The Drive & Control Company

Rexroth
Bosch Group

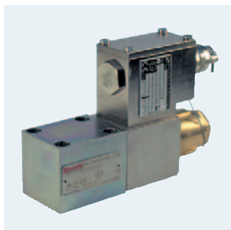
Product catalog Industrial hydraulics

Part 10: ATEX units for potentially explosive atmospheres









Product catalog Industrial hydraulics

Part 10: ATEX units for potentially explosive atmospheres

Product catalogs Industrial hydraulics of Bosch Rexroth at a glance:

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Should you have queries with regard to the products in this catalog, please contact the Rexroth sales partner in your vicinity.

www.boschrexroth.com/contact

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General

Explosion-proof hydraulic products

RE 07010-X-B1/03.12
Replaces: 03.05

Operating Instructions

for explosion-proof
  control valves
  continuous valves

ATEX - units
For potentially explosive atmospheres

Operating Instructions
Part I General Information

What you need to know about these Operating Instructions

These operating instructions apply to Rexroth explosion-proof hydraulic products and consist of the following three parts:

Part I General Information 07010-X-B1
Part II Data Sheet
Part III Product-specific instructions

For further information on the correct use of Rexroth hydraulic products please refer to our publication *General product information on hydraulic products, 07008.*

Contents

1 Important basic information

1.1 Conventions used in this product information document

Cross-references are printed in *italics*.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

IMPORTANT

This symbol indicates additional information.

2 Responsibilities

2.1 Liability, warranty, guarantee

Bosch Rexroth AG shall not be liable for damages resulting from these Operating Instructions not being adhered to or not being adhered to in full.

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 that are 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.

2.2 Operator/user responsibilities

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

It may be used only if the relevant safety datasheet 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.

The operator is responsible for ensuring that

- ➢ the hydraulic product is used only in accordance with the proper use as defined in these Operating Instructions;
- ➢ the hydraulic product is used only in accordance with the technical data, as well as the ambient and operating conditions indicated in these Operating Instructions, and in particular that the limiting values given in the *Data Sheet* are not exceeded;
- ➢ the applicable rules, regulations, and directives on explosion protection are complied with.

If the hydraulic product is part of another product, e.g. a hydraulic system, then the person or organisation responsible for this other product (e.g. the designer/constructor of the system) shall ensure that

- ➢ the hydraulic product is used only in accordance with the proper use as defined in these Operating Instructions;
- ➢ the hydraulic product is used only in such a manner that the technical data, as well as the ambient and operating conditions indicated in these Operating Instructions, are complied with, and in particular that the limiting values given in the *Data Sheet* are not exceeded as far as anyone can judge and are in compliance with its user's manual;
- ➢ the applicable regulations and directives on explosion protection are complied with.

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2.3 Copyright

This product information may only be reproduced – electronically or mechanically, in whole or in part – with the express permission of Bosch Rexroth AG. Similarly, it may 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 Requirements of personnel, duty of care

3.1.1 General requirements, qualifications

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 their training objective;
- their protection is guaranteed through the supervision of an experienced, specialist member of staff;
- they are only allowed to use tools, equipment, and protective gear that preclude the risk of injury.

Specialist personnel are those who, using their specialist training, knowledge, and experience as well as familiarity with the relevant conditions, can recognise possible dangers and undertake the necessary measures to eliminate possible accidents.

3.1.2 Requirements of maintenance personnel

It may be necessary to carry out maintenance tasks on the hydraulic product in order to keep it in proper working order. For details, please refer to *Part III, Product-specific Instructions*. Maintenance tasks include the inspection, servicing, and repair of hydraulic and electrical components. Personnel carrying out these various tasks must have certain minimum qualifications.

For the inspection of the hydraulic components, personnel must fulfil the following requirements:

- They must be instructed about the tasks.
- Specialist knowledge of hydraulics is not required.

For the servicing of the hydraulic components, personnel must fulfil the following requirements:

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

For the maintenance of the hydraulic components, personnel must fulfil the following requirements:

- They must be hydraulics experts instructed in the tasks as defined above.
- They must be familiar with the function of the hydraulic system as a whole, from subsystems to their interaction with the function of the machine as a whole.
- They must be able to read hydraulic circuit diagrams, interpret individual functions from their symbols, and understand function diagrams.
- They must possess knowledge of the function and construction of hydraulic elements.

