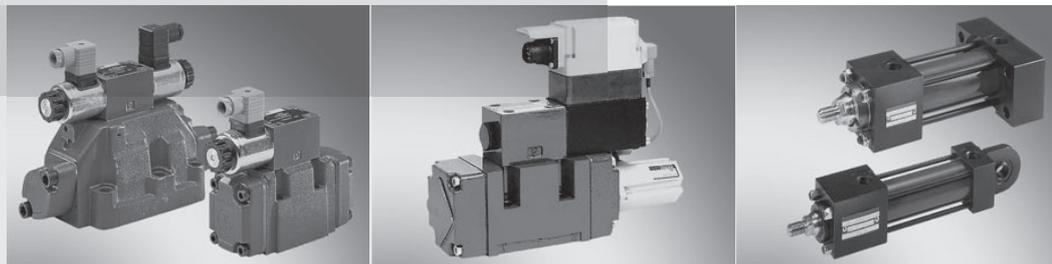


General product information on hydraulic products

RE 07008/02.05

1/32



DE	Ihre Sprache? – Siehe Rückseite!
EN	Your language? – See back page!
FR	Votre langue ? – Voir au dos !
IT	La vostra lingua? – Vedi retro!
FI	Kohdekielet? – Katso takankatta!
ES	¿Su idioma? – ¡Vea al dorso!
NL	Uw taal? – Zie achterzijde!
SV	Ditt språk? – Se omslagets baksida!
PT	O seu idioma? – Consulte a contracapa!
DA	Dit sprog? – Se bagside!
EL	Η γλώσσα σας; – Βλέπε πίσω πλευρά!

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1 Important basic information

1.1 Conventions used in this product information

Cross-references are printed in *italics*.



This symbol indicates a threat of danger which will result directly in death or very serious injury if not avoided.



This symbol indicates a threat of danger which may result in death or very serious injury if not avoided.



This symbol indicates possible danger which may lead to minor or serious injury and/or to material damage.

IMPORTANT

This symbol indicates additional information.

1.2 What you need to know about this product information

This product information applies to the following types of hydraulic products:

- Hydraulic components
- Hydraulic power units
- Hydraulic systems.

This product information applies exclusively to hydraulic products that are operated with mineral-oil-based pressure fluids, if the *Operating Instructions* do not expressly permit the use of other pressure fluids.

IMPORTANT

As this product information for Rexroth hydraulic products applies in a general sense, some of the content may not necessarily apply to the hydraulic product you have purchased.

However, only by strictly observing this product information and the *Operating Instructions* can accidents be prevented and problem-free operation of your Rexroth hydraulic product be guaranteed.

Observing the product information and *Operating Instructions*

- reduces downtimes and maintenance costs
- increases the service life of your hydraulic products.

The *Operating Instructions* must be directly accessible to one of the personnel at the hydraulic product and kept readily available at all times in a place known to the personnel.

The *Operating Instructions* must be read and understood and all its provisions observed by those responsible and by the operative personnel. We recommend that a record is made in writing of the employees' familiarisation with all the relevant parts.

The cross-references to directives, standards and regulations contained in this product information refer to the versions current at the time of writing of this product information, which can be obtained from the title page of this product information.

1.3 The contents of this product information

In addition to this document, product information for Rexroth hydraulic products normally includes *Operating Instructions* consisting of three parts:

- **Part I**, the general *Operating Instructions* for the relevant class of products
- **Part II**, the *Technical Datasheet*
- **Part III**, the *Product- and Application-specific Operating Instructions*.

If you do not have all three parts, please request the missing part from Bosch Rexroth. Only if all the information contained in all parts of the three-part *Operating Instructions* is observed can safe operation of Rexroth hydraulic products be ensured.

Specific cross-references are used to draw your attention to information that you can find in the *Operating Instructions*.

The *Operating Instructions* contain detailed information about the product, including

- Information about the scope of delivery
- Safety instructions
- Technical data and operating limits
- Information about bringing into (first) use and maintenance
- Information about the mode of operation
- Layouts, drawings
- Parts lists if appropriate
- Information about replacement parts and accessories.

2 Scope of delivery and responsibilities

2.1 Scope of delivery and responsibilities of Bosch Rexroth

Rexroth hydraulic products fulfil all safety requirements applicable to fluid power systems and their components.

IMPORTANT

For the scope of delivery and the responsibilities of Bosch Rexroth with respect to the product, please refer to the *Product-specific Operating Instructions*.

2.2 Responsibilities of the plant operator



If Rexroth hydraulic products are positioned in the vicinity of sources of ignition or strong radiators of heat, protection must be put in place that would prevent any escaping pressure fluid from igniting and the hose lines from aging prematurely.

Mineral-oil-based pressure fluid is hazardous to water and flammable. It may only be used if the relevant safety data-sheet from the manufacturer is available and all the measures stipulated therein have been implemented.

If there is a risk of fluid leaking from the hydraulic product and contaminating water or the ground, the hydraulic product in question must be placed in a suitable collecting trough. In connection with this, the applicable statutory regulations must be observed.

You must also observe the EU directives for the use of work equipment (Directive 89/391/EC) and the associated individual directives, especially Directive 1999/92/EC for the protection from the danger arising from potentially explosive atmospheres and their implementations in national legislation. The legislation contains minimum requirements with respect to the making available by the employer of work equipment and for the use of work equipment by employees at work, including the regulations for operating equipment requiring supervision and the obligation to produce explosion protection documentation. This involves, for example, dividing areas endangered by potentially explosive atmospheres into zones and specifying suitable work equipment and procedures for these areas.

2.2.1 Noise protection

The A-weighted equivalent continuous sound power level of Rexroth hydraulic products can be obtained from the relevant *Operating Instructions*. If no values are documented then it can be taken that the value is less than 70 dB(A).

Installation of Rexroth hydraulic products in a machine or system may increase this value, and if so, the manufacturer of the machine/system must document this.

At or above 85 dB(A), the plant operator must make suitable hearing protection available to the personnel.

2.2.2 Special points concerning the installation of certain products

A Rexroth hydraulic product is intended above all for installation in machines, systems and power units as a part machine or a component for installation into another machine or system and is not a complete machine in the sense of the EU directive. In addition to the Machinery Directive, still further directives may apply, such as the Pressure Equipment Directive or the Explosion Protection Directive.

A wide range of dangers can arise from the combined actions of the hydraulic product and the machine or system in which the hydraulic product is installed. Therefore you must always make sure that the hydraulic product is also suitable without restriction for the proposed application at the installation location. The interfaces with the overall machine and the operating conditions are also of the greatest importance. We recommend that the results of the hazard analysis (risk assessment) of the overall machine are taken into account in the design of the hydraulic product.

The functioning of the hydraulic product is also influenced by the machine or system in which it is installed.

For this reason, you must also always observe the Operating Instructions of the overall system in which your hydraulic product is installed. It is most important for you to also consider the possible use of the hydraulic product in a potentially explosive atmosphere (see 94/9/EC).

IMPORTANT

Bosch Rexroth points out that, at the time of their first introduction on to the market, hydraulic products comply with the requirements of all relevant EU directives and/or their implementation into national legislation in Germany. If the scope of delivery is intended to be installed in a machine or system, then the Machinery Directive applies as appropriate – including the then currently applicable amendments – in that the scope of delivery does not necessarily comply with the requirements of the Machinery Directive because the scope of delivery is intended for installation in a machine or because the scope of delivery is intended for combination with other machines into a machine or a hydraulic system.

The bringing into use of the scope of delivery shall therefore not be permitted until the machine or system in which the scope of delivery is to be installed or of which it represents a component complies with the requirements of all relevant EU directives.

Details of further responsibilities can be found in *3 Important basic safety instructions* and in the *Operating Instructions*.

2.3 Liability, guarantee, warranty

Bosch Rexroth shall not be liable for damages that result from non-compliance with or disregard of these and other parts of the Operating Instructions.

Unauthorised tampering shall render the warranty null and void.

Bosch Rexroth shall only be liable if the scope of delivery was shown to be defective. Bosch Rexroth shall not be liable if a deficiency occurs that involves parts having been replaced by the customer with equivalent but not identical parts as specified by the manufacturer.

Please refer to our general terms of supply or your contract for details of the guarantee and manufacturer's warranty.

