning Lines**

To minimize the noise output resulting from the transmission of structure-borne noise, observe the following:

- Use hoses instead of pipes.
- Secure pipes with elastic clamps.

### Suction Line

**NOTICE**

**Damage to property from cavitation!**
Lack of pressure in the suction line may lead to the formation of air bubbles in the operating fluid, which may result in severe damage to the pump.

- ▸ Configure the layout of the suction lines so that the inlet pressure cannot be any lower than the minimum of 0.8 bar absolute at the suction port.
- ▸ Ensure that the operating fluid is of the correct viscosity.

- Short suction lines with wide inside diameters are needed to ensure that the noise output is low.
- Suction speed < 1 m/sec.
- Avoid sharp angles and screwed pipe joints (danger of air intake and dispersion, high flow resistance). Use curved pipes or hoses instead.
- Maintain the minimum inlet pressure.
- Reduce the length of the suction line right before the pump entry.
- If a suction filter (min. 0.15 mm mesh aperture) or a shut-off valve is used, install the devices below the fluid level.

### Pressure Line

- Ensure sufficient stability.
- Check the tightening torques of the screws.

### Drain Line

- Install the drain line so that the pump housing is always completely filled with hydraulic fluid (use the upper connection).
- Route directly into the tank, separate from the other return lines.
- The end of the line must be below the fluid level in the tank, even at the lowest fluid level.
- The distance from the suction line should be as large as possible. Do not place a filter, cooler or non-return valve in the drain line. Max. length 3 m.
- Pressure at the drain line max. 2 bar absolute (1 bar above atmosphere).
- The recommended outside diameter of the pipe used as a drain line (lightweight version): ⇨ Tab. 3, Page 38

# 6.4 Connecting the Lines

**Connecting the Lines**

For the pump, the connections do not depend on the direction of rotation. Except for RKP19 with counterclockwise rotation the suction port is port B and the pressure port is port A.

**Procedure:**

The appropriate screw connections must be used to secure the control and leak oil port and the suction and pressure flange.

1. Remove the end caps from each connection.
2. Clean the sealing surfaces and the lines.
3. Connect the lines in accordance with the block diagram (suction line **A**, pressure line **B**). ⇨ Chap. "12.2 Tightening torques", Page 84
4. For pumps with "Load-Sensing Compensator with p-T Control Notch":
   - The tank line of the compensator must **not** be combined with the leak oil line of the pump.
5. For multiple pump arrangements that are equipped with the "load-sensing compensator with p-T control notch", in the event that a circular flow is required:
   - To activate the p-T control notch, only connect the tank line to the tank at the compensator for the first pump.
   - Close off the T-connections of the compensators for the add-on pumps.

# 6.5 Electrically Connecting the Pump

## 6.5.1 RKP-D

**RKP-D**

The pump is connected electrically to the control unit:
⇨ Application Instruction RKP-D with CAN Bus Interface, CA58548-002
⇨ Tab. 1, Page 10
⇨ RKP firmware user manual, B99224
⇨ Electrical connections user manual, CA63420-002

**NOTICE**

**Risk of damage!**
Electrical discharges can damage the internal components of the electro-hydraulic control unit of pumps (ESD).
- The pump, its accessories and spare parts must be protected from electrostatic discharges. In particular, touching the contacts of the connectors must be avoided.
- Wear ESD protective equipment.

## 6.5.2 Dual Displacement, N1

**Dual Displacement, N1**

The valve on the pump is connected using a DIN 43650 connector socket.
⇨ "Series X820 Directional Valves", product catalogue www.moog.de/literature/ICD/Moog-Cartridge-DirectionalControlValvesX820-catalog-de.pdf

# 6.6 Arranging Multiple Pumps

## 6.6.1 Determining the Through Drive Torque

**Arranging Multiple Pumps, Determining the Through Drive Torque**

Additional pump stages can be mounted axially to the pump; as a result, all pumps can be driven by the same shaft. Available for multiple mounting purposes are radial piston pumps (the maximum size to be selected should be equal to pump stage 1) or other pumps with adapter flanges for SAE-A, SAE-B or SAE-C. For the maximum permissible through drive torque of the add-on pumps, see the table below. ⇨ Tab. 7, Page 50

**Through drive torque for added RKP, SAE-A, SAE-B or SAE-C adapters**

| **Pump Stage 1** | **Pump Stage 2** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **RKP** | **RKP** | | | | | **SAE-A** | **SAE-B** | **SAE-C** |
| Size [$cm^3$/U] | 19 | 32<br>45 | 63<br>80<br>100 | 140 | 250 | – | – | – |
| 19 | 90 Nm | – | – | – | – | 90 Nm | – | – |
| 32, 45 | 185 Nm | 185 Nm | – | – | – | 110 Nm | 185 Nm | – |
| 63, 80, 100 | 400 Nm | 400 Nm | 400 Nm | – | – | 110 Nm | 280 Nm | 400 Nm |
| 140 | 400 Nm | 400 Nm | 400 Nm[1] | 620 Nm | – | 110 Nm | 280 Nm | 620 Nm |
| 250 | 400 Nm | 400 Nm | 400 Nm | 620 Nm | 1470 Nm | 110 Nm | 280 Nm | 1300 Nm |

Table 7: Permissible Through Drive Torques

[1] Special flange for 620 Nm (5,487 lbf in) upon request

The required through drive torque to drive the add-on pumps is determined using the following variables:

V [$cm^3$/R] : Displacement
p [bar] : Pressure
$\eta_{hm}$ [%] : Hydro-mechanical efficiency
M [Nm] : Through drive torque

**Through Drive Torque of Pump Stage 1 to 2:**

**Formula for Through Drive Torque for Multiple Pumps**

$$M_1 = 1.59 \cdot \sum_{i=2}^{n} \frac{V_i \cdot p_i}{\eta_{hm_i}}$$

**Example:**

Based on a pump combination
RKP 63 + RKP 63 + RKP 32 + AZP 16
280 bar, 210 bar, 150 bar, 50 bar
this would mean:

**Design of the first through drive**

The pressure and the current flow for the first pump have no effect on the torque transferred by the through drive. According to the formula shown above, this torque is the result of

$$M_1 = 1.59 \cdot \left( \frac{V_2 \cdot p_2}{\eta_{hm_2}} + \frac{V_3 \cdot p_3}{\eta_{hm_3}} + \frac{V_4 \cdot p_4}{\eta_{hm_4}} \right)$$

$M_1$ = 1.59 · (63 · 210 / 95 + 32 · 150 / 93 + 16 · 50 / 90) Nm

$M_1$ = 318 Nm

The value 318 Nm is below the threshold value of 400 Nm listed in the table for adding an RKP 63 to an RKP 63.

**Design of the second through drive**

$$M_2 = 1.59 \cdot \left( \frac{V_3 \cdot p_3}{\eta_{hm_3}} + \frac{V_4 \cdot p_4}{\eta_{hm_4}} \right)$$

$M_2$ = 1.59 · (32 · 150 / 93 + 16 · 50 / 90) Nm

$M_2$ = 96 Nm

In this case as well, the value 96 Nm is below the respective threshold value of 400 Nm for the through drive of an RKP 63 on an RKP 32.

**Design of the third through drive**

In the same manner, 14 Nm is obtained for the torque required to drive the add-on gear pump. As a result, the through drives of these pump arrangements are permissible with the specified pressure values.