The following applies to work on the electrical systems:

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

3.2 Ancillary dangers and protective measures

⚠ DANGER

Danger zone	Ancillary danger	Protective measure(s), safety instructions
Connections and pressure lines (pipes and conduits)	Risk of injury or loss of life from sprayed pressure fluid under high pressure during maintenance work.	Depressurise hydraulic system before starting maintenance work. Relieve any accumulators of pressure. Rectify leaks immediately.
Surfaces of components and pressure lines	Risk of burning due to high surface temperatures	Allow hydraulic parts to cool before commencing maintenance work. Wear protective clothing.
Electrical components	Electric shock Loss of explosion protection	Work on electrical components only in a non-powered state. Switch electrical connections off before assembly and disassembly work begins. All tasks that require product components to be dismantled may be performed only within the scope given in *Part III*, *Product-specific instructions*.
	Failure caused by excessive moisture penetration following cleaning with a high pressure cleaner	Shield the hydraulic product from the direct effect of high pressure water jets.

Handling pressure fluid without protection is hazardous to your health.

Please observe the manufacturer's *safety instructions* for the pressure fluid used and the associated *Safety Data Sheet*.

⚠ CAUTION

Danger zone	Ancillary danger	Protective measure(s), safety instructions
Connections and pressure lines (pipes and conduits)	Water or ground pollution due to leakage	Collecting trough. Rectify leaks immediately.

IMPORTANT

See also *2.2 Operator/user responsibilities.*

3.3 Proper use

Your hydraulic product has been conceived and designed for the transmission, open-loop control, or closed-loop control of energy and signals with the aid of the flow of oil. It fulfils the requirements of EU Directive 94/9/EC on Equipment used in Potentially Explosive Atmospheres (Atex). The equipment groups and categories can be found in the *Data Sheet* under *Areas of use in accordance with Directive 94/9/EC*.

Safety components integrated in the Bosch Rexroth hydraulic product satisfy at least Safety Category B in accordance with EN ISO 13849-1:2008.

However, only by carefully observing this user's manual can accidents be prevented and the problem-free operation of your Bosch Rexroth hydraulic product be guaranteed.

Store the hydraulic product only in a dry, dust-free environment that is free of corrosive agents and vapours, has a low moisture content, and undergoes no large variations in temperature. We recommend the use of clean conservation oil for storage periods longer than six months.

IMPORTANT

The factory-applied corrosion protection is adequate for storage under the conditions given above, provided that no condensation or leaked water can penetrate the hydraulic product.

The hydraulic product is only to be used with the operating fluids listed in the *Data Sheet*. Information on using products with different pressure fluids is available on request.

Use the hydraulic product only if it is in perfect technical condition and only in accordance with the proper use as defined in these Operating Instructions. The connections, operating conditions and performance data defined in these Operating Instructions must not be changed.

IMPORTANT

Please contact Bosch Rexroth AG first should you wish to use the hydraulic product under other connection, usage, or performance data than those specified by Bosch Rexroth AG in these operating instructions. The hydraulic product may not be used with any other connection, usage, or performance data other than those described in these operating instructions without written permission from Bosch Rexroth AG.

The hydraulic product must only be converted within the scope given in *Part III*, *Product-specific Instructions*.

During setting up or maintenance work, the safety devices fitted by Bosch Rexroth AG must be present, properly installed, and in full working order, unless this is impossible. They must not be relocated, bypassed, or rendered ineffective.

Rexroth hydraulic products must never be operated or maintained by persons under the influence of alcohol, drugs, or other medication which can affect one's ability to react.

3.4 Use in areas endangered by explosion

⚠ DANGER

The hydraulic product is only to be used in the areas indicated in the *Data Sheet, Requirements for explosion protection* or in areas with lower requirements.

3.4.1 Zones, equipment groups, and categories

The user/operator must divide areas endangered by explosion into zones in accordance with EU Directive 1999/92/EC. The following table shows the equipment groups and categories alongside the zones.