2.4 Copyright

This product information may only be reproduced – electronically or mechanically, in whole or in part – with the express written permission of Bosch Rexroth. It may likewise not be distributed, amended, transmitted, translated into another language or employed or copied for other purposes or by other parties without such consent.

3 Important basic safety instructions

3.1 What to do in an emergency

In the event of an emergency, fault or other abnormal occurrences:

1. Switch off the hydraulic system.
2. Secure the main switch against being unintentionally switched on again.
3. Secure the danger area so that no one can enter the danger area unknowingly or uncontrolled.
4. Notify the relevant specialist personnel immediately.
5. In the event of fire, observe the provisions of the safety datasheets issued by the manufacturer of the pressure fluid and the fire precautions specifically applicable to your place of work, which must be documented in the plant operator's operating manual.



Fighting fires with materials other than those permitted can lead to explosions and/or more rapid spread of the fire!

Danger to life from smoke inhalation!

3.2 Safety labelling on the hydraulic product

IMPORTANT

- The meanings of the safety labelling on the Rexroth product are explained in the *Operating Instructions*.
- For a diagram of the nameplate and an explanation of the information on it please refer to the *Operating Instructions*.

3.3 Proper use

Rexroth hydraulic products are designed and constructed for the provision, transmission, control or regulation of energy and signals using the flow of oil.

Unless otherwise agreed, the Rexroth hydraulic product satisfies at least safety category B in accordance with EN 954-1.

If the hazard analysis/risk assessment of the overall machine in which the Rexroth hydraulic product is to be installed indicates that a safety category higher than category B in accordance with EN 954-1 is required for the Rexroth hydraulic product, then a correspondingly higher rated hydraulic product can be supplied and installed only after special agreement with Bosch Rexroth.

IMPORTANT

The hydraulic product shall be operated exclusively with pressure fluids complying with DIN 51524. Where other pressure fluids are permitted, for example brake fluids for brake valves, this is specially mentioned in the *Operating Instructions*.

For details on proper use see 4 *Technical data and ambient conditions*.

The following information can be found in the *Operating Instructions*:

- the proper use, specific to the hydraulic product
- where applicable, the safety category in accordance with EN 954-1
- non-permitted and improper use.

3.3.1 Proper use, requirements before operation

- Rexroth hydraulic products may only be operated if they are in perfect technical condition.
 - In the event of disturbances in the power supply and/or damage to the electrical equipment, switch off immediately and secure the main switch against being switched on again without authorisation.
 - Report and rectify all faults and damage indicated by the system or discovered by other means.
- The connections, operating conditions and performance data specified in the *Operating Instructions* must be observed and never changed.
- Rexroth hydraulic products shall not be converted or otherwise modified without prior consultation with Bosch Rexroth.
- The plant operator shall not modify the program code of programmable control systems.
- Dependencies and time factors shall not be modified without prior consultation.
- The safety devices fitted by Rexroth must be present, properly installed and in full working order – except when this is impractical during setting up or maintenance work. They shall not be relocated, bypassed or rendered ineffective.
- Safety components such as limit switches, valves and other control components shall not be rendered inoperative.
- Tamperproof lead seals installed by the manufacturer shall not be removed or damaged except when this is necessary in the course of maintenance tasks defined in the *Operating Instructions*.
- The specified maintenance tasks in the *Operating Instructions* shall be carried out at the intervals stated in the *Operating Instructions*.

- Uncontrolled access by persons unfamiliar with the system to the immediate operating zone of Rexroth hydraulic products is prohibited (even if the product in question has been shut down).
- Rexroth hydraulic products must never be assembled, operated or maintained by persons under the influence of alcohol, drugs or other medication which affect one's ability to react.

3.4 Requirements for personnel, duty of care

3.4.1 Qualifications of specialist personnel

A specialist person is someone who, using his specialist training, knowledge and experience as well as familiarity with the relevant conditions, can

- safely carry out the tasks allocated to him and correctly assess the scope and implications of his work
- recognise possible dangers
- undertake the necessary measures to eliminate possible accidents.

3.4.2 Requirements for hydraulics maintenance personnel

In accordance with DIN 31051, maintenance comprises the individual activities of **inspection**, **servicing** and **repair**. All personnel involved in maintenance shall be familiar with and observe all parts of the Operating Instructions and this product information.

Inspection personnel shall fulfil the following requirements:

- They have been instructed in the relevant activity.
- Specialist knowledge of hydraulics is not required for purely inspection activities but the personnel must be aware of the particular dangers associated with hydraulic products.

Servicing personnel (who carry out filter and oil changes, for example) shall fulfil the following requirements:

- They have been instructed in the relevant activity.
- Specialist knowledge of hydraulics is not required to carry out servicing work.

Repair personnel shall fulfil the following requirements:

- The personnel must be hydraulics experts, who have been instructed and meet the definition given above,
- Repair personnel must be familiar with the function of the hydraulic system as a whole, from subsystems to their interaction with the function of the entire machine.
- Repair personnel must be able to read hydraulic circuit diagrams, interpret individual functions from their symbols and understand function diagrams.
- Repair personnel must possess knowledge of the function and construction of hydraulic elements.

3.4.3 Requirements for electrical maintenance personnel

All work on electrical equipment shall only be carried out by an authorised, qualified electrician, or by instructed persons under the guidance and supervision of a qualified electrician, in accordance with the rules applicable to electrotechnical products.

3.4.4 Minimum age

Persons under the age of 18 who are currently receiving instruction or training or are working under supervision may not work on Rexroth hydraulic products.

This does not apply to young persons of 16 or over if

- working on Rexroth hydraulic products is necessary in order for them to accomplish a training objective
- their protection is guaranteed by the supervision of an experienced, competent person
- they are allowed to use only tools, work implements and protective gear that preclude the risk of injury.

3.4.5 Training

The plant operator using Bosch Rexroth hydraulic products shall train his personnel regularly in the following subjects:

- Observation and use of the Operating Instructions and legal requirements
- Proper operation of the Rexroth hydraulic product
- Observation of the instructions of safety officers and the plant operator's operating manual
- What to do in an emergency.

IMPORTANT

Bosch Rexroth can provide you with training support in specialist areas.

An overview of the training can be found on the Internet at <http://www.boschrexroth.de/didactic>.

3.5 General ancillary dangers and protective measures when operating hydraulic products



In the interests of your safety, all safety instructions shall be carefully observed, especially those in the Operating Instructions.

In spite of the high intrinsic safety of Rexroth hydraulic products, the risk of personal injury or damage to the environment cannot be excluded, even when the equipment is properly used.

New, additional dangers may arise if the hydraulic product is installed in another machine or installed with other machines in a system. This shall apply in particular to mechanical movements generated by the hydraulic product.

Information on these additional dangers can be found in the overall operating manual of the supplier of the overall system in which the hydraulic product is installed.

3.5.1 Dangers from pressure fluid



Handling pressure fluid without protection is **hazardous to health**.

Please observe the manufacturer's safety instructions and the safety datasheets for the pressure fluid that you are using.



Serious damage to health or death may result if pressure fluid enters the blood stream or is swallowed. If this occurs, contact a doctor immediately!

3.5.2 Malfunctions due to contamination of pressure fluid

Contamination of the pressure fluid can be caused by:

- Wear during operation of the machine/system (metallic and non-metallic abrasion)
- Leaks of the hydraulic product
- Contaminants introduced during servicing/repair
- The use of dirty (unfiltered) pressure fluid when the pressure fluid is changed.

Contaminants lead to malfunctions, increased wear and shorter service life of the hydraulic product. This can have negative effects on the safety and reliability of the hydraulic product.

Therefore the maintenance tasks specified in the *Operating Instructions* shall be carried out at regular intervals and the utmost cleanliness is required during work on the hydraulic product.



When changing the pressure fluid, always use factory-fresh pressure fluid and filter it before filling to remove any contaminants in the pressure fluid that it often contains from the packaging container (drum). Flush out lines and hoses before installation.

The cleanliness class of a pressure fluid is specified in accordance with ISO 4406. Detailed information can be obtained from the relevant datasheet or the *Operating Instructions*.