**Section Diagram for Multiple Pumps**

**Section Diagram for Multiple Pumps**

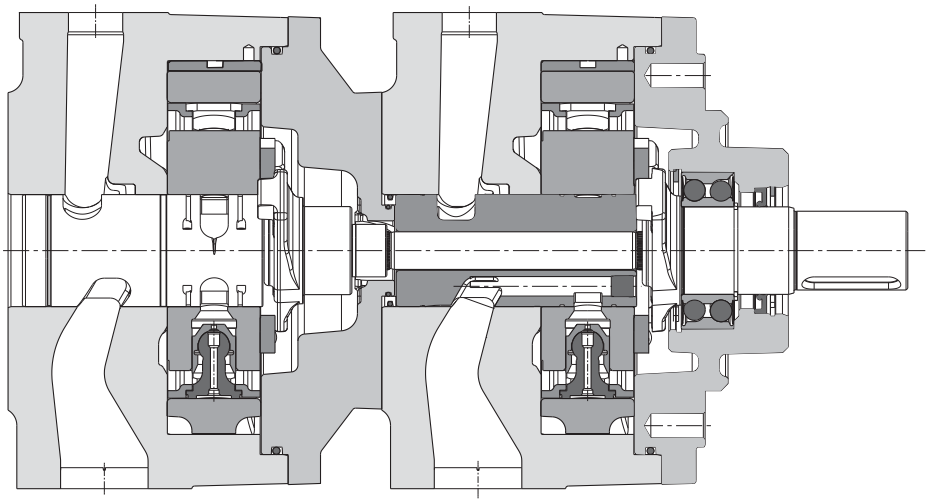


Fig. 21: Radial piston pump with heavy-duty through drive and add-on radial piston pump

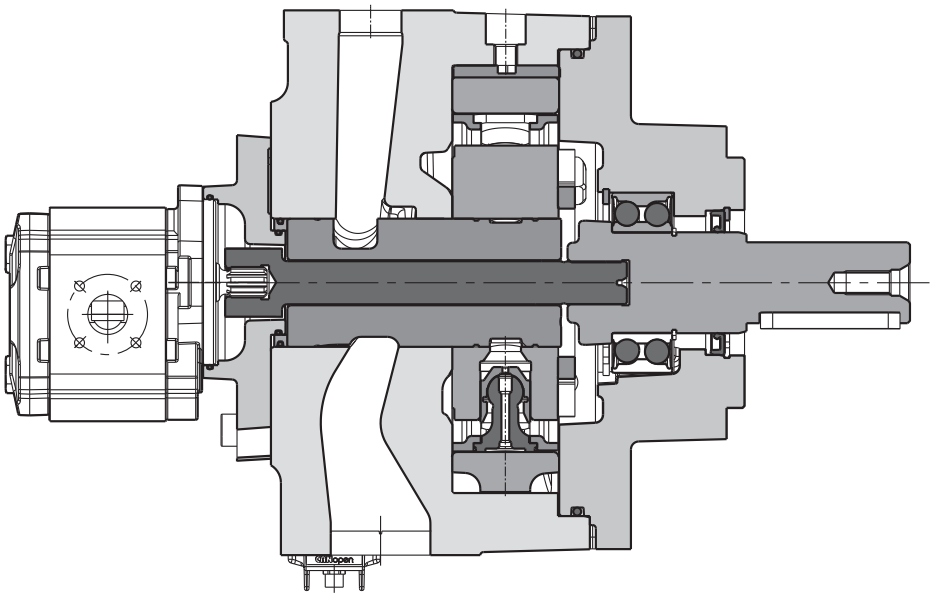


Fig. 22: Radial piston pump with add-on gear pump using SAE-A adapter

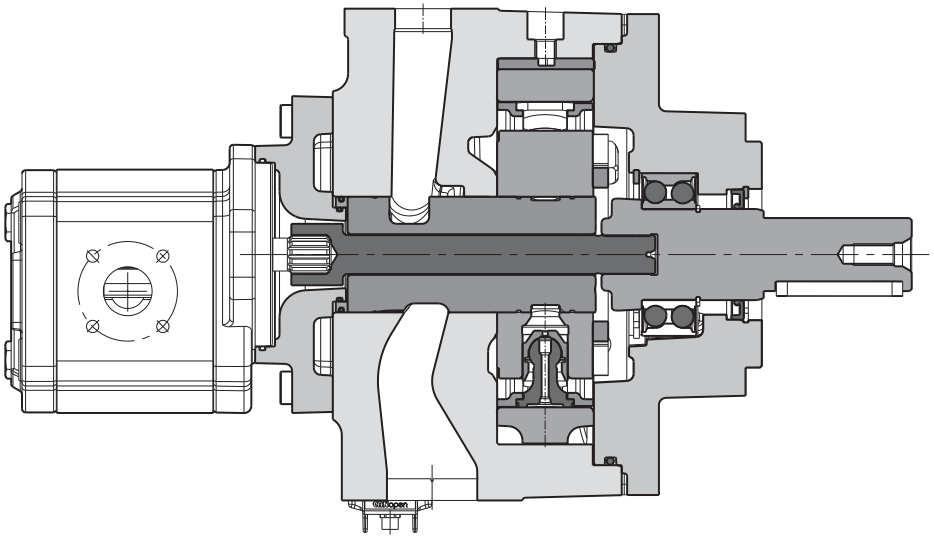


Fig. 23: Radial piston pump with add-on gear pump using SAE-B adapter

## 6.6.2 Attaching the Adapter Flange

**Attaching the Adapter Flange**

**Preconditions:**

- The centering diameters of both the adapter flange and the add-on pump match.
- The dimensions of the through drive shaft match those of the add-on pump.
- The flange diameters of both the adapter flange and the add-on pump match.
- The connection surfaces are clean.

**Procedure:**

1. Attach the adapter flange to the add-on pump without damaging the O-rings.
2. Bolt the adapter flange to the pump:
   - Observe the tightening torques for the fasteners.
     ⇨ Chap. "12.2 Tightening torques", Page 84

The following adapter flanges are available for attaching a pump:

**Adapter flange SAE-A with 9-tooth shaft**

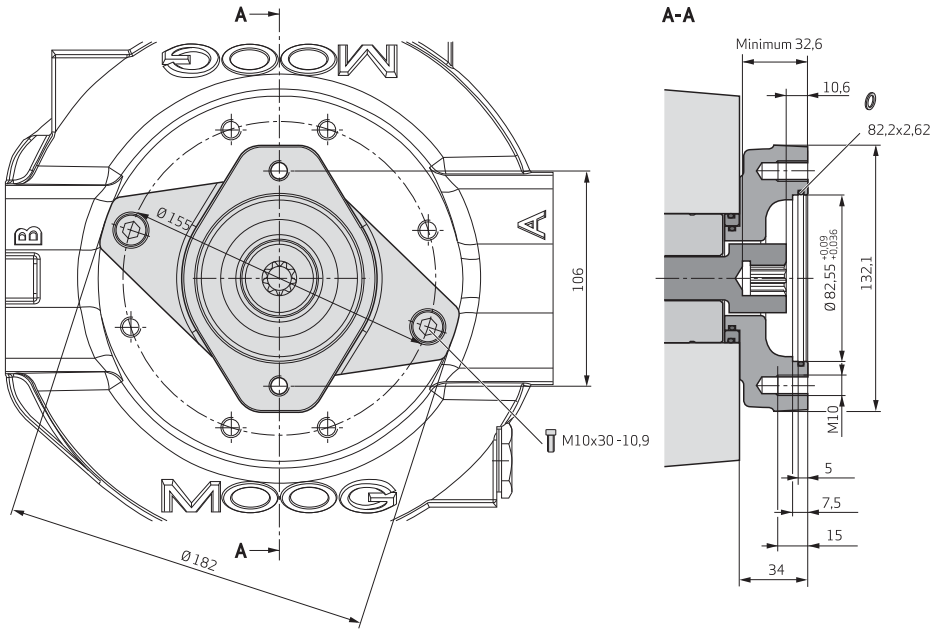



Fig. 24: Adapter flange SAE-A with 9-tooth shaft

| | |
|---|---|
| **Flange code:** | 82-2 |
| **Shaft code:** | 16-4 |
| **Spline as per:** | ANSI B92.1 9T 16/32 DP Flat root side fit |
| **Conditions for attachment:** | RKP with heavy-duty through drive |

The adapter includes a through drive shaft, seals (HNBR), an intermediate ring for RKP 63–250 and two fastening screws.

