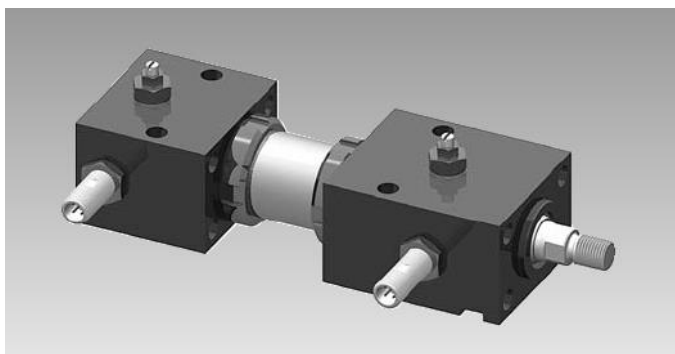




Hydraulic block cylinders

block cylinder, design with tube,
double acting



1 Description of the product

Double-acting hydro-cylinders with connecting dimensions according to DIN ISO 6020.

The piston rod is provided with an external thread and is hardened and chromium-plated.

For fixing the front and rear housing part is equipped with 4 interior threads.

Also an effective wiper seal is available.

The adjustable stroke end cushioning avoids a crash stop of the piston in the cylinder body in case of the following applications:

1. High piston speed
2. Additional load at the piston rod and
3. An external stop to compensate the additional load is not possible.

Table of contents

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2 Validity of the documentation

This document applies to the following products:

Hydraulic block cylinders of data sheet B 1.590.

The following types or part numbers are concerned:

- 1593-11-XXXX, -13-XXXX, -21-XXXX, -23-XXXX
- 1594-11-XXXX, -13-XXXX, -21-XXXX, -23-XXXX
- 1595-11-XXXX, -13-XXXX, -21-XXXX, -23-XXXX
- 1596-11-XXXX, -13-XXXX, -21-XXXX, -23-XXXX
- 1597-11-XXXX, -13-XXXX, -21-XXXX, -23-XXXX
- 1598-11-XXXX, -13-XXXX, -21-XXXX, -23-XXXX

-XXXX corresponds to the stroke in mm.

3 Target group of this document

- Specialists, fitters and set-up men of machines and installations with hydraulic expert knowledge.

Qualification of the personnel

Expert knowledge means that the personnel must

- be in the position to read and completely understand technical specifications such as circuit diagrams and product-specific drawing documents,
- have expert knowledge (electric, hydraulic, pneumatic knowledge, etc.) of function and design of the corresponding components.

An expert is somebody who has due to its professional education and experiences sufficient knowledge and is familiar with the relevant regulations so that he

- can judge the entrusted works,
- can recognize the possible dangers,
- can take the required measures to eliminate dangers,
- knows the acknowledged standards, rules and guidelines of the technology.
- has the required knowledge for repair and mounting.

4 Symbols and signal words

WARNING

Person damage

Stands for a possibly dangerous situation.

If it is not avoided, death or very severe injuries will result.

CAUTION

Easy injuries / property damage

Stands for a possibly dangerous situation.

If it is not avoided, minor injuries or material damages will result.

Hazardous to the environment



The symbol stands for important information for the proper handling with materials that are hazardous to the environment. Ignoring these notes can lead to heavy damages to the environment.

Note

This symbol stands for tips for users or especially useful information. This is no signal word for a dangerous or harmful situation.

5 For your safety

5.1 Basic information

The operating instructions serve for information and avoidance of dangers when installing the products into the machine as well as information and references for transport, storage and maintenance.

Only in strict compliance with these operating instructions, accidents and property damages can be avoided as well as trouble-free operation of the products can be guaranteed.

Furthermore, the consideration of the operating instructions will:

- avoid injuries
- reduce down times and repair costs,
- increase the service life of the products.

5.2 Safety instructions

The product was manufactured in accordance with the generally accepted rules of the technology.

Observe the safety instructions and the operating instructions given in this manual, in order to avoid personal damage or material damage.

- Read these operating instructions thoroughly and completely, before you work with the product.
- Keep these operating instructions so that they are accessible to all users at any time.
- Pay attention to the current safety regulations, regulations for accident prevention and environmental protection of the country in which the product will be used.
- Use the ROEMHELD product only in perfect technical condition.
- Observe all notes on the product.
- Use only accessories and spare parts approved by the manufacturer in order to exclude danger to persons because of not suited spare parts.
- Respect the intended use.