In older datasheets, the cleanliness class is sometimes specified in accordance with NAS 1638. The following table can be used to convert this to an equivalent ISO 4406 cleanliness class:

Comparison table for cleanliness classes

Earlier class to NAS 1638	Current class to ISO 4406 (c)
Class 7	Class 18/16/13
Class 9	Class 20/18/15

3.5.3 Electrical dangers

When working on electrical systems:

- De-energise the hydraulic system before beginning any maintenance work.
- Cordon off the working area with red-white safety chain and warning signs.
- Lock the main switch, remove the key and keep it in a safe place until the work is completed.
- Attach a warning sign to the main switch.
- Check that there is no voltage using a **two-pole** voltage detector.
- Earth and short-circuit the point where you are working.
- Cover neighbouring live parts.
- Clear your workplace to prevent contact with live parts as a result of tripping or slipping. Wear safety footwear.
- Always use electrically insulated tools.
- Disconnect plugs at sensors and valves – even those with low voltages – after the system has been de-energised.



Even after disconnection of the electrical supply (main switch OFF) the following supply systems/danger areas can still give rise to life-threatening voltages:

- Electrics, electronics, hydraulics (e.g. accumulators, rechargeable batteries)
- Main switch
- Power supply cables
- Points identified with an electric shock warning sign.

3.5.4 Product-specific ancillary dangers

All product-specific ancillary dangers and precautions can be found in the relevant *Operating Instructions*.

3.5.5 Disposal

- Take metal, cable and plastic ducts to a recycling materials collection centre.
- Dispose of electronic components as electronic waste.
- Dispose of back-up batteries as special waste.
- Cleaning agents, operating fluids and other materials:



Please observe the disposal regulations specified in the appropriate *Safety Datasheets*.

4 Technical data and ambient conditions

IMPORTANT

The product-specific technical data, operating limits and ambient conditions for the operation of your Rexroth hydraulic product can be found in the *Operating Instructions*.

This includes the following information:

- Minimum flow rate for adequate cooling
- Permissible maximum temperature of the coolant
- Performance data
- Type of control and regulation functions
- Permissible pressures, flow rates
- Connections.

4.1 Information about pressure fluids

Unless otherwise indicated in the *Operating Instructions*, the following specification applies to the pressure fluid to be used:

- Mineral-oil-based pressure fluid complying with the requirements of DIN 51524.
- Operating temperature range 0°C...+80°C (in tank <72°C).

Any deviations from this can be found in the *Operating Instructions*.

IMPORTANT

Bosch Rexroth recommends a maximum operating temperature of 55°C, because the rate of ageing of the pressure fluid increases and the service life of the seals and hoses is reduced at higher temperatures.

- Viscosity ranges:
see RE 07075 and RE 90220
- Max. permissible contamination class of the pressure fluid in accordance with ISO 4406: see 3.5.2 *Malfunctions due to contamination of pressure fluid*.

The maximum permissible cleanliness class can be found in the *Operating Instructions*. The following types of pressure fluids shall be used.

IMPORTANT

Rexroth hydraulic components are tested with test oil MZ45 manufactured by ESSO (class ISO VG 46 at 40°C), (Viscosity η = approx. 46 mm²/s).

4.2 Ambient conditions

4.2.1 Use in potentially explosive atmospheres



Rexroth hydraulic products shall be used in potentially explosive atmospheres only if they are designed for this purpose and this is expressly stated in the *Operating Instructions*.

IMPORTANT

Directive 1999/92/EC of the European Parliament and Council dated 16 December 1999 concerning the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres governs protection from danger from potentially explosive atmospheres. Observe the requirements contained in the regulations for operating equipment requiring supervision and the obligation to produce explosion protection documentation.

This involves, for example, dividing areas endangered by potentially explosive atmospheres into zones and specifying suitable work equipment and procedures for these areas.

Observe the requirements of *Directive 94/9/EC of the European Parliament and Council dated 23 March 1994 on the approximation of laws of the member states concerning equipment and protective systems intended for use in potentially explosive atmospheres (ATEX Product Directive)* and/or the corresponding national legislation by means of which the Directive was implemented in law in the EU member states. The directive contains requirements for the use of equipment and protective systems in potentially explosive atmospheres.

4.2.2 Climatic operating conditions

Unless otherwise indicated in the Operating Instructions, the permissible ambient temperature

- for control units: 0 °C...+50 °C
- for drive units with electric motors without heat exchangers, surface-cooled by free air circulation: 0 °C...+30 °C
- for drive units with heat exchangers: <+40 °C.

Unless otherwise specified, Rexroth hydraulic products are designed for use in temperate climate zones and in covered areas (not in the open air) at relative air humidities of <70 % and at room temperatures of 22 °C.

IMPORTANT

For systems with oil-air heat exchangers:
Observe the information given in the circuit diagram in the *Operating Instructions*.

In relation to the electronic equipment, the permissible ambient conditions apply to installed and protected electrical connections of class IP 55.

- Ambient temperature +5 °C...+40 °C
assuming that the average air temperature over a 24 hour period does not exceed +35 °C.
- Relative air humidity: 23...95 %, non-condensing.
- Altitude: up to 1000 m above national datum.



Rexroth hydraulic products shall not be used in aeronautical equipment, except where they have been specially approved and appropriately labelled to this effect.

5 What you need to know about pressure fluids

5.1 How to handle pressure fluids safely



Mineral-oil-based pressure fluid is hazardous to water and flammable.

It may only be used if the relevant safety datasheet from the manufacturer is present and all the measures stipulated therein have been implemented.

5.2 Functions and effectiveness

Due to the many tasks of pressure fluid, its selection, inspection and maintenance are of vital importance for:

- proper functioning
- operating safety
- service life
- and the cost effectiveness of the hydraulic product.

The tasks of pressure fluid:

- to transmit hydraulic energy from the pump to the hydraulic cylinder/motor
- to lubricate parts moving against one another
- corrosion protection
- to remove contaminants
- to remove locally accumulated heat.

5.2.1 Reduced function due to ageing

The effectiveness of pressure fluid diminishes as it ages (undergoes chemical changes). Acids and resinous residues form, which may cause valve spools to stick.

The following factors accelerate the ageing process:

- high temperatures
- oxygen in the pressure fluid
- air humidity
- water
- metallic catalysers
- operating pressure
- contaminants.

IMPORTANT

Observe the following rules of thumb:

At pressure fluid temperatures $>70^{\circ}\text{C}$, the rate of ageing doubles for each 10°C .

5.3 Viscosity

5.3.1 Viscosity grades

The most important characteristic of a pressure fluid is its viscosity, i.e. stickiness. Viscosity range always plays a priority role in the selection of a pressure fluid.

Viscosity is measured in the SI unit $[\text{mm}^2/\text{s}]$. Many manufacturers still provide their information in centiStoke $[\text{cSt}]$, the equivalent of $[\text{mm}^2/\text{s}]$.

The viscosity grades (VG = viscosity grade) in accordance with ISO 3448 relate to the viscosity at 40°C . The viscosity grade is appended to the type designation or the commercial name of the pressure fluid.

Example: A pressure fluid with a viscosity grade of ISO VG 46 has a viscosity of $46 \text{ mm}^2/\text{s}$ at 40°C .

The relationship between medium temperature and viscosity for hydraulic oil (example)

Medium temperature	Viscosity
3°C	$800 \text{ mm}^2/\text{s}$
8°C	$500 \text{ mm}^2/\text{s}$
25°C	$100 \text{ mm}^2/\text{s}$
60°C	$20 \text{ mm}^2/\text{s}$
77°C	$12 \text{ mm}^2/\text{s}$

Too high a viscosity leads to the formation of air and vapour bubbles as a result of low pressure (cavitation). Too low a viscosity leads to increased leakage losses. Increased leakage losses cause the pressure fluid to heat up more, leading in turn to a further reduction in viscosity. The pressure fluid then loses its ability to lubricate.

Valves, pumps and hydraulic motors, in particular, require exact compliance with the defined viscosity ranges.

For certain ambient and operating temperatures, not all the requirements can always be covered with the available ranges of the viscosity grades.

In order to comply with all the requirements, high viscosity pressure fluids with viscosity index improvers or a pressure fluid cooler/heater may be used.

5.4 Leakage fluid

Clearances and play mean that some leakage fluid escapes from all hydraulic products. Leakage fluid can be lead away internally or externally, depending on the component. It can be fed back into the tank or must be disposed of.



Make sure that the leakage fluid is fed back into the tank in a proper manner.

Dispose of leakage fluid that is not fed back into the tank properly, in compliance with the applicable environmental protection regulations.