### Adapter flange SAE-B with 13-tooth shaft

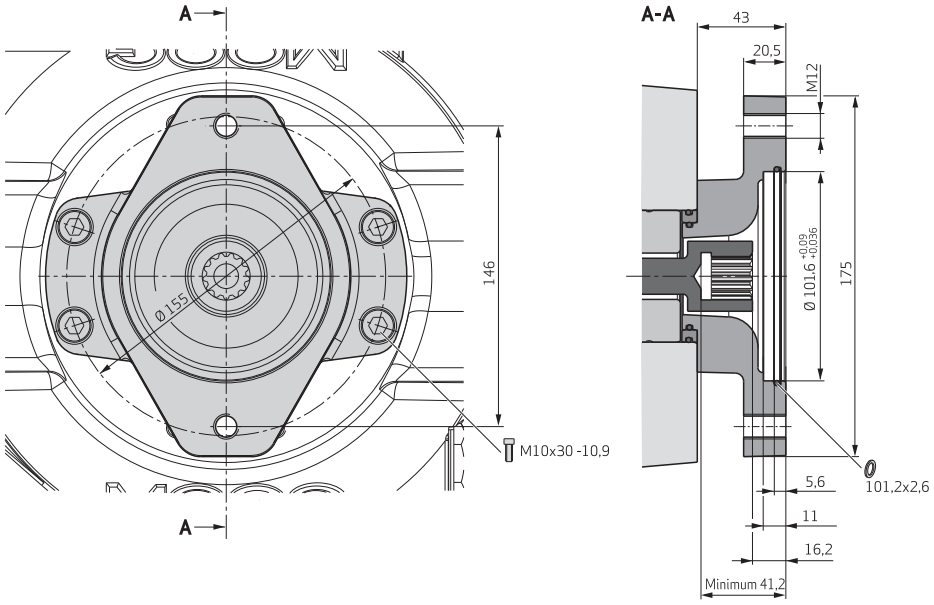



Fig. 25: Adapter flange SAE-B with 13-tooth shaft

| | |
|---|---|
| **Flange code:** | 101-2 |
| **Shaft code:** | 22-4 |
| **Spline as per:** | ANSI B92.1 13T 16/32 DP Flat root side fit |
| **Conditions for attachment:** | RKP with heavy-duty through drive |

The adapter includes a through drive shaft, seals (HNBR), an intermediate ring for RKP 63–250 and four fastening screws.

### Adapter flange SAE-C with 14-tooth shaft

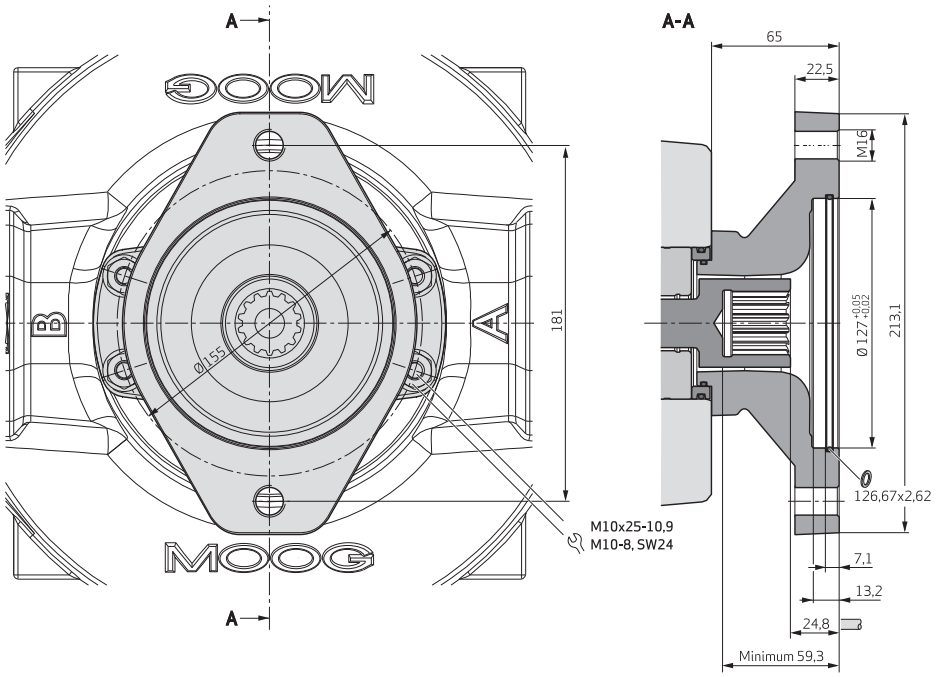



Fig. 26: Adapter flange SAE-C with 14-tooth shaft

| | |
|---|---|
| **Flange code:** | 127-2 |
| **Shaft code:** | 32-4 |
| **Spline as per:** | ANSI B92.1 14T 12/24 DP Flat root side fit |
| **Conditions for attachment:** | RKP with heavy-duty through drive |

The adapter includes a through-drive shaft, seals (HNB-R), an intermediate ring for RKP 140 and 250 and four fastening screws and special nuts.

# 7 Operation

**Operation**

For pumps in explosive areas, also refer to the supplementary documentation:
⇨ User Manual RKP Explosion-Proof
⇨ Tab. 1, Page 10

Always wear appropriate personal protective equipment when working on the pump.
⇨ Chap. "2.2.4 Work Safety", Page 19

## 7.1 Initial Pump Set-Up

**Initial Pump Set-Up**

**DANGER**

**Risk of injury and property damage as a result of hydraulic fluid squirting out!**
Risk of severe injury or death due to hydraulic fluid squirting out under high pressure.
- Only trained personnel should be allowed to initially set up the pump.
- Check that the pump is mounted correctly before start-up
- Make sure that all hydraulic ports are connected correctly.
- The maximum permissible operating pressure in the hydraulic system must not be exceeded.

**DANGER**

**Unexpected and uncontrolled movement of the machine/system may lead to severe injury or property damage!**
Unexpected or uncontrolled movements of the machine/equipment can cause serious personal injury or property damage.
- Only trained personnel should be allowed to initially set up the pump.
- Have the system manufacturer or operator assure that no uncontrolled signals are being transmitted to the pump.
- Have the system manufacturer or operator assure that a pump malfunction (e. g. piston jam caused by swarf) is recognized so that a malfunction of the axle/machine/system can be avoided.
- Make sure that all plug connections are wired and allocated correctly.
- Make sure that all hydraulic ports are connected correctly.
- Make sure that the rotational direction of the drive motor is correct.
- Check for correct drive shaft connection to the drive motor.
- Have the system manufacturer or operator assure that customer specific parameters were loaded correctly.

**WARNING**

**Unexpected or uncontrolled movements of the machine or system may lead to servere personal injury and property damage!**

Unexpected or uncontrolled movements of the machine or system may occur during the parameterization of pumps with electro-hydraulic control.

- Only trained and qualified personnel may enter settings e.g. for calibrating sensors, changing control parameters or characteristics parameters.

**WARNING**

**Risk of poisoning and injury!**

Contact with operating fluid can cause health problems such as injury to eyes, damage to the skin or inhalation poisoning.