- You only may start up the product, when it has been found that the incomplete machine or machine, in which the product shall be mounted, corresponds to the country-specific provisions, safety regulations and standards.
- Perform a risk analysis for the incomplete machine, or the machine.

Due to the interactions between the product and the machine/fixture or the environment, risks may arise that only can be determined and minimized by the user, e.g. :

- generated forces,
- generated movements,
- Influence of hydraulic and electrical control,
- etc.

6 Application

6.1 Intended use

The products are used in industrial applications to transform hydraulic pressure to a linear movement and /or force. They must only be operated with hydraulic oil.

Furthermore the following belongs to possible uses:

- Use within the capacity indicated in the technical characteristics.
- Use as per operating instructions.
- Compliance with service intervals.
- Qualified and trained personnel for the corresponding activities.
- Mounting of spare parts only with the same specifications as the original part.

6.2 Misapplication

WARNING

Injuries, material damages or malfunctions!

- Do not modify the product!

The use of these products is not admitted:

- For domestic use.
- On pallets or machine tool tables in primary shaping and metal forming machine tools.
- If due to physical / chemical effects (vibrations, welding currents or others) damages of the products or seals can be caused.
- In machines, on pallets or machine tool tables that are used to change the characteristics of the material (magnetise, radiation, photochemical procedures, etc.).
- In areas for which special guidelines apply, especially installations and machines:
 - For the use on fun fairs and in leisure parks.
 - In food processing or in areas with special hygiene regulations.
 - For military purposes.
 - In mines.
 - In explosive and aggressive environments (e.g. ATEX).
 - In medical engineering.
 - In the aerospace industry.
 - For passenger transport.
- For other operating and environmental conditions e.g.:
 - Higher operating pressures than indicated on the data sheet or installation drawing.
 - With hydraulic fluids that do not correspond to the specifications.
 - Higher flow rates than indicated on the data sheet or installation drawing.

Side load acting on the piston rod

The application of side loads to the piston rod as well as the use of the product as a guiding element is inadmissible.

Special solutions are available on request!

7 Installation

⚠ WARNING

Injury by high-pressure injection (squirting out of hydraulic oil under high pressure)!

- Improper connection can lead to escapes of oil under high pressure at the connections.
- Mounting or dismounting of the element must only be made in depressurised mode of the hydraulic system.
- Connection of the hydraulic line as per DIN 3852/ISO 1179.
- Unused connections have to be locked professionally.
- Use all mounting holes.

Injury by high-pressure injection (squirting out of hydraulic oil under high pressure)!

Wear, damage of the seals, ageing and incorrect mounting of the seal kit by the operator can lead to escapes of oil under high pressure.

- Before using them make a visual control.

Injury by falling parts!

- Keep hands and other parts of the body out of the working area.
- Wear personal protection equipment!

Poisoning due to contact with hydraulic oil!

Wear, damage of the seals, ageing and incorrect mounting of the seal kit by the operator can lead to escapes of oil. Incorrect connection can lead to escapes of oil at the ports.

- For handling with hydraulic oil consider the material safety data sheet.
- Wear protection equipment.

Injury by crushing!

- Due to the stored energy, an unexpected start of the product can occur.
- Maintenance works at the product must only be made in depressurised mode!
- Keep hands and other parts of the body out of the working area!

Injury by cutting!

- Sharp-edged threads can cause cut injuries.
- Wear personal protection equipment!

⚠ CAUTION

Great weight may fall

Some product types have a considerable weight. These have to be secured against working free during transport. Weight specifications see chapter "Technical characteristics".

Side loads and forced conditions acting on the piston lead to increased wear

- Provide external guides.
- Avoid forced conditions (overdetermination) of the piston.