5.5 Topping up/refilling



When topping up/refilling your hydraulic system, make sure that you use pressure fluid of the same sort and type and from the same manufacturer.

If the fluid is heavily contaminated or prematurely aged, then the system, including the tank must be cleaned and flushed before refilling. New pressure fluid must always be filtered in accordance with the required cleanliness class, as it does not normally meet the required cleanliness class in the as-supplied state.

6 Construction and mode of operation of a hydraulic system

6.1 Definitions of terms

Hydraulics (fluid technology)

Transmission, control and distribution of energy and signals using a pressurised fluid medium.

Hydraulic system

Arrangement of interconnected components for transferring and controlling hydraulic energy.

Component

A single unit (e.g. a valve, filter, cylinder, motor) that consists of one or more parts and which is a functional constituent of a hydraulic system.

Drive

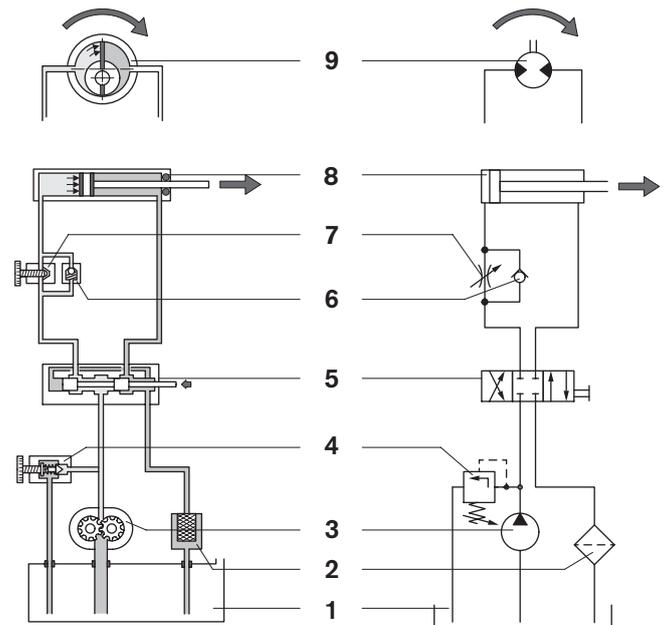
A component that converts the energy of the hydraulic fluid into mechanical energy (e.g. motor, cylinder).

6.2 Schematic

In a system operated with hydraulic oil, first of all mechanical energy is converted into hydraulic energy, transported and controlled in this form, to finally be converted once more into mechanical work.

The hydraulic elements are arranged in accordance with these functions. The following diagram shows a schematic representation of the elements of a complete hydraulic system.

To demonstrate their operating principle, standardised symbols (ISO 1219) are used instead of sectional diagrams of the various devices. Line connections are represented by simple lines, as can be seen in the example.



1	Tank	}	Oil preparation
2	Filter		
3	Pump	}	Energy conversion
4	Pressure limiting valve		
5	Directional valve	}	Energy control
6	Check valve		
7	Throttle valve		
8	Hydraulic cylinder	}	Energy conversion
9	Hydraulic motor		

6.3 Safety concept

Hydraulic products contain sensors and actuators, the interaction of which is particularly important with regard to the fulfilment of technical safety functions.

Individual hydraulic products form part of an overall safety concept.

Applications required to perform safety functions are designed using special hydraulic components that satisfy the requirements of the relevant directives, such as the Pressure Equipment Directive and other standards.

The manufacturer of the overall machine or system defines and bears responsibility for the safety category to EN 954-1 to be fulfilled.

IMPORTANT

A more detailed description of the safety concept and the specific safety components installed can be found in the *Operating Instructions* and the *Operating Instructions of the supplier of the overall system* in which the hydraulic product is installed.

7 Moving hydraulic units/components

Hydraulic units or components may be moved by a fork-lift truck or a hoist, depending on their size and the local conditions.

IMPORTANT

For details see the *Operating Instructions*.



Always ensure hydraulic products are empty of pressure fluid for transportation.

Rexroth hydraulic products are delivered empty of pressure fluid. However, products may contain oil residues left over from the final inspection at our factory.

8 Storage and longer standstills

8.1 Hydraulic systems - subsequent bringing into use after storage

Corrosion, especially oxidation, can cause metal surfaces to lose the standard of surface finish required for the hydraulic system to function properly.

Rust and other metallic and non-metallic particles lead to abrasive wear (erosion), which detrimentally affects the functioning of the hydraulic system.



If a hydraulic system is to be brought into use again following a long standstill, it must first be flushed clean.

8.1.1 Factory-applied corrosion protection

Rexroth hydraulic products are tested in accordance with Class III using a hydraulic oil that has additional anti-corrosive properties. The film of oil that remains in the product after the test provides sufficient internal corrosion protection.

This factory lubrication ensures that valves do not stick during subsequent use of the hydraulic product, and guarantees compatibility with seals and the pressure fluid to be used.

IMPORTANT

The factory-applied corrosion protection is adequate provided that

- no condensation or leakage water can enter the system
- long standstills are avoided.

Contact Bosch Rexroth if you are not clear about the consequences of long standstills on the state of the hydraulic product.

8.1.2 Storage times in relation to the ambient conditions

Delays in bringing into use, long shipping and storage times or long periods of non-use can lead to rust formation in Rexroth hydraulic products. Additional corrosion protection measures must be implemented to prevent this.

IMPORTANT

If all the openings on the hydraulic products are not sealed so as to be air-tight, this will reduce the storage life of the hydraulic product by nine months.

After the specified storage time has expired, in any event not longer than 24 months, the corrosion protection must be checked and further conservation measures applied if necessary.

8.2 Seals, hoses and hose lines



Seals:

Observe the requirements of ISO 2230 and/or DIN 7716 and the specific manufacturer's data on seals.

Hoses and hose lines:

In the Federal Republic of Germany, please observe the requirements of *DIN 20066, ZH 1/74 Safety rules for hydraulic hose lines* and the specific manufacturer's data on hoses and hose lines.

In addition, the following conditions shall be observed:

- Seals, hoses and hose lines are stored in cool, dry and dust-free conditions.

The hoses and hose lines can be enclosed in plastic foil to ensure low-dust storage conditions. Ideal storage conditions for hoses and hose lines are temperatures from +15 °C to +25 °C and a relative humidity of below 65 %.

- Do not store elastomers below –10 °C. The ideal storage conditions for seals are temperatures from +10 °C to +20 °C and a relative humidity of between 65 % and 75 %.
- Store hoses and hose lines in the original packaging if possible. Prevent the entry of air.
- Avoid direct sunlight and UV radiation and shield from nearby sources of heat.
- Darkened storage locations are preferred.
- Do not use ozone-forming light sources or equipment (e.g. fluorescent lamps, mercury-vapour lamps, copiers, laser printers) or electrical spark-forming devices in the vicinity of hoses and hose lines.
- Seals, hoses and hose lines must not come into contact in particular with materials or vapours that could damage them (e.g. acids, alkalis, solvents).
- Store seals, hoses and hose lines lying down and free from tension. If the hoses and hose lines are coiled, take care not to bend them to less than the smallest bending radius specified by the manufacturer.

Maximum storage times

- NBR seals: 4 years
- FKM seals: 10 years
- Hoses: 4 years
- Hose lines: 2 years

For reasons of safety, seals, hoses/hose lines shall not be used once these permissible storage times are reached or exceeded. Permissible storage times could be considerably reduced if the permissible storage conditions are not maintained. If you are not clear about the storage times and/or storage conditions then you should not use the product.

9 Assembly and bringing into first use

IMPORTANT

Only the permissible pressure fluids given in the Operating Instructions are to be used. Information on other pressure fluids can be found in the *Operating Instructions* or are available on request.

Filling the pressure fluid tank must always take place through a suitable filter unit. Experience has shown that even new pressure fluid can often have more than the maximum permissible level of contamination.

All information specific to assembly and bringing into first use can be found in the *Operating Instructions*.

Pay attention to cleanliness:

- Do not use cleaning wool or cloths containing fibres for cleaning.

Depending on the condition of the system or machine, cleaning with fibre-free cloths may be sufficient. Use suitable liquid cleaning agents to remove lubricants and other stronger contaminants. Make sure that cleaning agent does not get into the hydraulic system.