- Before initial set-up, check the lines and connection ports for any damage.
- Adhere to the operating fluid manufacturer's instructions.

**WARNING**

**Risk of injury and property damage as a result of fire!**

Easily flammable operating fluid may cause fire.

- Keep the pump away from any open flames.

**WARNING**

**Risk of injury and property damage as a result of catching or winding!**

Freely accessible rotating machine/system parts may lead to severe injuries or property damage as a result of catching or winding.

- Use suitable protective devices to ensure that access to the drive shaft is prevented.

**CAUTION**

**Risk of burns!**

Pump components become hot during operation.

- Do not touch the pump while it is in operation.
- Wear suitable safety equipment if you have to touch the pump while it is in operation or shortly afterwards.

**NOTICE**

**Damage to the pump!**

Setting up the pump for initial operation without the required basic mechanical and hydraulic knowledge may result in damage to the pump.

- The pump may only be set up initially by qualified personnel.

## 7.1.1 Filling the Pump

**Filling the Pump**

The pump must be completely filled with operating fluid before initial operation.

**Procedure:**

1. Fill the pump through the leakage port with operating fluid completely.

**Multiple pump circuits**

For vertical installation: before operation, the pump housing of all pump stages must be filled completely with hydraulic fluid via the leakage port.

## 7.1.2 Adjusting the Compensator

**Adjusting the Compensator**

Information on the compensator functions:
⇨ Chap. "3.5 Compensator Operation", Page 25

All compensators are pre-set in the factory. In this section, information on the parameters needed to adjust the compensators is provided.

**The following information is the same for F, H, J and R compensators:**

Tightening torque for the lock nuts of the adjusting screw for adjusting the compensator pressure: WS 19 = 10 Nm + 5 Nm

**Procedure:**

1. Depending on the compensator, refer to the respective subchapter.
2. If required: Adjust the compensator according to the information provided in the subchapter.
3. For G compensators: Adjust the compensator using the lockable adjustment knob.

### 7.1.2.1 Hydraulically Driven Remote Pressure Compensator, H1

Information on the compensator:
⇨ Chap. "3.5.2 Remote Pressure Compensator, H1", Page 27

The information in this section also applies to:
⇨ Chap. "3.5.4 Load-Sensing Compensator, J1", Page 29

When high dynamics are required for flow control, orifice and control displacement, contact us to discuss application specific compensator adjustments.

**Default Compensator Settings**

$\Delta p$ = 10 bar + 2 bar or $\Delta p$ = 20 bar + 2 bar

**Hose for Control Line**

The following information shows recommended values:

Hose length approx. 800 mm

| Pump Type | NW [mm] |
|---|---|
| RKP 19 | 6 |
| RKP 32, 45 | 8 |
| RKP 63, 80, 100 | 10 |

Table 8: Nominal width for Control Line Hose

## 7.1.2.2 Load-Sensing Compensator with P-T Control Notch, R1

Information on the compensator:
⇨ Chap. "3.5.5 Combined Pressure and Flow Compensator with P-T Control Notch, R1", Page 30

**Default Compensator Settings**

RKP 16–100: ∆p = 10 bar + 2 bar
RKP 140: ∆p = 13 bar + 2 bar

**Hose for Control Line**

The following information shows recommended values:

Hose length approx. 800 mm

| Pump Type | NW [mm] | D1 [mm] | D2 [mm] |
|---|---|---|---|
| RKP 19, 32, 45 | 6 | 0.9 | 1.2 |
| RKP 63, 80, 100 | 8 | 0.9 | 1.2 |
| RKP 140 | 8 | 0.8 | 1.1 |

Table 9: Nominal width for Control Line Hose

## 7.1.2.3 Mechanical Stroke Adjustment

Information on stroke adjustments:
⇨ Chap. "3.5.6 Mechanical Stroke Adjustment, B1", Page 31

When adjusting the required displacement, make sure that the stroke ring is held tightly between the two adjusting screws. The pump is set to $V_{max.}$ on delivery.

The information in the following table refers to ⇨ Chap. 10, Page 31

| Displacement V [$cm^3$/R] | 19 | 32 | 45 | 63 | 80 | 100 | 140 |
|---|---|---|---|---|---|---|---|
| Item 1 | WS 8 = 15 Nm + 5 Nm | | | WS 8 = 26 Nm + 4 Nm | | | |
| Item 2 | WS 24 = 105 + 20 Nm | | | | | | |
| ∆V for 1 mm adjusting screw travel (pitch 1.5 mm/R) | 3.4 | 5.5 | 6.4 | 8.6 | 8.7 | 11.1 | 11.3 |

Table 10: Mechanical Stroke Adjustment

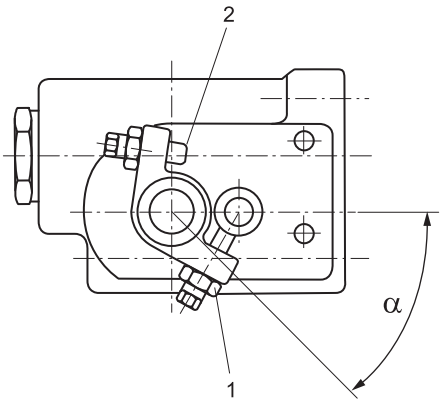
**Procedure:**

1. Set the adjusting screws of the mechanical stroke adjustment and tighten them.
   - Tightening torque: ⇨ Tab. 10, Page 59
2. Secure the adjusting screws with SEAL-Lock® sealing nuts WS 24 (M16x1.5).
   - Tightening torque: ⇨ Tab. 10, Page 59
3. Attach a note that the seal capacity can no longer be guaranteed after loosening them five times.
   - If required: replace SEAL-Lock® sealing nut.

### 7.1.2.4 Servo Control, C1

Information about the Servo Control:
⇨ Chap. "3.5.7 Servo Control, C1", Page 32

The zero position and the end position are set at the factory. Manual or mechanical operations are performed using the adjustment lever.




| Item | Description |
|---|---|
| 1 | Zero position (set at the factory) |
| 2 | End position / $\pm V_{max.}$ (set at the factory) |

Fig. 27: Servo Control, C1

| Displacement V [$cm^3$/R] | | 19 | 32 | 45 | 63 | 80 | 100 |
|---|---|---|---|---|---|---|---|
| Angle α [°] | | 44 | 47 | 57 | 44 | 56 | 56 |
| Control torque M [Nm] | Zero position | 1.2 | | | 1.6 | | |
| | End position | 1.6 | 1.7 | | 2.4 | 2.6 | 2.6 |
| | max. | 8 | | | | | |

Table 11: Servo Control Adjustment Torques

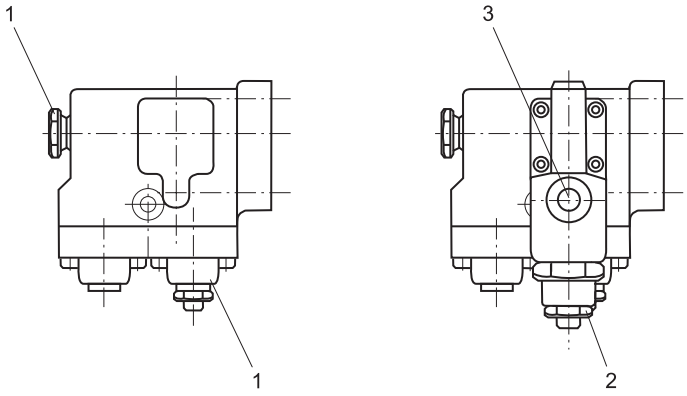
**Procedure:**

1. Regulate the pump's displacement by positioning the adjustment lever.

## 7.1.2.5 Power Control, S1, S2

Information on the power control:
⇨ Chap. "3.5.8 Power Control, S1", Page 33
⇨ Chap. "3.5.9 Power Control, S2", Page 36