The hydraulic product is to be used exclusively in the area and zone corresponding to the appropriate equipment group and category. Use of the product must also comply with the other Requirements for explosion protection in the *Data Sheet.*

Comparison of the equipment groups and categories in accordance with 94/9/EC and the associated zone in accordance with 1999/92/EC

Equipment group to 94/9/EC	Category to 94/9/EC	Area of use, characteristics (extract from the Directive)	Usable in zone according to 1999/92/EC
I	M1	Atmospheres endangered by firedamp (equipment group I), i.e. underground mines and their surface installations. Can remain operational in the presence of a potentially explosive atmosphere. Very high level of safety.	-
I	M2	Atmospheres endangered by firedamp (equipment group I), i.e. underground mines and their surface installations. Must be able to be switched off in the presence of a potentially explosive atmosphere. High level of safety.	-
II	1G	Potentially explosive atmospheres in which potentially explosive gases, mists, or vapours are present permanently, or frequently, or for long periods (equipment group II). Equates to Zone 0 in accordance with Directive 1999/92/EC. Very high level of safety.	0, 1, 2
II	2G	Potentially explosive atmospheres in which potentially explosive gases, mists, or vapours are occasionally present (equipment group II). Equates to Zone 1 in accordance with Directive 1999/92/EC. High level of safety.	1,2
II	3G	Potentially explosive atmospheres in which potentially explosive gases, mists, or vapours are normally not present, or present only infrequently, or for short periods (equipment group II). Equates to Zone 2 in accordance with Directive 1999/92/EC. Normal level of safety.	2
II	1D	Potentially explosive atmospheres in which potentially explosive dust/air mixtures are present permanently, or frequently, or for long periods (equipment group II). Equates to Zone 22 in accordance with Directive 1999/92/EC. Very high level of safety.	20, 21, 22
II	2D	Potentially explosive atmospheres in which potentially explosive dust/air mixtures are occasionally present (equipment group II). Equates to Zone 21 in accordance with Directive 1999/92/EC. High level of safety.	21, 22
II	3D	Potentially explosive atmospheres in which a potentially explosive atmosphere from raised dust is normally not present, or present only infrequently, or for short periods (equipment group II). Equates to Zone 22 in accordance with Directive 1999/92/EC. Normal level of safety.	22

3.4.2 Temperature classes in equipment group II

In potentially explosive atmospheres where a risk of explosion from explosive gases, mists, or vapours exists (zones **0, 1, 2**, applicable devices: equipment group **II**, categories **1G**, **2G** and **3G**), the maximum surface temperature of the hydraulic product must, in addition, be below the ignition temperature of the surrounding potentially explosive gases, mists, or vapours.

These hydraulic products are divided in accordance with EN 13463-1 into the temperature classes T1 to T6, in line with their maximum surface temperature. With hydraulic products of equipment group **II** and categories **1G**, **2G** and **3G**, the temperature class is a constituent of the explosion protection mark, see *Part II, Data Sheet*, providing information on the suitability of the hydraulic product for use in a particular potentially explosive atmosphere where there are potentially explosive gases, mists, or vapours.

Temperature class	Highest permissible surface temperature	Permissible ignition temperature of the gas, mist, or vapour
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C
T3	200 °C	> 200 °C
T4	135 °C	> 135 °C
T5	100 °C	> 100 °C
T6	85 °C	> 85 °C

3.5 Improper use

DANGER

Modifications to the product are only permitted within the scope given in *Part III*, *Product-specific Instructions*.

The hydraulic product is pre-coated at the factory with a surface protection ready for service. This surface protection must not normally be altered – through the application of paint, for example – as this would render the explosion protection ineffective. Should, by way of exception, alteration to the surface protection be permitted, this will be expressly stipulated in *Part III, Product-specific Instructions.* Please observe the limitations specified here, where applicable.

3.6 Disposal

- Empty the hydraulic product and dispose of it as scrap metal.
- Collect residual oil and dispose of it in accordance with the instructions in the safety datasheet for hydraulic fluids.
- Dispose of any electronic components properly and in accordance with applicable regulations.

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Rexroth
Bosch Group

Hydraulic cylinders

Tie rod / mill type
Mill type for explosive areas

RE 07100-B/03.11

Replaces: RE 07100-B/08.07
RE 07100-X-B/10.04

Operating instructions

The data specified below only serve to describe the product. Any information with regard to use only refers to application examples and recommendations.
Data available in catalogs are no guaranteed characteristics. The information given does not exempt the user from making own evaluations and tests. Our products are subject to a natural process of wear and aging.

The cover shows an example configuration. The product supplied may therefore differ from the photo shown.

The original operating instructions were prepared in German.