- Never use hemp and putty as sealants.

The functional or failure behaviour of identical hydraulic products may vary due to conditions specific to the machine or system in which the hydraulic product is installed (mass, speed, electrical triggering at setpoint values, etc.), see also Section 11 *Trouble-shooting*.

9.1 Safety advice for assembly and bringing into first use



Hydraulic products are generally intended for installation in machines/systems or devices.

The function of the hydraulic product must therefore always be seen in relation to the function of this machine – i.e. seemingly identical hydraulic products may demonstrate different functional behaviours as a result of the function of the machine in which they are installed.

For this reason, a hydraulic drive must not be brought into use until it has been determined that the machine in which it is installed conforms to EU standards.

Do not bring hydraulic drives into use until you have familiarised yourself completely, firstly with the function of the hydraulic product and hydraulic equipment and secondly with the hydraulically powered machine functions, and have clarified and dealt with any possible dangers.

Bringing into (first) use shall only be done by an instructed, authorised hydraulics expert who has the required specialist knowledge.

Specialist hydraulics knowledge means, among other things, that the person can read and fully understand hydraulics drawings. In particular, he must fully comprehend the range of functions of the integrated safety components as part of the overall safety concept.

9.2 Before bringing into first use

1. Check the scope of delivery for transport damage.
2. Check that the Operating Instructions for the Rexroth hydraulic product are present and complete. Contact us if the Operating Instructions are not there or are incomplete.
3. Assemble the hydraulic product.
 - Observe the *Operating Instructions* and this product information.
 - Assemble the hydraulic components, so that they are mounted strain-free on even surfaces.
 - Tighten the fastening bolts evenly using the specified tightening torque.
4. Ensure that the interfaces of the system/machine and the installation conditions provide for safe operation of the hydraulic product. If in doubt, consult the people responsible for the overall system/functional machine.
5. Check the construction of the hydraulic product against the circuit diagrams, lists of equipment and assembly drawings. If there are any differences, draw this to the attention of the people responsible. If important documents are missing, they can be requested from Bosch Rexroth. Only documents issued by the bodies authorised to do so shall be used.
6. Based on the *Operating Instructions* for the system or machine in which the hydraulic product is installed, check whether bringing the hydraulic system into use could lead to uncontrolled, dangerous movements. Where appropriate, take into account the hazard analysis/risk assessment for the system or machine.
7. Take the precautions appropriate to the anticipated dangers, e.g.
 - Ensure that the cylinder piston rod can move out without danger.
 - Use a hoist or other lifting device to additionally secure lifted loads.

8. As part of bringing into (first) use, check whether the electric motors and valve solenoids can be switched manually using the electrical controls of the system/machine. If they cannot be switched manually – or can but with difficulty – you must provide a remote control (e.g. test boxes for Rexroth proportional valves) for the internal function test of the hydraulic system.

IMPORTANT

Starting up the hydraulics solely by means of emergency manual operation is not recommended, as several valves at once cannot be switched as required in the correct sequence.

9. Draw up a sequential program for bringing into (first) use and store it with the technical documentation as an appendix to the Operating Instructions.
For this you should consider the following:
Hydraulic drives basically consist of the following functional groups
- Pump circuit (generation of pressurised oil flow); pump, electric motor, oil tank, filters, monitoring devices, etc.
 - Control system for at least one hydraulic consumer (cylinder, motor); directional control valves, pressure and flow control valves, check valves
 - Hydraulic consumers (cylinders, motors) with specially assigned valves, e.g. braking valve.
10. Divide the functional circuit diagram into separate mini-circuits that can each be started up in succession.
11. Read the functional circuit diagram and seek clarification of any unclear text or diagrams. More information about the functioning of components, e.g. a pump regulator, is available in the *Technical Datasheet*.
12. Establish into which position valves are to be switched, or how valves are to be set.
13. Put up any necessary directional, prohibitive or informative signs and check whether the meaning of these signs are explained in the *Operating Instructions*.
14. Follow this sequence for bringing into (first) use
- Pump circuit
 - Parts of control system:
e.g. pressure cut-off and switchover, open centre, pressure reduction etc.
 - Cylinder and motor circuits:
First move, fill and bleed, then finally optimise all settings.

9.3 Bringing into first use, subsequent bringing into use

DANGER

Before bringing into (first) use, have all pressure accumulators and safety systems checked by an expert or specialist in accordance with national regulations.

1. Clean the lock on the transport and storage container before opening.
2. Clean the hydraulic unit and all other component groups, so that no dirt can get into the hydraulic system during bringing into (first) use.
3. Check the paint on the tank for integrity.
4. Flush the connection lines to remove dirt, scale, chips etc.
5. Pickle and flush welded pipes.

CAUTION

Remove all residues of water and cleaning agents before performing further work.

6. Clean the interior of the hydraulic components to get rid of contaminants:
 - Clean the filler plug of the pressure fluid tank.
 - Remove dust and chips using an industrial vacuum cleaner, by rinsing parts or similar cleaning method.
 - Completely remove any oil residues left over from the factory test.
 - Remove any gummed oil which may have formed due to incorrect storage.
7. Connect up all connection lines.

IMPORTANT

Observe the installation instructions from the manufacturer of the connection components.

DANGER

Make sure that pipes and hoses are connected at all ports or that the ports are sealed with screw plugs.

8. Carry out a special check to make sure that the union nuts and flanges are correctly tightened at the pipe connections and flanges.

IMPORTANT

Mark all the checked connections, e.g. with paint.

Make sure that all pipes and hoses and every combination of connection pieces, couplings or connection points with hoses or pipes are checked for their operational safety by someone who has the appropriate knowledge and experience.

9. Connect the hydraulic consumers. Dimension the connection lines in accordance with the performance data in the *Circuit Diagram* and the *Operating Instructions*.
10. Install the electrical system for the drive and control system:
 - Check the connected loads.
 - Connect coolant water if necessary.
 - Check the direction of rotation of the pumps (e.g. as indicated by attached arrow markings).
11. Check the pressure fluid to ensure that no water has entered it.
12. Before filling the pressure fluid tank, please observe the following requirements:
 - The pressure fluid must conform to the specification in the *Operating Instructions*.



Never fill new hydraulic products with used pressure fluid.

- The drums of pressure fluid must be sealed and clean on the outside.

IMPORTANT

If the pressure fluid has a high level of initial contamination (see 4 *Technical data and ambient conditions*):

Use a filter unit to fill the pressure fluid tank. Ensure that the filter element is clean.

IMPORTANT

The fineness of the filter shall correspond to the cleanliness class required by the overall system and if possible be even finer.

The filter unit used shall fulfil the requirements for functional safety and service life.

- If possible, fill the pressure fluid tank via a filling coupling, using a return filter if possible.



Use oil filler units (filter units) suitable for pressure fluids.

- Do not remove the filter strainers from filler necks or the filter element from filters before filling the pressure fluid tank.
13. Fill the pressure fluid tank up to the upper mark on the inspection window. Observe the maximum fluid level, taking into consideration the volume in the connection lines and hydraulic consumers.
 14. Set the pressure and flow control valves, pump regulator, signalling elements such as pressure switches, limit switches and temperature regulators to the settings and values defined in the sequential program (see 9.2 *Before bringing into first use*).



Do not change the settings of valves with a safety function, valves with a position switch or valves with preset electronics.

- Set operating-pressure valves and flow control valves to the lowest possible values.
 - Set directional control valves to their basic setting.
 - Reduce the setpoint values of proportional valves to minimum values.
 - Do not remove the tamperproof lead seals. Damaged or removed tamperproof lead seals indicate improper use of the hydraulic product.
15. If applicable:
Fill the pressure accumulator to the specified gas pre-charge pressure and then check the pressure, see *Operating Instructions*.
 16. Fill the pump body:
Use the leakage oil port to fill pump bodies that have this feature, see *Operating Instructions*.
 17. If applicable:
Open the cocks in the suction line.
 18. Start the drive motors:
 - With electric motor in jogging mode, allow to start briefly
 - Combustion engines in idle
 - Pay attention to the direction of rotation.

19. Bleed the hydraulics (valve, pump, motor, line, cylinder).

IMPORTANT

Details on bleeding can be found in the *Operating Instructions*.