7.1 Design

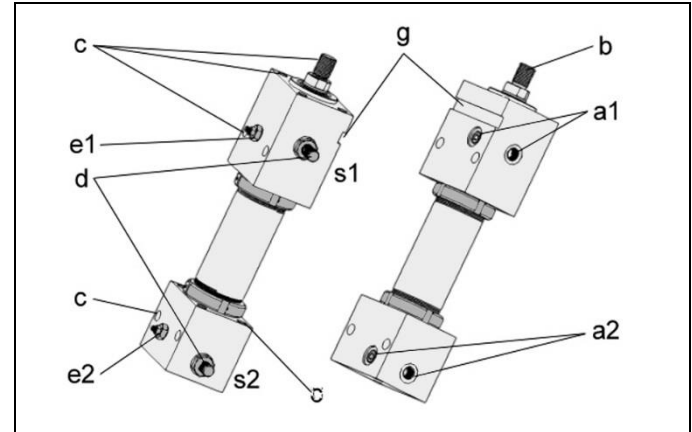


Figure 1: Components

a1 Hydraulic port retracting (pipe thread or without pipes)	d Accessories magnetic sensors S1 (extended) S2 (retracted)
a2 Hydraulic port extending (pipe thread or without pipes)	e1 Stroke end cushioning retracting
b Piston with interior or exterior thread	e2 Stroke end cushioning extending
c Fixing possibilities	g Tenon slot

7.2 Mounting types

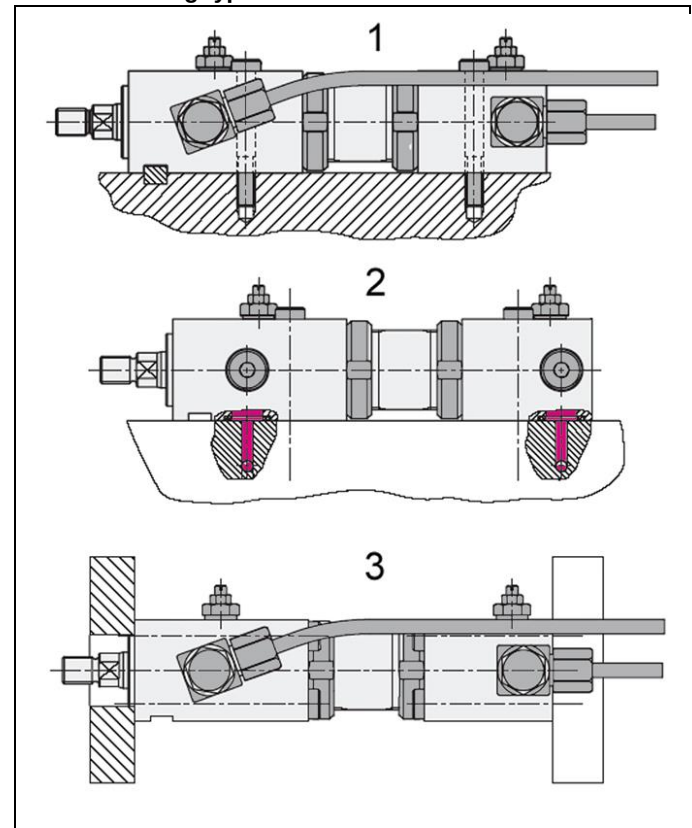


Figure 2: Fixing possibilities

1 Oil supply through high-pressure hose or pipes, key to transmit the forces.	3 Fixing at the front or at the bottom with oil supply through high-pressure hoses or pipes
2 Oil supply through drilled channels	

7.3 Support of the product

⚠ CAUTION

Provide operating pressure > 100 bar and > 200 support

For operating pressures exceeding 100 bar and a fixing with two screws 12.9 or for operating pressures exceeding 200 bar and a fixing with four screws 12.9, the products have to be supported in the slot in order to compensate the occurring forces.

Screws for fixing can be damaged.

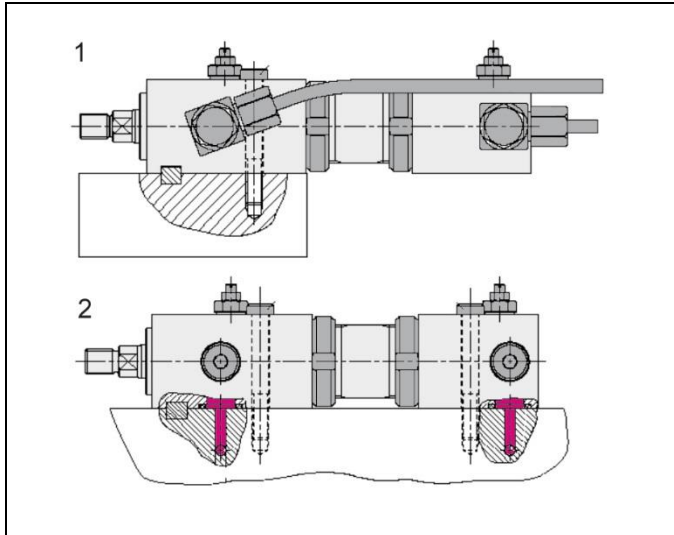


Figure 3: Hydraulic block cylinders supported in the slot

1 Fixing with 2 screws and pressure $p > 100$ bar	2 Fixing with 4 screws and pressure $p > 200$ bar
---	---

7.4 Admissible oil flow rate

⚠ WARNING

Injury due to overload of the element

High-pressure injection (squirting out of hydraulic oil under high pressure) or flying components!