**The power control settings are set at the factory and may not be changed!**




| Item | Description |
|---|---|
| 1 | Power control setting (set at the factory; must not be changed) |
| 2 | Pressure decrease (set at the factory: ∆p = 10 bar + 2 bar) |
| 3 | Control port G 1/4" |

Fig. 28: Power Control, S1, S2

### Default Compensator Settings

∆p = 10 bar + 2 bar

### Hose for Control Line

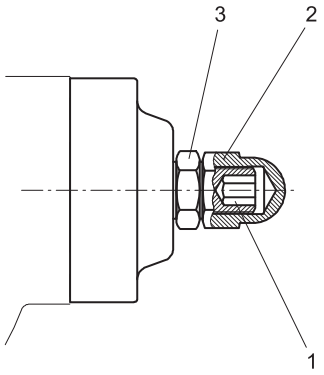
The following information shows recommended values:

Hose length approx. 800 mm

| Pump Type | NW [mm] |
|---|---|
| RKP 19 | 6 |
| RKP 32, 45 | 8 |
| RKP 63, 80, 100 | 10 |

Table 12: Nominal width for Control Line Hose

## 7.1.2.6 Limiting the Maximum Flow




| Item | Description |
|---|---|
| 1 | Adjusting screw |
| 2 | Cap nut |
| 3 | Lock nut |

Fig. 29: Limiting the Maximum Flow

| Displacement V [$cm^3$/R] | 19 | 32 | 45 | 63 | 80 | 100 | 140 | 250 |
|---|---|---|---|---|---|---|---|---|
| Item 1 | WS 8 | | | WS 12 | | | WS 10 | WS12 |
| Item 2 | WS 24 = 40 Nm + 10 Nm | | | WS 32 = 80 Nm + 10 Nm | | | WS 27 = 80 Nm + 10 Nm | WS 32 = 80 Nm + 10 Nm |
| Item 3 | WS 24 = 50 Nm + 10 Nm | | | WS 32 = 90 Nm + 10 Nm | | | WS 27 = 90 Nm + 10 Nm | WS 32 = 90 Nm + 10 Nm |
| ∆V for 1 mm adjusting screw travel (pitch 1.5 mm/rev) | 3.4 | 5.5 | 6.4 | 8.6 | 8.7 | 11.1 | 11.3 | 21.9 |

Table 13: Adjustments Limiting the Maximum Flow

### 7.1.2.7 Dual Displacement, N1

Information on Dual Displacement:
⇨ Chap. "3.5.10 Dual Displacement, N1", Page 37

The minimum ($V_{min.}$) and maximum displacement ($V_{max.}$) is set at the factory:

Factory setting: $V_{min.} = 0.5 \cdot V_{max.}$

The settings of $V_{min.}$ and $V_{max.}$ can be changed by turning the adjusting screws (⇨ Tab. 14, Page 63).
In order for the pump to work properly, it must be ensured that $V_{min.}$ is always $> 0.1 \cdot V_{max.}$ whenever the $V_{min.}$ setting is changed. $V_{max.}$ in this sense is always the maximum possible geometric displacement of the pump.

The information in the following table refers to
⇨ Chap. 18, Page 37.

| **Displacement V [cm³/rev]** | **19** | **32** | **45** | **63** | **80** | **100** | **140** |
|---|---|---|---|---|---|---|---|
| Item 1 | WS 24 = 105 + 20 Nm | | | | | | |
| ΔV for 1 mm adjusting screw travel (pitch 1.5 mm/rev) | 3.4 | 5.5 | 6.4 | 8.6 | 8.7 | 11.1 | 11.3 |

Table 14: Dual Displacement, N1

**Procedure:**

1. Set the adjusting screw of $V_{min.}$and $V_{max.}$.
2. Secure the adjusting screws with SEAL-Lock® sealing nuts WS 24 (M16x1.5).
   - Tightening torque: ⇨ Tab. 14, Page 63
3. Attach a note that the seal capacity can no longer be guaranteed after loosening them five times.
   - If required: replace SEAL-Lock® sealing nut.

# 7.2 Performing Functional Tests

**Performing Functional Tests**

The functional tests are performed to ensure that the pump has been installed into the machine/system properly.

**Preconditions:**

- Initial set-up of the pump is complete: ⇨ Chap. "7.1 Initial Pump Set-Up", Page 56
- The end caps on the through drive of the pump stages have been removed.
- It has been assured that the pump is being supplied with operating fluid.
- The pump has been visually inspected, with particular attention given to the lines and port connections.

**Procedure:**

1. Carry out the functions tests in accordance with the instructions provided by the machine/system manufacturer.

2. In doing so, watch especially for:
   - Noise development
   - Any exterior leaks

**WARNING**

**Unexpected or uncontrolled movements of the machine or system may lead to servere personal injury and property damage!**

Unexpected or uncontrolled movements of the machine or system may occur during the electrical signals measurement on pumps with electro-hydraulic control.

- Only trained and specially instructed personnel may perform work such as sensor calibration, or the modification of control parameters or characteristics.

# 7.3 Operating the Pump

**Operating the Pump**

**DANGER**

**Personal injury and property damage!**
Incorrectly setting the pump in operation may lead to unexpected and uncontrolled movements of the machine/system and as a result may lead to bodily injuries or property damage.

- Only trained personnel should be allowed to operate the pump.
- Have the system manufacturer or operator assure that no uncontrolled signals are being transmitted to the pump.
- Have the system manufacturer or operator assure that a pump malfunction (e. g. piston jam caused by swarf) is recognized so that a malfunction of the axis/machine/system can be avoided.

**WARNING**

**Unexpected or uncontrolled movements of the machine or system may lead to servere personal injury and property damage!**
While parameters for electro-hydraulically controlled pumps are being entered, or as a result of those parameters, there is always the possibility that the machine or system will make an unexpected or uncontrolled movement.

- Only trained and specially instructed personnel may perform work such as sensor calibration, or the modification of control parameters or characteristics.

**WARNING**

**Risk of injury and property damage as a result of engaging or winding!**
Freely accessible rotating machine/system parts may lead to severe injuries or property damage as a result of engaging or winding.

- Use suitable protective devices to ensure that access to the drive shaft is prevented.

**WARNING**

**Risk of injury and property damage as a result of vibration!**
Vibrations from machine/system parts may result in personal injury or property damage.

- Decouple the pump using suitable anti-vibration elements.

**CAUTION**

**Risk of personal injury and property damage!**
Altering the configuration of the pumps may change the functionality of the pump to such an extent that it leads to damage, malfunction or failure of the pump or machine.

- Modifying the pump configuration while the pump is in operation is only permitted if such an action does not place the machine and its environment in a hazardous condition.

**CAUTION**

**Risk of burns!**
Pump components become hot during operation.

- Do not touch the pump while it is in operation.
- Wear suitable safety equipment if you have to touch the pump while it is in operation or shortly afterwards.

**CAUTION**

**Unexpected or uncontrolled movements of the machine or system may lead to servere personal injury and property damage!**
Unexpected or uncontrolled movements of the machine or system may occur during the electrical signals measurement on running pumps with electro-hydraulic control.

- Only trained and specially instructed personnel may perform work such as sensor calibration, or the modification of control parameters or characteristics.

**CAUTION**

**Risk of personal injury and property damage!**
Improper protective grounding and shielding can cause damage, malfunctions or failures of the pump or machine.

- The pumps with electro-hydraulic control should only be used in such machines and systems which comply with the requirements of the standard EN 60204-1.