- Operate the hydraulic product at low pressure until it is fully bled.
- Bleed the hydraulics lines to consumers or measuring points at the highest point, if possible.
- Operate the directional valves in jogging mode.
- Next, advance and retract all hydraulic consumers several times.
- Increase the load slowly. Check the pressure fluid level in the pressure fluid tank. If necessary, top it up with pressure fluid.

Bleeding has been accomplished fully and correctly if the pressure fluid in the tank does not foam, if the hydraulic consumers do not make any jerky movements and if no abnormal noises can be heard.

20. Set the valves and sensors and start up the machine:

- Set the switching operations of valves with a switching time adjustment/ramp in accordance with the dynamic conditions, see *Operating Instructions*.
- Finely adjust and optimise the setting of proportional valves without on-board electronics (OBE).

Manufacturing tolerances mean that valves and amplifiers have to be adjusted in line with one another. Valves with in-built electronics (OBE, On Board Electronics) have the valve and amplifiers adjusted in line with one another at the factory.

Amplifiers for valves without OBE are supplied from the factory with a basic setting. Depending on the type of valve and amplifier, you may have to fine-tune the null point and sensitivity before bringing the valve into use.

IMPORTANT

Details on fine-tuning can be found in the *Operating Instructions*.

21. Check the operating temperature after the machine has been running continuously for several hours. Too high an operating temperature indicates that there are faults that need to be analysed and rectified.
22. Rectify any leakages, e.g. by relieving couplings from pressure and then retightening.

IMPORTANT

Apart from moisture, which should not be sufficient to form one drop, no measurable, unintentional leakage shall be found.

23. After bringing the machine into first use, have a sample of the pressure fluid analysed to ensure that it achieves the required cleanliness class. Change the pressure fluid if the required cleanliness class is not achieved. If the pressure fluid is not tested in the laboratory after bringing the machine into first use: Change the pressure fluid.

24. Replace the pressure fluid filter.

25. Document and file all set values.



26. To ensure the safety of persons and the system, after bringing the machine into first use, perform the following tests using the defined maximum values:

- Function test
- Pressure test.

Prepare a record of the bringing into (first) use or acceptance and have it signed by the plant operator. This record is an important document and requires to be filed.

IMPORTANT

Information on how to perform the function test and pressure test can be found in the *Operating Instructions*.

10 Operation

IMPORTANT

Please refer to the *Operating Instructions* for all information on how to operate the Rexroth hydraulic product.

11 Trouble-shooting

11.1 What to do in the event of a fault



In the event of abnormal occurrences or malfunctions, stop all work on the Rexroth hydraulic product immediately and inform the responsible personnel.

IMPORTANT

A table for product-specific trouble-shooting can be found in the *Operating Instructions*.

If the responsible personnel are unable to rectify the problem immediately:

- Switch off the main switch. If applicable, turn off any combustion engines used as drive motors.
- Secure the main switch against being unintentionally switched on again.
- Inform the machine manufacturer.

11.2 The basic approach to trouble-shooting

The information in this section is intended to help you create the ideal conditions for carrying out trouble-shooting as efficiently as possible.

11.2.1 General conditions

- Is all the necessary technical documentation to hand?
- If no hydraulic circuit diagram is available: Can a hydraulic circuit diagram be drawn using the structure, signs and labelling of the equipment?
- Are there enough measuring points?
- Has the customer provided useful information about how the malfunction manifests itself and about the functional behaviour of the system/component prior to the malfunction?

- Is there a machine record book that may document similar malfunctions in the past?

11.2.2 Recommended way of working when trouble-shooting

Successful trouble-shooting for a hydraulic product requires precise knowledge about the structure and method of operation of the individual components.

Where hydraulics are combined with electrics/electronics, in particular, trouble-shooting is rendered more difficult and co-operation between electricians and hydraulic specialists is required.

- Even if you are under time pressure, proceed systematically and methodically. Indiscriminate, hasty dismantling and readjustments may, in the worst case, result in the original cause of failure being impossible to determine.
- Make sure that you gain an overview of the function of the hydraulics in respect of the overall system in which the hydraulics are installed.
- Try to find out whether the hydraulics performed the required function in the overall system prior to the occurrence of the fault.
- Try to determine any modifications to the overall system in which the hydraulics are installed:
 - Have the operating conditions or operating range of the hydraulics been changed?
 - Have modifications (e.g. retrofitted equipment) or repairs been carried out on the overall system (machine/system, electrics, control system) or on the hydraulics? If yes: What were they?
 - Have the set values of the hydraulics been changed?
 - Have the hydraulics recently undergone maintenance?
 - Has the hydraulic product/machine been operated improperly?
 - How does the malfunction manifest itself?
- Form a clear picture of the cause of the fault. Ask the machine operators directly, if necessary.
- Document any work undertaken, changed set values, etc.
- Document any amendments/additional information that should be included in the *Operating Instructions*.

11.2.3 Systematic trouble-shooting procedure

- Is there an inspection and maintenance book which might provide information about the trend of test parameters (e.g. temperature of hydraulic fluid, replacement intervals of filter elements, noises)?
- Have there been any identical or similar failures in the past?
 - Make a note of causes of failures with a low probability. Only investigate the failure causes you have noted down if all failure causes with a high probability have been proven to be inapplicable.
 - Draw up a list of priorities of the most probable failure causes.
 - Verify these listed failure causes one after the other (by means of theoretical conclusions, disassembly, measurements or tests).
 - Document the causes of failure you have discovered, and note down how you discovered them.

11.3 Trouble-shooting tables

IMPORTANT

The causes of failure in hydraulic systems can be extremely complex. Therefore, general rules for trouble-shooting can only be laid down to a limited degree.

Please refer to the relevant *Operating Instructions* for product specific information about trouble-shooting the Rexroth hydraulic product.

12 Maintenance

12.1 Definitions of terms

The term **Maintenance** as defined in DIN 31051 encompasses all measures to maintain and restore the desired conditions and to determine and assess the actual condition of the technical devices of a system .

These measures are divided into the following categories:

- Inspection (determining the actual condition)
- Servicing (maintaining the desired condition)
- Repair (restoring the desired condition).

The above measures include:

- Adapting maintenance objectives to suit company objectives
- Determining appropriate maintenance strategies.

12.2 Safety during maintenance tasks



In the interests of safety, please observe all the following safety instructions carefully and at all times.

- Check safety devices regularly to see that they are working properly.
- Perform all maintenance work properly, completely and within the stipulated periods and make a record of the work.
- Inform all personnel before commencing maintenance work.
- Generously cordon off the maintenance zone before commencing work.
- Inform all persons of ongoing maintenance work by means of the appropriate signs.
In particular, attach warning signs to the control cabinet, main switch, actuators and points of access.

If you have to switch off the hydraulic product, secure it against being unintentionally switched on again as follows:

- Switch off all drives, disconnect the hydraulics from the mains at the main switch.
- Depressurise the hydraulic product (relieve any pressure accumulators of pressure).
- Secure the main switch against being unintentionally switched on again.

Before undertaking any manual intervention in the Rexroth hydraulic product:



Please refer to the *Operating Instructions* for all the necessary information on depressurisation and on those parts of the Rexroth hydraulic product that are not depressurised automatically.

- **Advance all cylinders to their safe end position.**
- **Lower all loads.**
- **Switch off all pumps.**
- **Mechanically support vertical cylinders so that they cannot drop. Never perform any maintenance work on raised units without external support.**
- **Relieve any accumulators of pressure in the proper manner.**
- **Switch off the pressure supply and secure the hydraulic product against being inadvertently switched on again.**
- **Ensure that only authorised personnel remain in the work zone.**
- **Wear safety glasses, gloves and boots.**
- **Allow pressure lines and sections of the system which have to be opened to cool down before commencing maintenance work.**
- **Open with care any segments that have to remain under pressure.**

Since check valves are located in the pressure lines above the pumps, the hydraulic system may still be under pressure even after it has been disconnected from the actual pressure supply.

Certain segments, such as servo cylinders, also continue to remain under pressure because the proportional valves remain in the closed position (all valves are illustrated in their basic position in the hydraulics diagram).

Observe the following:

- Only new, interchangeable and tested components, replacement parts and lubricants in original-equipment quality are approved for use/replacement.
- For reasons of safety, the installation of used and/or untested components is strictly prohibited and leads to loss of EU Conformity.

Exercise extreme vigilance when operating the hydraulic product in maintenance mode, which may in certain circumstances necessitate the temporary removal of certain safety devices.