- Due to throttling or closing of ports a pressure intensification can occur.
- Connect the ports professionally!

⚠ CAUTION

Maximum flow rates do not exceed

The maximum flow rate must not be exceeded.

7.4.1 Calculation of the admissible flow rate

Admissible flow rate

The admissible flow rate or the admissible stroke speed is valid for vertical mounting positions in combination with standard add-on parts as clamping arms or contact bolts, etc.

In case of other mounting positions and/or add-on parts the flow rate has to be reduced.

If the pump flow rate divided by the number of elements is larger than the admissible flow rate of one element, the flow rate has to be throttled.

This prevents an overload and therewith an early failure.

The flow rate can be checked as follows:

$$Q_P \leq 0,06 \cdot \dot{V}_Z \cdot n \quad \text{and/or} \quad Q_P \leq 6 \cdot v_Z \cdot A_K \cdot n$$

for clamping elements and work supports (indicated on the data sheets)

Maximum piston speed

At specified pump flow rate Q_P and with the effective piston area A_K the piston speed can be calculated as follows:

$$v_m < \frac{Q_P}{6 \cdot A_K \cdot n}$$

Legend

$\dot{V}_Z$ = Admissible flow rate of the element in [cm³/s]

Q_P = Flow rate of the pump in [l/min]

A_K = Piston area in [cm²]

n = Number of elements, same dimensions

$v_Z = v_m$ = Admissible/maximum stroke speed in [m/s]

NOTE

Flow rate

- The maximum oil volume and/or the maximum stroke speed depend on the corresponding product.
- For clamping cylinders see data sheet A 0.100.
- For clamping elements, work supports, hydraulic valves, power units and other hydraulic elements indicated on the corresponding data sheets.

Further "things worth knowing about hydraulic cylinders, basics, detailed knowledge and calculations on hydraulic cylinders" see Technical information on the internet!

7.4.2 Throttling of the flow rate

The throttling always has to be effected in the supply line to the element. Only thus pressure intensification and thereby pressures exceeding the operating pressure are avoided. The hydraulic circuit diagram shows flow control valves which allow oil return from the element without any impediments.

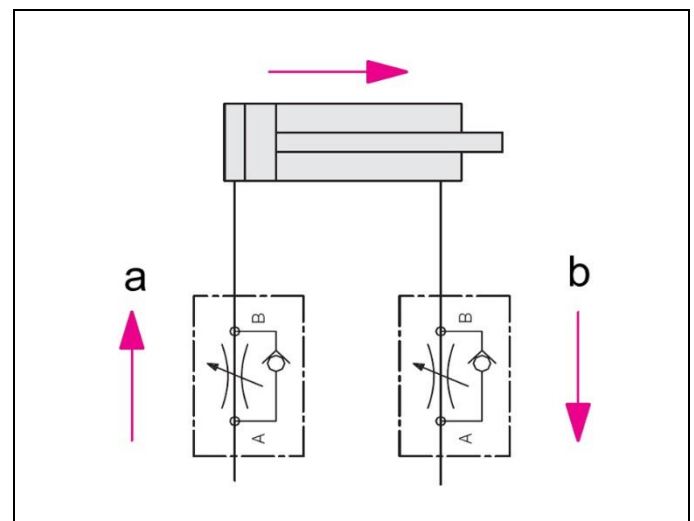


Figure 4: Hydraulic circuit diagram without flow control valves

a Throttling direction	b Free flow
------------------------	-------------

If a return-flow throttling is required due to a negative load, it must be guaranteed that the max. operating pressure (see technical characteristics) will not be exceeded.

7.5 Installation of pipe-mounted types

1. Clean the support surfaces.
2. Fasten the element support at the flange surface (see figure "Mounting types").

WARNING

Injury by falling products!