Content

Content

1 About this documentation

1.1 Validity of the documentation

This documentation applies to hydraulic cylinders in mill type and tie rod design as well as to hydraulic cylinders in explosive areas.

This documentation is intended for system manufacturers, assembly fitters, operators and service technicians and system operators.

This documentation contains important information on the safe and appropriate transport, storage, assembly, commissioning, operation, maintenance, disassembly and disposal of the product.

- You should read this documentation completely and in particular chapter 2 "Safety instructions" before working with the product.

1.2 Necessary and amending documentation

- The product must not be commissioned until you have been provided with the documentation marked with the book symbol 🕮 and you have understood and observed it.

Table 1: Necessary and amending documentation

	Title	Document number	Document type
🕮	General Information on hydraulic products	RE 07008	Data sheet
🕮	General Information on the assembly, commissioning and maintenance of hydraulic systems	RE 07900	Data sheet

1.3 Illustration of information

Consistent safety instructions, symbols, terms and abbreviations are used so that you can quickly and safely work with your product using this documentation. For a better understanding, they are explained in the following sections.

1.3.1 Safety instructions

In this documentation, safety instructions are indicated whenever sequences of operations are explained which bear the risk of personal injury or damage to property. The measures described for preventing these hazards must be observed.

Safety instructions are set out as follows:

DANGER
Type and source of danger
Consequences in case of non-compliance
▶ Measures for the prevention of dangers
▶ <Enumeration>

- **Warning sign:** Draws attention to the danger
- **Signal word:** Identifies the degree of danger
- **Type and source of danger:** Specifies the type or source of danger
- **Consequences:** Describes the consequences in case of non-compliance
- **Precautions:** Specifies how the danger can be prevented

Table 2: Risk classes according to ANSI Z535.6-2006

Warning sign, signal word	Meaning
DANGER	Indicates a dangerous situation which may cause death or severe personal injuries if not avoided.
WARNING	Indicates a dangerous situation which may cause death or severe personal injuries if not avoided.
CAUTION	Indicates a dangerous situation which may cause minor or medium personal injuries if not avoided.
NOTICE	Damage to property: The product or the environment could be damaged.

1.3.2 Symbols

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

Table 3: Meaning of the symbols

Symbol	Meaning
i	If this information is not observed, the product cannot be used and/or operated optimally.
▶	Individual, self-dependent step
1. 2. 3.	Numbered instruction: The numbers indicate that the steps must be carried out one after the other.

1.3.3 Abbreviations

The following abbreviations are used in this documentation:

Table 4: Abbreviations

Abbreviation	Meaning
S	Center of gravity
ATEX	EU Explosion Protection Directive (Atmosphère explosible)
Ex	EU Explosion Protection Directive (Atmosphère explosible)
ICS	Interactive Catalog System (Rexroth project planning software)

2 Safety instructions

2.1 General information on this chapter

The product has been manufactured according to the accepted rules of current technology. However, there is still the risk of personal injury and damage to property if you do not observe this chapter and the safety instructions in this documentation.

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

2.2 Intended use

The product is a hydraulic system component.

According to directive "2006/42/EC" by the EU and EN 982, this hydraulic cylinder is a component that is not ready for use and exclusively intended for installation into machinery or systems.

You may only use the product for installation into machinery or systems! Hydraulic cylinders are thus not covered by the Machinery Directive.

According to the Pressure Equipment Directive, hydraulic cylinders are not to be classified as pressure vessel but as hydraulic controlling equipment as the pressure is not the decisive factor for the construction but rigidity, dimensional stability and stability against static and dynamic operating loads.

The product is only intended for industrial use and not for private use.

Intended use includes having read and understood this documentation completely, especially the chapter 2 "Safety instructions".

The product may only be used within the data and specifications specified in the valid data sheets.

2.2.1 Intended use in explosive areas

Hydraulic cylinders without Ex mark must not be used and operated in explosive atmospheres.

Only hydraulic cylinders with the type designation CDH2..X.. and CGH2..X.. with Ex mark (see section 5.3 "Product identification") are suitable for use in explosive areas. The products are specified for device group and category according to EU Directive 94/9/EC which can be found in the data sheet of the ATEX hydraulic cylinder. They can be used in an Ex area according to the device group and category specified there.

2.3 Improper use

Any use deviating from the intended use is improper and thus not admissible.