Make sure that all safety devices are properly installed and have undergone a function test before bringing the system (back) into use.

- Perform welding, burning or grinding work on the hydraulic unit or its attachments only with the approval of local safety authorities/fire brigade and with suitable protective covering to prevent ingress of contaminants.
- When performing assembly work above your height, use the steps and platforms provided by the plant operator. Do not climb on any parts of the system.
- Remove all tools and materials needed for maintenance from the hydraulic product.
- Always rectify any leakage from the hydraulic product immediately.
- Always inform personnel before (re)starting the hydraulic product.
- Document and file details of any work undertaken, changed set values, etc.
- Document and file details of any amendments/additional information that should be included in the Operating Instructions.
- Modifications and additions could affect the validity of the EU Conformity Declaration/Manufacturer's Declaration. Always consult Bosch Rexroth about any proposed modifications or additions.

12.3 Inspection and servicing

The objective of inspection and servicing is

- To maintain all system functions along with the initial parameters of the system
- To ensure continual availability of the system
- To detect weak points
- To ensure that the system attains the required service life.

IMPORTANT

The following general specifications are based on use of the hydraulic product in central Europe and under the usual operating conditions of commercial and industrial plants.

We strongly recommend the use of an inspection and servicing book, in which all work specific to that site, and all inspection and servicing intervals should be defined and documented.

An inspection and servicing book is also helpful in that

- It provides comparison values to aid with early detection of malfunctions
- It allows warranty claims to be dealt with more easily.



Ensure cleanliness during all work.

- Please observe the requirements for pressure fluids mentioned in Section 9 *Assembly and bringing into first use*.
- Clean the external environment of couplings/joints and devices before disassembly. Do not use cleaning wool or cloths containing fibres for cleaning.
- Seal all openings using protective caps.
- Bleed the hydraulic product after each item of servicing work.

12.3.1 Inspection procedures and test equipment, general

The following are some of the typical inspection and testing procedures that are regularly used in connection with hydraulic systems and components.

IMPORTANT

Keep the indicated typical test equipment ready for this type of work.

Type of test	Typical test equipment	Typical testing activities
Pressure measurement	Pressure gauge or sensor with suitable measuring range and connection pipe and connection coupling	Checking of <ul style="list-style-type: none"> specified pressure opening pressure pressure difference before and after the object under test
Visual inspection	–	Checks for <ul style="list-style-type: none"> all components securely seated damage wear leakage (formation of oil droplets) presence of all warning and informative signs
Touch inspection	–	Checks for <ul style="list-style-type: none"> unusual local vibrations
Temperature inspection	Temperature measuring instrument	Checks for <ul style="list-style-type: none"> unusual local temperature zones
Acoustic inspection	–	Checks for <ul style="list-style-type: none"> changes in running noise of the unit changes in flow noise changes in operating noise in the unit and valve control.

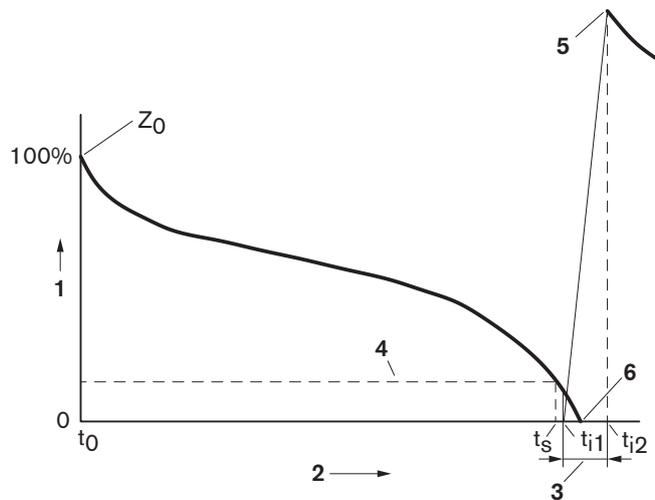
12.3.2 Location of testing and measuring points

IMPORTANT

Please refer to the *Operating Instructions* for the installation location of filling level indicators, filling points, drainage points, filters, testing points, strainers, solenoids, etc. that require regular inspection and servicing.

12.3.3 Inspection and servicing plan, hydraulic products, general

The graph illustrates the concept of wear/wear margin. The wear margin is a characteristic feature used to describe the condition of the system for the purpose of maintenance.



- 1 Wear margin Z_0
- 2 Time t
- 3 Repair (corrective maintenance) time ($t_{i2} - t_{i1}$)
- 4 Damage threshold (damage time t_s)
- 5 Desired condition after corrective maintenance
- 6 Failure

The reduction in the wear margin reflects wear. The curve represents one possible form of the wear profile during the period of use. It is determined during inspection and varies depending, firstly, on the system itself (e.g. material selection, surface treatment, quality) and secondly on external influences or boundary conditions such as servicing levels, corrosive circulating air and dust. Thirdly, it depends on how the system is operated; whether with partial load or partially with excess load, whether it is subject to surge loads or steady load, etc. Where hydraulic systems are concerned, the curve is also influenced by the cleanliness class and degree of fouling of the pressure fluid, the number of cycles and the ambient conditions.

All the factors mentioned above can exert an influence on the curve but this need not necessarily adversely affect the quality of its information, as wear always signifies the reduction in the wear margin, which is understood to be the primary initial variable before wear commences.

Consequently, this means that a sudden change in the wear margin must also count as wear, and that the element of time on its own is not of decisive importance for wear, but is of considerable interest in the assessment and evaluation of such wear.

An increase in the wear margin to over 100 % above its baseline may be achieved through corrective maintenance, if such measures entail an improvement and this increase is established as the new desired condition for future corrective maintenance.

Certain system parts may be subject to a wear margin which diminishes in such a way that the time available for use is insufficient for the requirements of the plant or operation. In this case, investigations must be carried out to ascertain whether the introduction of suitable technical measures might counter this reduction in the wear margin to a satisfactory extent. The time and expenditure required for such measures must naturally be kept in reasonable proportion to the expected degree of success.

If such conditions arise, we refer to these parts as weak points. Since their elimination may provide economic and safety advantages, weak points require to be rectified immediately.

IMPORTANT

The inspection and servicing plan for your particular product can be found in the *Operating Instructions*.

12.3.4 Inspection and servicing plan, electrohydraulic systems

Electrohydraulic systems with proportional valves must be serviced in accordance with hydraulic requirements and strategies. However, technical control components must also be incorporated in these servicing cycles.

On this basis, an overall strategy for system servicing must be developed and documented.

IMPORTANT

The appropriate component characteristics relevant to servicing can be found in the *Operating Instructions*.

12.3.5 Inspection and servicing plan: electrics and control system

IMPORTANT

The product-specific inspection and servicing plan for electrics and control systems can be found in the *Operating Instructions*.

12.3.6 Lubrication points, lubricants, intervals

IMPORTANT

The details of the specified lubricants, lubrication points and associated lubrication cycles can be found in the *Operating Instructions*.

12.3.7 Set values of valves, regulators and signalling elements

Pressure and flow control valves, pump regulators and signalling elements such as pressure sensors, pressure switches, limit switches and temperature regulators are given their optimum setting when the system is brought into first use.

Check regularly whether all values are correctly set with the aid of the hydraulics diagram and the documented values.



The set values of valves with position switches shall only be calibrated or readjusted at the factory.

The set values of safety valves shall not be altered by the user. Any readjustment shall be performed by authorised testing bodies only.

Too low a pressure difference between the operating pressure and the opening pressure can lead to frequent opening of safety valves. This leads to increased power losses and an unacceptable increase in temperature of the pressure fluid. In this event, select a lower operating pressure.

12.3.8 Replacement of pressure fluid filters and ventilation filters

CAUTION

Unfiltered pressure fluid filters lead to increased wear of all the system's hydraulic products and can cause functional failures with dangerous effects. Therefore, always replace contaminated oil filters immediately.

Clogged ventilation filters result in inadequate cooling and can therefore cause excessive heating up and malfunctions of the hydraulic system. Therefore, always replace contaminated ventilation filters immediately.

- Clogged filters must always be replaced immediately. Do not clean clogged filters.
- Allow the contents of the replaced oil filter to drip and fully drain.
- Dispose of the filter in accordance with the applicable regulations.