Safety shoes have to be worn to avoid injuries due to falling objects.

NOTE

Tightening

- To determine the tightening torque of the fixing screws a screw calculation as per VDI 2230 page 1 has to be effected. The screw material is indicated in the chapter "Technical characteristics".

NOTE

Tightening torques

- The tightening torques for the fixing screws have to be designed with reference to the application (e. g. as per VDI 2230).

Proposals and approximate values for the tightening torques see chapter "Technical characteristics".

7.6 Installation of manifold-mounted types

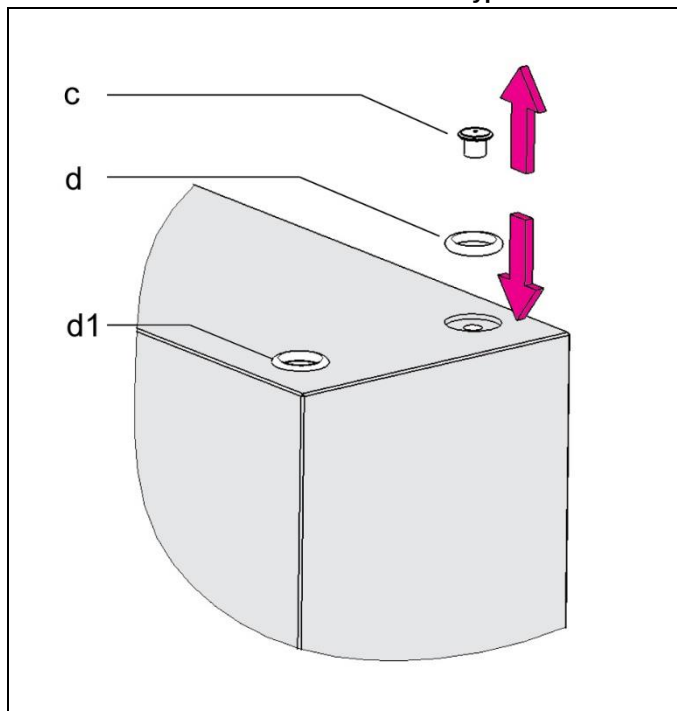


Figure 5: Example, preparation for hydraulic ports without pipes

HINWEIS

schematic diagram

- The shown figure is a schematic diagram. The arrangement of the ports depends on the respective product (see chapter "Design").

c Countersunk plug against dirt during transport	d1 Mounted O-ring
d O-ring (accessory, depending on the version)	

1. Drill the holes for hydraulic oil supply and return in the fixture (see also data sheet).
2. Grind or finish mill the 0.8 and a flatness of 0.04 mm to ≤manifold-mounting surface (Ra ≤100 μm, marks, scratches, shrink holes, concentric machining marks are inadmissible).
3. Countersunk plug remove., insert o-rings (accessories, if required).
4. Clean the support surfaces.
5. Position and fasten on the fixture.
6. Install bleeding screws at the upper ends of the piping.

NOTE

Tightening torques

- The tightening torques for the fixing screws have to be designed with reference to the application (e. g. as per VDI 2230).

Proposals and approximate values for the tightening torques see chapter "Technical characteristics".

7.7 Connection of the hydraulic equipment

1. Connect hydraulic lines to qualifying standards and pay attention to scrupulous cleanliness (A = Extend, B = Retract)!

NOTE

More details

- See ROEMHELD data sheets A 0.100, F 9.300, F 9.310 and F 9.360.

Screwed Plug

- Use only fittings "screwed plug B and E" as per DIN 3852 (ISO 1179).

hydraulic connection

- Do not use sealing tape, copper rings or coned fittings.

Pressure fluids

- Use hydraulic oil as per ROEMHELD data sheet A 0.100.

7.8 Leakage due to the system

The piston rod is set in motion by the hydraulic oil to perform the clamping task.

The hydraulic oil must be sealed at the piston rod to the atmosphere. During extension of the piston rod, the hydraulic oil must remain in the cylinder.

For ROEMHELD products, sealing systems are used for the piston rod, generally consisting of several sealing elements. Those sealing systems enable the sealing points to be absolutely leak-proof in the total specified pressure area, when the system is not in operation. Neither does oil escape at the piston rod, nor is oil transferred from the piston side and piston rod side.