**CAUTION**

**Risk of burns!**
The radial piston pump and the hydraulic connection lines can get very hot during operation and may burn your skin if you touch them.

- Wear suitable safety equipment such as work gloves.
- Allow the pump and the connection cable to cool off before contact.

**CAUTION**

**Noise!**
Operating the machinery may expose its operators to loud noise, which can lead to hearing damage.

- The manufacturer/operator must take appropriate soundproofing measures, such as to stipulate that ear protection be worn.

**NOTICE**

**Damage to property!**
Operating the pump without operating fluid will cause the pump to run dry and to damage.

- Only activate the pump when the pump housing is completely filled with operating fluid.
- Ensure that the pump housing remains filled with operating fluid at all times while the pump is running.

On pumps with electro-hydraulic control, the protective conductor connection - if present - is connected to the electronics housing or the control valve body. The insulating elements used are designed for the safety extra-low voltage range. The circuits of the field bus connections, if provided, are only functionally isolated from other circuits.

Compliance with the safety regulations requires that the equipment be isolated from mains system in accordance with EN 61558-1 and EN 61558-2-6 and that all voltages be limited in accordance with EN 60204-1. We recommend the use of SELV/PELV power packs.

## 7.3.1 Start up

**Start up**

**Preconditions:**

- Pump has been filled: ⇨ Chap. "7.1.1 Filling the Pump", Page 58
- The temperature of the operating fluid in the tank must not exceed the pump temperature by more than 25 °C.

**Procedure:**

If the temperature of the operating fluid in the tank exceeds the pump temperature by more than 25 °C, the pump should only be switched on in short intervals of 1 to 2 seconds until it warms up.

1. Start up the drive motor.
2. Check the rotational direction of the drive motor.
3. Operate the pump at low pressure until the hydraulic system has been fully de-aerated.
4. For pumps with HF fluids: Run the pump for approx. one hour at low pressure (30 to 50 bar).

## 7.3.2 Flushing the Pump

**Flushing the Pump**

If the pump is operated for longer periods of time at low pressure without delivery (t > 15 min, p < 30 bar, Q = 0 l/min) it will be necessary to flush the pump to dissipate the heat. The 140 $cm^3$/rev and 250 $cm^3$/rev pumps must always be flushed.

**Procedure:**

1. The flushing line must be connected to the pump's lowest leakage connection. For RKP250 use leakage port L2.
2. Flush the pump using operating fluid quantities depending on pump size:

| **Displacement V [$cm^3$/R]** | **19** | **32** | **45** | **63** | **80** | **100** | **140** | **250** |
|---|---|---|---|---|---|---|---|---|
| Flushing quantity [l/min] | 4–6 | | | | | | 6–8 | 10–12 |

Table 15: Flushing Quantity

# 7.4 Placing the Pump out of Operation

**Placing the Pump out of Operation**

**DANGER**

**Risk of personal injury and property damage as the result of uncontrolled movements!**
Unexpected or uncontrolled movements of the machine/equipment can cause serious personal injury or property damage.
- Only trained personnel should be allowed to demount the pump.
- Check with the equipment manufacturer or operator that no uncontrolled signals will be sent to the pump.
- Ensure that the drive motor cannot start up.

**DANGER**

**Risk of death from electric shock!**
Touching any live parts can result in serious injury or death.
- Ensure that the machine/system is de-energized.

**WARNING**

**Risk of injury and poisoning from hazardous operating fluids!**
Escaping operating fluid may lead to severe personal injury and property damage.
- Only trained personnel should be allowed to place the pump out of operation.

**WARNING**

**Risk of injury and poisoning from hazardous operating fluids!**
Any hazardous operating fluids that escape or leak can cause serious injuries.
- Check whether the operating fluids being used pose a risk.
- Ensure that the machine/system is depressurized and de-energized.
- Wear safety equipment such as work gloves.
  ⇨ Chap. "2.2.4 Work Safety", Page 19

**WARNING**

**Danger of crushing!**
The pump can drop down as it is being mounted and crush body parts.
- Select lifting tackle that is capable of handling the total weight of the pump.
- Attach the lifting tackle to the pump in the approved manner.
  ⇨ Chap. "5.2 Transporting the Pump", Page 41
- Do not stand under a suspended load.

**WARNING**

**Risk of burns!**
Pump components become hot during operation.
- Do not touch the pump while it is in operation.
- Wear suitable safety equipment if you have to touch the pump while it is in operation or shortly afterwards.

**Preconditions:**

- The drive motor has been switched off and is secured from being switched back on.
- Machine/system is at zero pressure and in dead-voltage state.
- Pump has cooled down.

**Procedure:**

1. Close the fittings on the suction and pressure side.
2. Completely drain the pump through the leakage oil port.
3. Depending on what is required:
   - Remove the pump:
     ⇨ Chap. "9.1 Demounting the Pump", Page 76
   - Store the pump:
     ⇨ Chap. "5.3 Storing the Pump", Page 43

# 7.5 Reconnecting the Pump

**Reconnecting the Pump**

**DANGER**

**Risk of personal injury and property damage as the result of uncontrolled movements!**
Unexpected or uncontrolled movements of the machine/equipment can cause serious personal injury or property damage.
- Only trained personnel should be allowed to demount the pump.
- Check with the equipment manufacturer or operator that no uncontrolled signals will be sent to the pump.
- Ensure that the drive motor cannot start up.

**DANGER**

**Risk of death from electric shock!**
Touching any live parts can result in serious injury or death.
- Ensure that the machine/system is de-energized.

**WARNING**

**Risk of burns!**
Pump components become hot during operation.
- Do not touch the pump while it is in operation.
- Wear suitable safety equipment if you have to touch the pump while it is in operation or shortly afterwards.

**WARNING**

**Danger of crushing!**
The pump can drop down as it is being mounted and crush body parts.
- Select lifting tackle that is capable of handling the total weight of the pump.
- Attach the lifting tackle to the pump in the approved manner. ⇨ Chap. "5.2 Transporting the Pump", Page 41
- Do not stand under a suspended load.

**WARNING**

**Risk of injury and poisoning from hazardous operating fluids!**
Any hazardous operating fluids that escape or leak can cause serious injuries.
- Check whether the operating fluids being used pose a risk.
- Ensure that the machine/system is depressurized and in dead-voltage state.
- Wear safety equipment such as work gloves. ⇨ Chap. "2.2.4 Work Safety", Page 19

**Preconditions:**

- If the pump was stored: Measures were carried out that were necessary because of the duration of storage. ⇨ Tab. 6, Page 43
- Pump is installed. ⇨ Chap. "6 Mounting", Page 45

**Procedure:**

1. Carry out all the steps applicable for the initial set-up of the pump. ⇨ Chap. "7.1 Initial Pump Set-Up", Page 56

# 8 Maintenance and Repairs



**DANGER**

**Risk of personal injury and property damage as the result of uncontrolled movements!**
Unexpected or uncontrolled movements of the machine/equipment can cause serious personal injury or property damage.

- Only trained personnel should be allowed to demount the pump.
- Check with the equipment manufacturer or operator that no uncontrolled signals will be sent to the pump.
- Ensure that the drive motor cannot start up.
- Ensure that the operation of the pump will not be impaired by maintenance and repairs.

**DANGER**

**Risk of death from electric shock!**
Touching any live parts can result in serious injury or death.

- Ensure that the machine/system is de-energized.

**WARNING**

**Danger of crushing!**
The pump can drop down as it is being mounted and crush body parts.

- Select lifting tackle that is capable of handling the total weight of the pump.
- Attach the lifting tackle to the pump in the approved manner. ⇨ Chap. "5.2 Transporting the Pump", Page 41
- Do not stand under a suspended load.