Bosch Rexroth AG does not assume any liability for damage caused by improper use. The user assumes all risks involved with improper use.

Not intended use of the product includes the operation of the hydraulic cylinders:

- With higher operating pressures than intended in the data sheets and/or installation drawings
- With hydraulic fluids not corresponding to the specifications of the data sheets
- With deviating operating and environmental conditions
- The hydraulic cylinder must not be used as guide element in the system (see section 7.2 "Installation conditions").

2.3.1 Improper use in explosive areas

The hydraulic cylinder may heat up considerably during operation. An additional protective structure like e.g. coating may only be applied in the usual layer thicknesses (~ 80 - 100 μm) As a consequence of any non-compliance, the upper temperature limit of the product tested according to the Ex Directives may be exceeded.

2.4 Qualification of personnel

The activities described in this documentation require basic knowledge of mechanics, electrics and hydraulics as well as knowledge of the appropriate technical terms. In order to ensure safe use, these activities may only be carried out by a corresponding expert or an instructed person under the direction and supervision of an expert.

Experts are those who can recognize potential hazards and apply the appropriate safety measures due to their professional training, knowledge and experience, as well as their understanding of the relevant conditions pertaining to the work to be undertaken. An expert must observe the relevant specific professional rules.

The product may only be used by qualified persons who have been instructed

- to carry out the transport.
- to assemble and disassemble hydraulic and mechanical parts.
- to commissioning hydraulic systems and assemblies.

2.5 General safety instructions

- ▶ Observe the valid regulations on accident prevention and for environmental protection.
- ▶ Observe the safety regulations and provisions of the country where the product is implemented/used.
- ▶ Exclusively use Rexroth products in good technical order and condition.
- ▶ Observe all notes on the product.

- Persons who assemble, operate, disassemble or maintain Rexroth products must not consume any alcohol, drugs or pharmaceuticals that may affect their ability to react and their ability to judge.
- Only use accessories and spare parts authorized by the manufacturer in order to exclude hazards to persons due to inappropriate spare parts.
- Comply with the technical data and environmental conditions indicated in the product documentation.
- The installation or use of inappropriate products in safety-relevant applications could result in unintended operating conditions when being used which in turn could cause personal injuries and/or damage to property. Therefore please only use a product for safety-relevant applications if this use is expressly specified and permitted in the documentation of the product. For example in explosion-proof areas or in safety-related control components (functional safety).
- Do not commission the product until you can be sure that the end product (for example a machine or system) where the Rexroth product is installed complies with the country-specific provisions, safety regulations and standards of the application.

2.6 Product- and technology-related safety instructions

The installation of the hydraulic cylinders in the machine may result in risks caused by the interaction of hydraulic cylinder and machinery which can only be identified and minimized by means of a risk assessment of the machine. Particularly the influence of hydraulic and electric controls on hydraulic drives generating mechanical movements requires a risk analysis and operating instructions for the machinery.

⚠ WARNING

Pressurized system!

Danger to life, risk of injury, severe injury when working at systems that have not been stopped! Damage to property!

- Make sure that the hydraulic cylinder has been completely depressurized.
- Do not disconnect lines, connections or components as long as the hydraulic cylinder is under pressure.
- Switch off all force-transmitting components and ports (electric, pneumatic, hydraulic) according to the manufacturer's instructions and secure them against restarting. If possible, remove the main fuse of the system.

Leaking oil mist due to defective or improperly assembled seals!

Risk of fire, risk of explosion, risk due to allergic reactions, environmental pollution!

- Welding works may only be undertaken when the hydraulic cylinder is depressurized.
- Keep open fire and sources of ignition away from the hydraulic cylinder.
- Make sure that the earthing (electric welding circuit) during welding works at the system is not lead via hydraulic cylinders.

WARNING

Electrostatic charging!

Danger to life in the explosive area!

- The equipotential bonding of the hydraulic ATEX cylinder must always be connected in order to prevent electrostatic charging.

CAUTION

Hot surfaces at hydraulic cylinders!

Risk of injury! Risk of burning!

- Only touch cylinder surfaces with protective gloves or do not work at hot surfaces. During or after the operation, the temperatures may exceed 60 °C (140 °F), depending on the operating conditions.
- Allow the hydraulic cylinder to cool down sufficiently before touching it.
- Observe the protective measures of the end machine manufacturer.