Important: ROEMHELD products do not leak oil when static. To ensure an adequate working life, the sealing systems must be lubricated by the hydraulic fluid while in motion, in dynamic operation. Since the hydraulic fluid must reach the sealing lip, a certain amount of oil is lost from leakage, in the process. According to the used sealing and the corresponding application conditions the amount can be very different depending on the product group. However the leakage should be very little (see A 0.100 General characteristics of hydraulic equipment).

Leakage-free cylinders (leakage re-circulation or special sealing) are available on request.

8 Start up

WARNING

Poisoning due to contact with hydraulic oil!

Wear, damage of the seals, ageing and incorrect mounting of the seal kit by the operator can lead to escapes of oil. Incorrect connection can lead to escapes of oil at the ports.

- For handling with hydraulic oil consider the material safety data sheet.
- Wear protection equipment.

Injury by crushing!

Components of the product make a movement while they are in operation.

- This can cause injuries.
- Keep parts of the body and items out of the working area!

Injury by crushing!

- Due to the stored energy, an unexpected start of the product can occur.
- Maintenance works at the product must only be made in de-pressurised mode!
- Keep hands and other parts of the body out of the working area!

Injury by cutting!

- Sharp-edged threads can cause cut injuries.
- Wear personal protection equipment!

CAUTION

Operating pressure should not exceed

The max. operating pressure must not be exceeded (see technical characteristics).

- Check tight seating (check tightening torque of the fixing screws, see chapter "Technical characteristics").
- Check tight seating of hydraulic connections (check tightening torque of the hydraulic connections, see chapter "Technical characteristics").
- Bleed the hydraulic system.

NOTE

Clamping time

- Without bleeding the clamping time will be considerably prolonged and function problems may occur.

8.1 Bleeding of pipe-mounted types

1. Loosen carefully at low pressure union nut of the pipe at the hydraulic ports.
2. Pump until bubble free oil comes out.
3. Fasten union nuts of the pipe.
4. Check tightness.

8.2 Bleeding of manifold-mounted types

1. Loosen carefully the bleeding screws of the fixture at low pressure.
2. Pump until bubble free oil comes out.
3. Fasten the bleeding screws.
4. Check correct function.
5. Check sealing of the hydraulic connections!

8.3 Adjust stroke end cushioning

WARNING

Danger of injury due to high-pressure injection!

- Do not completely turn out the throttle pin, otherwise hydraulic oil will spill.

Injury by crushing!

Components of the product make a movement while they are in operation.

- This can cause injuries.
- Keep parts of the body and items out of the working area!

Adjustment of the cushioning depends on the viscosity and temperature of the hydraulic oil. Adjust in succession the cushioning for the extended and retracted piston rod.

- Loosen lock nut (see design e1 or e2).
- Screw in throttle pin to increase the cushioning or screw out to reduce the cushioning.
- Hold and tighten lock nut.

9 Maintenance

WARNING

Burning due to hot surface!

- In operating conditions, surface temperatures of more than 70 °C can appear at the product.
- All maintenance and repair works must only be effected in cooled mode or with safety gloves.

Injury by cutting!

- Sharp-edged threads can cause cut injuries.
- Wear personal protection equipment!

9.1 Cleaning

⚠ CAUTION

Avoid damages of the moved components

Avoid damages of the moved components (rods, plungers, bolts, etc.) as well as of wiper and seal.

Aggressive cleaning agents

The product must not be cleaned with:

- Corrosive or corroding components or
- Organic solvents as halogen or aromatic hydrocarbons and ketones (cellulose thinner, acetone, etc.), because this can destroy the seals.

The product must be cleaned at regular intervals, especially the area of the piston or the plunger housing has to be cleaned from swarf and other liquids.

In the case of heavy contamination, the cleaning has to be made in shorter intervals.

9.2 Regular checks

1. Check tightness of hydraulic connections (visual control).
2. Check running surfaces (of the piston rod or bolt) if there are marks and scratches. Traces of marks can be an indication for a contaminated hydraulic system or an inadmissible side load of the block cylinder.
3. Leakage check at the housing - piston rod, bolt or flange.
4. Clamping force control by pressure control.
5. Check if the maintenance intervals are kept.

9.3 Exchange seal kit

The exchange of the seal kit is made in case of external leakages. For high availability, the seals have to be changed at the latest after 500,000 cycles or 2 years.