**WARNING**

**Risk of burns!**
Pump components become hot during operation.

- Do not touch the pump while it is in operation.
- Wear suitable safety equipment if you have to touch the pump while it is in operation or shortly afterwards.

**WARNING**

**Unexpected or uncontrolled movements of the machine or system may lead to servere personal injury and property damage!**
While parameters for electro-hydraulically controlled pumps are being entered, or as a result of those parameters, there is always the possibility that the machine or system will make an unexpected or uncontrolled movement.

- Only trained and specially instructed personnel may perform work such as sensor calibration, or the modification of control parameters or characteristics.

**WARNING**

**Risk of injury and poisoning from hazardous operating fluids!**
Any hazardous operating fluids that escape or leak can cause serious injuries.
- Check whether the operating fluids being used pose a risk.
- Ensure that the machine/system is depressurized and de-energized.
- Wear safety equipment such as work gloves.
  ⇨ Chap. "2.2.4 Work Safety", Page 19

**CAUTION**

**Risk of personal injury and property damage!**
Altering the configuration of the pumps may change the functionality of the pump to such an extent that it leads to damage, malfunction or failure of the pump or machine.
- Modifying the pump configuration while the pump is in operation is only permitted if such an action does not place the machine and its environment in a hazardous condition.

For pumps in explosive areas, also refer to the supplementary documentation:
⇨ User Manual RKP Explosion-Proof
⇨ Tab. 1, Page 10

Always wear appropriate personal protective equipment when working on the pump.
⇨ Chap. "2.2.4 Work Safety", Page 19

Purging with compressed air or spraying/rinsing with pressurized fluids in the area around the rotary shaft seal is prohibited.

# 8.1 Monitoring

**Monitoring**

| Tasks | Intervals |
|---|---|
| Check pump for leaks | Daily |
| Check pump for noises | Daily |
| Check that fastening screws are tightened | Monthly |
| Check the operating temperature of the machine under constant operating conditions | Weekly |
| Check the level of operating fluid in the machine | Daily |
| Check the quality of the operating fluid | Annually or every 2000 operating hours |

Table 16: Monitoring

# 8.2 Troubleshooting

**Troubleshooting**

Should any repairs be necessary because of a fault with the pump, these should only be carried out by one of our service technicians or by an authorized service center.
⇨ Chap. "2.2.3 Structural Modifications", Page 18
⇨ Chap. "8.3 Moog Service Addresses", Page 75

| Fault | Cause | Repair |
|---|---|---|
| Radial Piston Pump | | |
| Peculiar noises | Cavitation,<br>pump sucking air,<br>speed too high,<br>mechanical damage | Configure the inlet suction so that the pressure in the suction line is not below its specified minimum level,<br>limit the speed,<br>contact us and have damaged parts replaced |
| Volume flow too low or non-existent | Pump has no change in displacement and does not extend, leak in the pump, performance of drive motor and pump do not match, wear caused by dirt, rotary group damage | Check inlet suction,<br>check for wear,<br>check adjustable parts,<br>contact us and have damaged parts replaced |
| Pressure too low or non-existent | Pump has no change in displacement and does not extend, leak in the pump,performance of drive motor and pump do not match, wear caused by dirt, rotary group damage | Check displacement,<br>seal leaky lines,<br>check control fluid supply,<br>contact us and have damaged parts replaced |
| Fluctuations in the pressure or volume flow | pump sucking air in, leak in the pump, wear caused by dirt, rotary group damage, unstable behavior of the compensator | Seal leaking areas,<br>check the configuration of the orifice and, if necessary,<br>use the correct orifice,<br>check the dimensions of the hose for control oil and, if necessary,<br>replace with the correct hose for control oil, contact us and have damaged parts replaced |

Table 17: Troubleshooting

# 8.3 Moog Service Addresses

Visit www.moog.com/worldwide to find your nearest location for application engineering, repairs and service.

**Moog Service Addresses**

# 9 Demounting

**Demounting**

For pumps for operation in hazardous areas, also refer to the supplementary documentation:
⇨ User Manual RKP Explosion-Proof
⇨ Tab. 1, Page 10

Always wear appropriate personal protective equipment when working on the pump.
⇨ Chap. "2.2.4 Work Safety", Page 19

## 9.1 Demounting the Pump

**Demounting the Pump**

This section describes how to remove the pump so that it can be sent to us or an authorized service workshop for repair; it does not describe how to dismantle the pump.

Purging with compressed air or spraying/rinsing with pressurized fluids in the area around the rotary shaft seal is prohibited.

**DANGER**

**Risk of death from electric shock!**
Touching any live parts can result in serious injury or death.
- Ensure that the machine/system is in dead voltage state and is impossible to turn on again accidentally.

**WARNING**

**Danger of crushing!**
The pump can drop down as it is being demounted and crush body parts.
- Select lifting tackle appropriate for the total weight of the pump.
- Attach the lifting tackle to the pump in the approved manner. ⇨ Chap. "5.2 Transporting the Pump", Page 41
- Do not stand under a suspended load.

**WARNING**

**Risk of injury and poisoning from hazardous operating fluids!**
Any hazardous operating fluids that escape or leak can cause serious injuries.
- Check whether the operating fluids being used pose a risk.
- Ensure that the machine/system is depressurized and de-energized.
- Wear safety equipment such as work gloves. ⇨ Chap. "2.2.4 Work Safety", Page 19

**WARNING**

**Risk of burns!**
Pump components become hot during operation.
- Allow the pump to cool down before demounting it.
- Wear suitable safety equipment if you have to touch the pump as it is being demounted.

**NOTICE**

**Material damage as a result of contamination!**
Removing the caps on the pump connections can result in contamination and hence material damage.
- Do not remove the caps until just before the pipes and hoses are connected.

**Preconditions:**

- Pump has been taken out of operation: ⇨ Chap. "7.4 Placing the Pump out of Operation", Page 69
- The demounting site is freely accessible.
- The machine/system has been depressurized and in dead voltage state.
- Operating fluids have been checked for possible risks and any necessary safety precautions have been implemented.
- Standard tools are available.
- Supplementary documentation is available.

**Procedure:**

1. Disconnect all electrical connections to the pump:
   ⇨Application Instruction RKP-D with CAN Bus Interface
   ⇨ Tab. 1, Page 10
2. Place a tray underneath the pump to collect the emerging operating fluid.
3. Disconnect the pipes from the pump.
4. Drain the pump completely.
5. Attach caps and flange covers to the pump.
6. Attach suitable lifting tackle to the pump. ⇨ Chap. "5.2 Transporting the Pump", Page 41
7. Detach the pump and coupling from the drive motor.
8. Place the pump on a stable, load-bearing surface.
9. Detach the lifting tackle from the pump.
10. Detach the coupling from the pump drive shaft in accordance with the instructions provided by the coupling manufacturer.
11. Attach transport protection to the ends of the pump drive shaft.

# 10 Spare Parts, Accessories, Repairs

**Spare Parts, Accessories**

The operator is not authorized to install spare parts and accessories. Repairs or other structural modifications to the pump may only be carried out by us or by an authorized service repair center.
⇨ Chap. "2.2.3 Structural Modifications", Page 18

**Tools**

For all tasks described in this User Manual, available standard tools may be used.

**CAUTION**

**Risk of personal injury and property damage!**
Like new pumps, spare pumps are also delivered with the relevant factory settings. In the event of a repair job for defective pumps, neither we nor our authorized service centers shall accept any liability for software, data and settings installed by the customer.

- Check the pumps for correct mechanical design and correct configuration before start-up.

**CAUTION**

**Risk of personal injury and property damage!**
Altering the configuration of the pumps may change the functionality of the pump in such way, that it leads to damage, malfunction or failure of the pump or machine.