Hydraulic fluid leaking at the hydraulic cylinder in an uncontrolled form!

Risk of fire! Risk of injury!

- Switch the system off immediately (emergency stop switch).
- Identify and remedy the cause of the leakage.
- Never try to stop or seal the leak or the oil jet using a cloth.
- Avoid direct contact with the leaking oil jet. It might be under high pressure.
- Carry out visual inspections for tightness of the hydraulic cylinder and the oil-containing components on a regular basis.

Slip hazard due to oily surfaces!

Risk of injury!

- Protect and mark the danger zone.
- Immediately remove leaked hydraulic oil.
- Use an oil binding agent in order to bind the leaked hydraulic oil.
- Remove and dispose of (see section 13 “Disposal”) of the contaminated oil binding agent.
- Wear the protective equipment prescribed for your activity like e.g. safety boots.

3 General warnings of damage to property and damage to the product

NOTICE

Danger due to improper handling!

Damage to property!

- The product may only be operated according to section 2.2 "Intended use".
- Do not knock against areas relevant for the functioning (e.g. piston rod surfaces, mounting areas) and attachment parts (e.g. end switches and threaded coupling).

Mixing hydraulic fluids!

Damage to property!

- Any mixing of hydraulic fluids of different manufacturers and/or of different types of the same manufacturer is generally not admissible.

Pollution by fluids and foreign bodies!

Early wear and malfunctions!
Take the following measures for protecting the hydraulic cylinder:

- During assembly, provide for cleanliness in order to prevent foreign bodies e.g. welding beads or metal chips from getting into the hydraulic lines and causing product wear or malfunctions.
- Make sure that all connections, hydraulic lines and attachment parts (e.g. measuring instruments) are clean and free of chips.
- For removing lubricants or any other pollution, use industrial residue-free wipes.
- Only complete cleaning processes at the hydraulic cylinder if the hydraulic connections are closed.
- Before commissioning, ensure that all hydraulic and mechanical connections are connected.

Improper cleaning!

Damage to property!

- Cover all openings with the appropriate protective plugs in order to prevent cleaning agents from penetrating the system.
- Check that all seals and electrical plug-in connections are firmly fitted to prevent the penetration of cleaning agents.
- Do not use aggressive cleaning agents for the cleaning. Clean the hydraulic cylinder using a suitable cleaning liquid.
- Do not use a pressure washer.
- Do not use compressed air for the cleaning at functional interfaces like e.g. spherical bearings, trunnion bearings, piston rods and in sealing areas.

Operation with a lack of hydraulic fluid!

Damage to property!

- Observe the system manufacturer's specifications regarding the point "Control of the hydraulic fluid" and the prescribed remedial measures for the control result.

NOTICE

Leaking or spilt hydraulic fluid!

Environmental pollution and pollution of the ground water!

- Use an oil binding agent in order to bind the leaked hydraulic oil.
- When filling and draining the hydraulic fluid, always put a drain tray under the hydraulic cylinder.
- Observe the information in the safety data sheet of the hydraulic fluid and the system manufacturer's specifications.

4 Scope of delivery

The scope of delivery comprises the hydraulic cylinder as ordered by the customer observing the ordering code and confirmed in the order confirmation. In addition, the ports are closed by means of blanking plugs and/or cover plates. They exclusively serve as protection against pollution of the hydraulic cylinder during transport.

Fig. 1: Blanking plug

Fig. 2: Cover plate

1

5 Information on this product

5.1 Performance description

A hydraulic cylinder converts hydraulic energy into a linear movement. The drive power is determined by the hydraulic pressure in the cylinder chamber on the piston and/or annulus area.

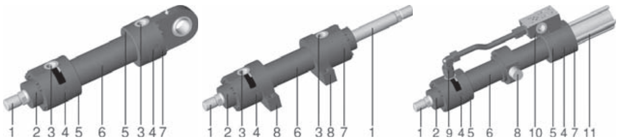
5.2 Product description

In the following, the main and functional parts of mill type and tie rod cylinders are displayed.

▶ For the mounting types, please refer to the valid data sheet!