Exact instructions on how to replace a filter can be found in the *Filter manufacturer's instructions for use*.

12.3.9 Checking filters with a contamination indicator

Filters with contamination indicators continuously measure the degree of fouling. The dirt-retention capacity of the filter is utilized to the full.

IMPORTANT

Check the contamination indicator when the pressure fluid is warm (during or immediately after operation).

If the ambient temperature is low or the pressure fluid is cold, its high viscosity may cause clogging to be indicated, although the pressure fluid is in fact clean.

Procedure:

1. Wait until the hydraulic product has reached operating temperature.
2. Press the indicator button (check function):
If the indicator button pops out again immediately, the filter must be replaced by the end of the shift at the latest.

Due to the progressive loss in pressure as the filter becomes increasingly contaminated, the indicator point has a certain reserve capacity, i.e. generally sufficient for a work shift of 8 h.

If the filter is not replaced after 8 h, dirt may penetrate the system, resulting in contamination of the hydraulic product.

CAUTION

In certain circumstances the contamination indicator does not show a required filter replacement.

If the check function never indicates filter replacement and the contamination indicator is functioning correctly, this may have the following causes:

- Faulty filter
- A bypass valve may have been installed and is not closing correctly, e.g. due to the entry of dirt particles.

12.4 Service and storage lives of hose lines

IMPORTANT

In terms of the service life of hydraulic hose lines in these Operating Instructions, replacement and storage lives are measured from the date of manufacture of the hose line.

Even when properly stored and subjected to permissible loads, seals, hoses and hose lines undergo a natural ageing process.

The replacement and storage lives of seals, hoses and hose lines are therefore limited (see 8.2 *Seals, hoses and hose lines*).

DANGER

Hose lines must be replaced in accordance with the provisions of the servicing plan, even if there are no detectable technical defects in the hose line.

Hoses that have already been used as part of a hose line shall not be reused in a hose line.

The first use may have changed the properties of the hose material to such an extent that reuse of the hose represents a very high risk.

12.5 Topping up the pressure fluid

IMPORTANT

Only pressure fluids specified in the *Operating Instructions* are to be used.

When changing or topping up the pressure fluid, fill the pressure fluid tank on the hydraulic product as follows:

1. Fill the pressure fluid tank using a special filling unit with an integral filter (min. 10 µm).
2. Drop the system pressure right down by resetting the pump. Set the pressure setting value on the pump pressure control to minimum or zero pressure.
3. Fill and bleed the line system of the hydraulic product from the unit to the cylinder. To do this actuate the cylinder in both directions, see *Operating Instructions*.
4. Top up the pressure fluid volume to the specified quantity.
5. Raise the pump pressure to the system pressure.

The hydraulic product is ready for operation.

6. Carry out a test run.
7. Check the level of the fluid after the hydraulic product has warmed up to the operating temperature and adjust if necessary.

IMPORTANT

Check the contamination indicator when the pressure fluid is warm (during or immediately after operation).

If the ambient temperature is low or the pressure fluid is cold, its high viscosity may cause clogging to be apparently indicated.

12.6 Servicing pressure accumulators



Pressure accumulators are subject to the national legislation on safety requirements for pressure vessels applicable in the place of installation.

Observe the Pressure Equipment Directive 97/23/EC.

IMPORTANT

The gas precharge pressure is measured with a testing and filling device.

Details of the procedure can be found in the *Operating Instructions*.

Inspection and servicing

- Carry out the tests required by law.
- Test and monitor the gas precharge pressure regularly.

12.7 Repair

IMPORTANT

Repair (corrective maintenance) is the restoring of the desired condition.

In addition, observe the special safety instructions in *12 Maintenance* and the safety instructions in the *Operating Instructions*.



Ensure cleanliness during all work.

- Clean the external environment of couplings/joints and devices before disassembly. Do not use cleaning wool or cloths containing fibres for cleaning.
- Seal all openings using protective caps.
- Bleed the hydraulic product after each item of repair work.
- If appropriate, follow the procedure for bringing into first use, see *9.3 Bringing into first use, subsequent bringing into use*.
- Document any amendments/additional information that should be included in the *Operating Instructions*.

12.7.1 General safety instructions for repair work



Repair work shall only be done by an authorised hydraulics expert who has the required specialist hydraulics knowledge.

Specialist hydraulics knowledge means, among other things, that the person can read and fully understand hydraulics drawings. In particular, he must fully comprehend the range of functions of the integrated safety components.

Components may only be dismantled for the purpose of repair to the extent described in the *Operating Instructions*.

Never repair a defective safety valve. It must be completely replaced.

Faulty parts may only be replaced by new, interchangeable, tested components in original-equipment quality. Any deviations from this can be found in the *Operating Instructions*.

Before each subsequent bringing into use after repair work, the hydraulic product shall be accepted by a hydraulics expert.

The operator of the hydraulic product is required to check by means of a servicing record that the inspection and servicing plan as been complied with.

Pressure vessels have to be pressure tested every 10 years and the information recorded in accordance with the Pressure Equipment Directive 97/23/EC or its implementation in national legislation.

13 General information about hydraulic pressure accumulators

13.1 General

The regulations applicable at the place of installation concerning hydraulic pressure accumulators (hydrostatic accumulators) must be observed before bringing into use and during operation.

The plant operator bears sole responsibility for compliance with the existing regulations.

Hydrostatic accumulators are subject to the national implementation of the EU Pressure Equipment Directive 97/23/EC.

Documents supplied with accumulators must be preserved with care; they will be required during recurring inspections by specialists.

The bringing into use of hydrostatic accumulators shall be carried out by trained expert personnel only.



Do not perform any welding, soldering or mechanical work on accumulator vessels.

Welding and soldering carry a risk of explosion!

Mechanical tampering may cause the vessel to burst and the operating permit will be withdrawn.

Do not charge hydrostatic accumulators with oxygen or air. Risk of explosion!

Depressurise the system before working on hydraulic installations.

Improper installation can lead to serious damage to persons and property.

13.2 Safety devices relating to hydraulic pressure accumulators

The equipping, installation and operation of hydrostatic accumulators is regulated by the national implementation of the EU Pressure Equipment Directive 97/23/EC and additionally in the Federal Republic of Germany by the *Technical Regulations for Pressure Vessels (TRB)*. This legislation requires the following safety equipment:

- Device to protect against excessive pressure (prototype-tested)
- Pressure relief device
- Pressure measuring device
- Test gauge connection
- Shut-off device
- Optional: electromagnetically operated pressure relief device
- Safety device to protect against overheating.

IMPORTANT

See the *Operating Instructions*.

14 Hydraulic systems

Hydraulic systems are generally intended for installation in machines or systems. In addition to the basic information about the installed components, the information contained in the Operating Instructions made available for each hydraulic system by Bosch Rexroth also applies to hydraulic systems.

By installing the hydraulic system in a machine or system, the interaction of the hydraulic system with the overall machine may give rise to changes in the potential dangers. In particular the effect of hydraulic and electrical control of hydraulic drives that create mechanical movement are to be considered.

This information shall be included in the hazard analysis/risk assessment of the overall machine carried out by its supplier and in the *Operating Instructions of the overall machine*. This also applies to the specification of the interfaces between the hydraulic system and the overall machine.

Hydraulic systems are subject to legislation including the Pressure Equipment Directive and other relevant EU directives that have been implemented in national legislation. Exact information can be found in the EU Conformity Declaration or Manufacturer's Declaration that is supplied with the hydraulic system or the hydraulic product.



Before installing a hydraulic system in a machine or modifying an existing hydraulic system in a machine, satisfy yourself that

- the hydraulic system is suitable for its application in the machine
- the ambient conditions in the machine are suitable and/or permissible for the use of the hydraulic system
- other installed items on or in the machine cannot disturb or endanger the functioning or the safe operation of the hydraulic system.

If the overall machine is to be used in a potentially explosive atmosphere, then it must be ensured that the hydraulic system has been designed and is suitable for this use.

14.1 Effects of leaks in the hydraulic system on the machine

If pressure fluid escapes from the hydraulic system and comes into contact with hot surfaces on the machine, this can lead to the generation of life-threatening smoke, fire and/or other dangerous operating conditions.

These risks shall be determined by the machine manufacturer by means of a hazard analysis and if necessary provision made for the appropriate safety devices.

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