- Modifying the pump configuration while the pump is in operation is only permitted if such an action does not place the machine and its environment in a hazardous condition.

**CAUTION**

**Property damage to the pump or system!**
Unsuitable or defective accessories or spare parts may lead to pump or machine/system failure as a result of damage.

- We recommend: Only use original accessories or original spare parts.
- All warranties and liability claims shall be void for injuries or property damage as a result of using unsuitable or defective accessories or spare parts.
  ⇨ Chap. "1.5 Warranty and Liability", Page 13

**Repairs**

**Steps to be taken when carrying out repair work:**

1. For repairs to the pump:
   ⇨ Chap. "9.1 Demounting the Pump", Page 76
2. Package the pump for transport to our facility or to an authorized service repair shop, preferably in its original packaging material.
   ⇨ Chap. "8.3 Moog Service Addresses", Page 75

**Moog Global Support**

Moog Global Support provides professional repair and corrective maintenance services of the highest level thanks to our experienced technicians. Our customer service and our professional expertise ensure that your systems will always remain in an optimal state. We offer the reliability that you can only expect from a leading manufacturer with branch offices around the globe.

**MOOG Global Support Logo**

**Your advantages:**

- Shorter downtimes, critical systems can be continuously operated at a high performance level
- Investment security thanks to the reliability, adaptability, and guaranteed life span of our products
- Optimized corrective maintenance planning and system set-up
- Use of our flexible corrective maintenance program according to your service requirements

**Our range of services:**

- Repair with original parts by trained technicians according to the latest Moog specifications
- Provision of original spare parts and products in order to avoid unplanned downtimes
- Flexible programs according to your needs for preventative corrective maintenance and set-up thanks to annual or multi-year contracts
- On-site service for start-up, set-up, and fault diagnosis
- Reliable service with the same high quality anywhere in the world

For more information about Moog Global Support, visit http://www.moog.com/industrial

In the event of a repair job for defective pumps, we and our authorized service centers reserve the right to perform a repair, or alternatively, to supply replacement pumps with an identical or compatible equipment specification upon consultation with the customer.

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

# 11 Index



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A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

## T



## U



## W



A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

# 12 Appendix

## 12.1 Abbreviations, Symbols and Code Letters

**Abbreviations, Symbols and Code Letters**

| Abbr. | Explanation |
|---|---|
| $\beta_x$ | Symbol for filter fineness |
| $\Delta p$ | Symbol for pressure drop |
| $\Delta p_N$ | Symbol for nominal pressure drop |
| $\nu$ | Symbol for viscosity |
| **A** | Connection port (suction port, except for RKP19 with counterclockwise rotation port A is the pressure port) |
| **ANSI** | **A**merican **N**ational **S**tandards **I**nstitute (http://www.ansi.org) |
| **ATEX** | **At**mosphère **ex**plosible (synonymous for the EU Directive pertaining toexplosion protection) |
| **B** | Connection port (pressure port, except for RKP19 with counterclockwise rotation port B is the suction port) |
| **D** | Orifice |
| **D1, D2** | Orifice diameter |
| **DIN** | **D**eutsches **I**nstitut für **N**ormung e. V. (German Institute for Standardization) (http://www.din.de) |
| **EN** | **E**uropa-**N**orm (European standard) |
| **EU** | **E**uropean **U**nion |
| **HFA** | Special operating fluid: consists of approx. 95 % water |
| **HFC** | Special operating fluid: water-based polymer solution |
| **HNBR** | **H**ydrogenated **N**itrile **B**utadiene **R**ubber (sealing compound, such as O-rings) - |
| **ISO** | **I**nternational **O**rganization for **S**tandardization (http://www.iso.org) |
| **M** | Symbol for through-drive torque |
| $M_A$ | Tightening torque |
| **n** | Revolution speed |
| $n_{max.}$ | Maximum revolution speed |
| **NW** | **N**ominal **w**idth |
| $\eta_{hm}$ | Symbol for hydraulic-mechanical efficiency |
| **p** | Symbol for pressure |
| $p_{min.}$ | Symbol for minimum pressure |
| $p_{max.}$ | Symbol for maximum pressure |
| $p_N$ | Symbol for nominal pressure |
| $p_n$ | Symbol for maximum operating pressure |
| **P** | Connection port (pressure connection) |
| **Q** | Symbol for flow |
| **Q** | Symbol for pump displacement |
| **SAE** | American series of standards (parallel to DIN-EN standards) |
| **WS** | **W**idth **A**cross **F**lats for wrenches |
| **t** | Symbol for time |
| **T** | Symbol for temperature |
| **T** | Connection port (**t**ank connection) |
| **TÜV** | **T**echnischer **Ü**berwachungs**v**erein (German Technical Inspection Agency) |
| **rev** | Revolution |

Table 18: Abbreviations, Symbols and Code Letters (Part 1 of 2)

| Abbr. | Explanation |
|---|---|
| **V** | Symbol for volume (such as tank capacity) |
| **$V_{max.}$** | Symbol for maximum displacement |
| $V_{min.}$ | Symbol for minimum displacement |
| **ΔV** | Change in pump displacement |
| **VDI** | **V**erein **D**eutscher **I**ngenieure e. V. (Association of German Engineers) (http://www.vdi.de) |
| **VDE** | **V**erband **d**er **E**lektrotechnik Elektronik Informationstechnik e. V. (German Association of Electrical Engineering, Electronics and Information Technology) (http://www.vde.de) |
| **X** | Control port |
| **L** | Leakage port |

Table 18: Abbreviations, Symbols and Code Letters (Part 2 of 2)

# 12.2 Tightening torques

**Tightening torques**

The data on the tightening torque in this segment is considered as reference values only. Preference should be given to the data provided by each manufacturer of the particular machine part!

### Flange for Suction and Pressure Connection

Flanges with corresponding screws and sealing elements are to be used in accordance with the information provided by the flange manufacturer. Respective tightening torques should be gathered from the information provided by the flange manufacturer or as per standard ISO 6162.

### Mounting screws

As per DIN 13 or ISO 68, in individual cases, tightening torques should be checked in accordance with VDI 2230.

Mounting screws for SAE-A, SAE-B and SAE-C flange:

| Adapter Flange Type | Thread Size | Max. Permissible Tightening Torque |
|---|---|---|
| SAE-A | M 10 | 58 ... 78 Nm |
| SAE-B | M 10 | 62 ... 75 Nm |
| SAE-C | M 10 | 62 ... 75 Nm |

Table 19: Tightening torques for mounting screws

### Sealing Plugs Form E with ED Seal (Reference Values)

| Thread Size | Max. Permissible Tightening Torque |
|---|---|
| M 18x1.5 | 65 Nm (+10 %) |
| M 22x1.5 | 90 Nm (+10 %) |
| M 26x1.5 | 135 Nm (+10 %) |
| M 42x2 | 360 Nm (+10 %) |
| G 1/4" | 30 Nm (+10 %) |
| G 3/8" | 60 Nm (+10 %) |

Table 20: Tightening torques for sealing plugs

### Straight Screw-In Sockets Form E with ED Seal (Reference Values)

| Thread Size | Max. Permissible Tightening Torque |
|---|---|
| M 18x1.5 | 70 Nm (+10 %) |
| M 22x1.5 | 125 Nm (+10 %) |
| M 26x1.5 | 180 Nm (+10 %) |
| M 42x2 | 450 Nm (+10 %) |
| G 1/4" | 35 Nm (+10 %) |
| G 3/8" | 70 Nm (+10 %) |

Table 21: Tightening torques for straight screw-in fittings

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User Manual Radial Piston Pump
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