5.2.1 Mill type cylinder

CD CG CS

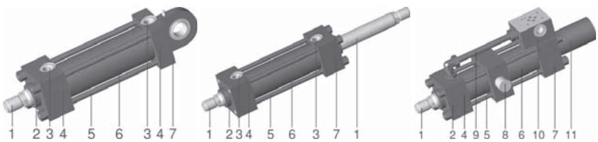


1 Piston rod
2 Cylinder head
3 Line connection
4 Safety bleeding
5 Flange
6 Cylinder pipe
7 Cylinder base (CD: Self-aligning clevis at cylinder base)
8 Fastening
9 Piping
10 Subplate
11 Position measurement system with protective pipe

Fig. 3: H series (example CDH2 / CGH2 / CSH2)

5.2.2 Tie rod cylinder

CD CG CS



1 Piston rod
2 Cylinder head
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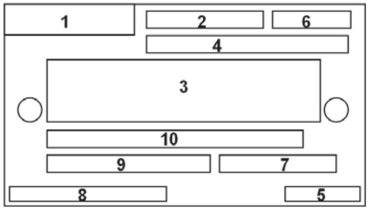
4 Safety bleeding
5 Tie rod
6 Cylinder pipe
7 Cylinder base (CD: Self-aligning clevis at cylinder base)
8 Fastening
9 Piping
10 Subplate
11 Position measurement system with protective pipe

Fig. 4: T3 series (example: CDT3 / CGT3 / CST3)

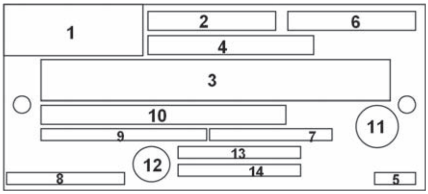
5.3 Product identification

The product is unambiguously identified by:

- The name plate
- The product-specific documentation
- The delivery note and accompanying documents



Name plate: R901052089 (original size: 36 x 20 mm)



Name plate: R900005158 (original size: 50 x 22 mm)

1 Rexroth logo
2 Material number
3 Material abbreviation
4 Serial number
5 Works number
6 Date of manufacture coded
7 RE number of the data sheet
8 Designation of origin
9 Customer, order or project number
10 Customer material number or additional information
11 CE mark
12 EX protection mark (only with ATEX version)
13 EX mark 1 (only with ATEX version)
14 EX mark 2 (only with ATEX version)

6 Transport and storage

6.1 Transporting hydraulic cylinders

WARNING

Uncontrolled extension of the piston rod and lifting of the hydraulic cylinder at set-ups (subplates, piping, etc.)!

Risk of injury or damage to property!

- Hydraulic cylinders may only be transported as described in section 6.1 "Transporting hydraulic cylinders".
- During transport, leave the plastic plugs in the line connections.

Depending on the size and the situation on site, hydraulic cylinders can be transported using a forklift, a crane or any other lifting gear.

When moving and lifting the hydraulic cylinder, please observe the following directives:

- Transport the hydraulic cylinder only in horizontal position, in its original packing, if possible, or on wooden blocks (prism-shaped squared timber) holding the hydraulic cylinder in a stable position.
- Make sure that when transporting the hydraulic cylinder on wooden blocks, there are no force effects on attachment parts (subplates, piping, threaded coupling, proximity switch, etc.).
- Use soft lifting slings in order to prevent damage in the preservation or coating.

Due to the tolerances, you must, during lifting, anticipate a weight of the hydraulic cylinder exceeding the one specified in the drawing or in the data sheets by 10 %. For the weight of the hydraulic cylinder (without packaging), please refer to the shipping documents.

Rexroth hydraulic cylinders are delivered without oil filling. Due to the final test in the Bosch Rexroth company there may, however, still be oil residues in the hydraulic cylinder (for deviations see 6.2 "Storing hydraulic cylinders").

6.1.1 Transport using forklifts

To transport the hydraulic cylinder using forklifts proceed as follows:

1. Move the fork of the forklift under the packaging of the hydraulic cylinder or under the hydraulic cylinder secured for transport.
2. Carefully lift the load for checking the position of the center of gravity. Ensure a stable position of the center of gravity (S)!
3. Make sure that the hydraulic cylinder cannot move out of the intended position.
4. Secure the hydraulic cylinder against the resulting acceleration forces.
5. During transport, only lift the hydraulic cylinder as far off the floor as necessary for the transport.