The seal kit is available as spare part. An instruction for the exchange of the seal kit is available on request.

NOTE

Seal Kits

- Do not install seal kits which were exposed to light for a longer time.
- Pay attention to the storage conditions (see chapter "Technical characteristics").
- Only use original seals.

10 Trouble shooting

Trouble	Cause	Remedy
Piston does not extend:	Hydraulic oil supply or return is impeded	Check and blow through tubes or channels.
Piston extends jerkily:	Air in the hydraulic system	Hydraulic bleeding
System pressure drops:	Hydraulic ports leaky	seal
	Wear of the seals	Replace sealing rings
Stroke end will not be obtained:	Cushioning needs adjusting	Screw out throttle pin
Proximity switch does not switch:	Proximity switch wrongly wired or adjusted	Check cabling Check switching distance and adjust to 0.5 mm

11 Accessory

11.1 Electronic proximity sensor

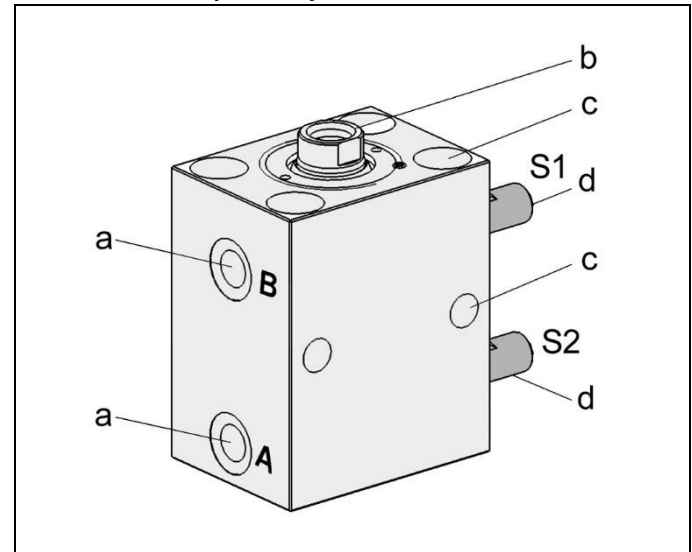


Fig. 6: design

d Accessories Magnetic sensors	S1 (extended), S2 (retracted),
-----------------------------------	-----------------------------------

11.1.1 Start up

⚠ WARNING

Injury by high-pressure injection due to damage of the sensor sealing!

- Moisten the seals slightly with oil in order to ease the assembly. When screwing in pay attention to possible resistance.

Condition for start up is that the magnetic sensors S1 and S2 are electrically wired as per circuit diagram and a correct supply voltage is available.

- Completely retract the piston.
- Slightly moisten the sensor seals to facilitate the assembly.
- Carefully screw in the proximity switch up to the stop.
- Turn back the sensor S1 by a ½ rotation, so that there is a switching distance of approx. 0.5 mm..
- Lock S1 in this position by means of a nut.
- Completely extend the piston.
- Proceed with S2 correspondingly so that there will be a signal course as per figure 8.

The following figure shows the principal signal course during extending and retracting the piston (max. = total stroke).

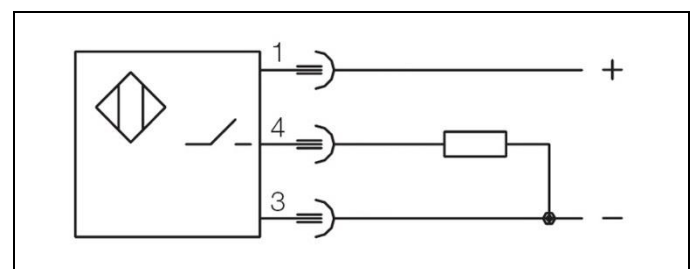


Fig. 7: circuit diagram for pnp (+) magnetic sensor

- 1 brown +
- 3 blue -
- 4 black

11.1.2 Technical characteristics for proximity switches

Ambient temperature:	-25 °C to +70 °C
Rated operating distance Sn	0.8 mm
Secured operating distance:	0 ... 0.65 mm
Hysteresis:	max. 15 %
Repeatability:	max. 5%
Material of housing:	stainless steel
Code class:	IP 67
Type of connection:	Plug S49
Voltage:	DC
Switching function:	Interlock
Switching output:	PNP
Operating voltage UB:	10. 30 V
Rated operating voltage:	24 V
Rated current:	100 mA
Residual ripple:	max. 10%
Switching frequency:	3 kHz
Protection against reverse battery:	yes
Protected against short circuits:	yes
Tightening torque:	1 Nm

NOTE

Further technical data with reference to the position monitoring are included in the data sheet.

11.1.3 Further accessory

NOTE

- Position monitoring

NOTE

- See ROEMHELD data sheet.

12 Technical characteristics

General characteristics

Type	Maximum operating pressure	Maximum force to push	Maximum force to pull
	[bar]	[kN]	[kN]
1593-XX-XXXX	250	12.3	7.25
1594-XX-XXXX	250	20.1	12.3
1595-XX-XXXX	250	31.4	19.1
1596-XX-XXXX	250	49.1	29
1597-XX-XXXX	250	77.9	46.5
1598-XX-XXXX	250	125.7	76.6

Proposal, tightening torques for screws of tensile strength 8.8, 10.9, 12.9

NOTE

The indicated values are approximate values and have to be interpreted according to the user's application!
See note!

Thread	Tightening torque [Nm]		
	8.8	10.9	12.9
M3	1,3	1,8	2,1
M4	2,9	4,1	4,9
M5	6,0	8,5	10
M6	10	15	18
M8	25	36	45
M10	49	72	84
M12	85	125	145
M14	135	200	235
M16	210	310	365
M20	425	610	710
M24	730	1050	1220
M30	1,450	2100	2450

Note: Valid for workpieces and set screws made of steel with metric thread and connecting surface dimensions as per DIN 912, 931, 933, 934 / ISO 4762, 4014, 4017, 4032

In the table values for tightening torques the following is considered:

Design steel/steel, friction value $\mu_{ges} = 0.14$ - not oiled, utilisation of the minimum yield point = 90%.

NOTE

Further information

- For further technical data see ROEMHELD data sheet. B1590

13 Storage

CAUTION

Storage of components!

- The product may not be exposed to direct solar radiation, because the UV light can destroy the seals.
- A storage differing from the storage conditions is inadmissible.
- In case of improper storage, the seals can embrittle and resinification of the anti-corrosive oil or corrosion at the element can occur.

The elements are tested by default with mineral oil. The exterior of the elements is treated with a corrosion inhibitor.

The oil film remaining after the test provides for a six-month interior corrosion protection, if stored in dry and uniformly tempered rooms.

For longer storage times, the element has to be filled with a non-resinifying corrosion inhibitor and the outside surfaces must be treated.

14 Disposal



Hazardous to the environment

Due to possible environmental pollution, the individual components must be disposed only by an authorised expert company.

The individual materials have to be disposed as per the existing regulations and directives as well as the environmental conditions.

Special attention has to be drawn to the disposal of components with residual portions of hydraulic fluids. The instructions

for the disposal at the material safety data sheet have to be considered.

For the disposal of electrical and electronic components (e.g. stroke measuring systems, proximity switches, etc.) country-specific legal regulations and specifications have to be kept.

15 Declaration of manufacture

Manufacturer

Römheld GmbH Friedrichshütte
Römheldstraße 1-5
35321 Laubach, Germany
Tel.: +49 (0) 64 05 / 89-0
Fax: +49 (0) 64 05 / 89-211
E-mail: info@roemheld.de
www.roemheld.com

Declaration of manufacture of the products

They are designed and manufactured in line with the relevant versions of the directives **2006/42/EC** (EC MSRL) and in compliance with the valid technical rules and standards.

In accordance with EC-MSRL, these products are components, that are not yet ready for use and are exclusively designed for the installation in a machine, a fixture or a plant.

According to the pressure equipment directives the products are not to be classified as pressure reservoirs but as hydraulic placing devices, since pressure is not the essential factor for the design, but the strength, the inherent stability and solidity with regard to static or dynamic operating stress.

The products may only be put into operation after it was assessed that the incomplete machine / machine, in which the product shall be installed, corresponds to the machinery directives (2006/42/EC).

The manufacturer commits to transmit the special documents of the products to state authorities on request.
The technical documentation as per appendix VII part B was prepared for the products.

Responsible person for the documentation:
Dipl.-Ing. (FH) Jürgen Niesner, Tel.: +49(0)6405 89-0.

Römheld GmbH
Friedrichshütte

Laubach, 22.03.2020