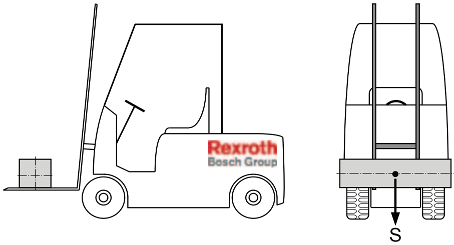


Fig. 5: Transport using forklifts

6.1.2 Transport using lifting gear

NOTICE
Action of forces caused by lifting slings on set-ups (subplates, piping, etc.) during lifting!
Damage to property!
▶ Fasten the lifting gear (load chains, lifting slings) at the hydraulic cylinder so that during lifting, the lifting slings are free, i.e. do not rest against set-ups.

Lifting by means of eyebolts at the hydraulic cylinder

Warning! Break of the eyebolt due to weight overload! Danger to life! Risk of injury! Damage to property!

1. Attach suitable lifting gear at hydraulic cylinders using supplied and already attached eyebolts (load chains, lifting slings). The hydraulic cylinder may only be lifted and transported in the condition as supplied at the supplied eyebolts.
2. Carefully lift the hydraulic cylinder for checking the position of the center of gravity. Ensure a stable position of the center of gravity (S)!
3. Make sure that the hydraulic cylinder cannot move out of the intended position.
4. During transport, only lift the hydraulic cylinder as far off the floor as necessary for the transport.

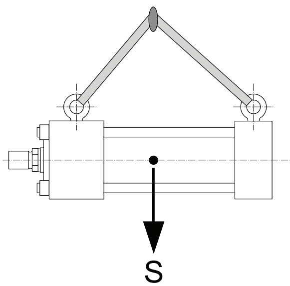


Fig. 6: Use of eyebolts

Lifting by means of lifting slings

1. Fasten two lifting slings of equal length at both ends of the cylinder pipe of the hydraulic cylinder by forming loops.

   Observe the admissible lifting capacity of the lifting slings!

2. Carefully lift the load for checking the position of the center of gravity. Ensure a stable position of the center of gravity (S)!
3. Make sure that the lifting slings do not slip during lifting.
4. During transport, only lift the hydraulic cylinder as far off the floor as necessary for the transport.

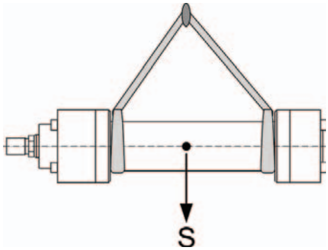


Fig. 7: Use of lifting slings

6.1.3 Manual transport

- Wherever possible, suitable lifting aids should be used such as e.g. carrying straps.

6.2 Storing hydraulic cylinders

6.2.1 Corrosion protection applied by the factory

Primer coat

By default, Rexroth hydraulic cylinders are primed with a primer coat (color gentian blue RAL 5010) of at least 40 μm.

With cylinders and attachment parts, the following surfaces are not primed or coated:

- All fit diameters and connection surfaces to the customer side
- Sealing faces for line connection
- Sealing faces for flange connection
- Connection surface for valve mounting
- Inductive proximity switches
- Position measurement system
- Minimess coupling
- Spherical/plain bearing
- Lubrication nipples

The surfaces that are not primed are protected by means of a corrosion protection oil.

With short storage times in dry rooms at constant temperature, the primer is sufficient as external preservation.

Internal preservation

By default, Rexroth hydraulic cylinders are tested with mineral oil according to DIN 51524, part 2. The oil film remaining inside after the test provides for short-term internal corrosion protection.

The line connections are closed after the test by screw plugs or flange covers.

6.2.2 Storage times according to table 6

After the values specified in table 6, the internal preservation of the hydraulic cylinders is achieved by testing/flushing or filling with corrosion protection oil.

Storage of oil-filled hydraulic cylinders

When storing hydraulic cylinders filled with oil, a pipeline from the line connection of the annulus area to the line connection of the piston chamber has to be attached on the customer side.

Hydraulic cylinders filled with oil must not be exposed to direct solar radiation or other sources of heat as due to the increase in the ambient temperature, the hydraulic pressure in the hydraulic cylinder increases.

Table 6: Storage times

Storage conditions	Packaging	Protective agent	Max. storage time in months Test with the protective agent	 Filling with the protective agent
Storage in dry rooms at constant temperature	For carriage overseas	A	12	24
	Not for carriage overseas	A	9	24
		B	12	24
Outdoor storage (protected against damage and water ingress)	For carriage overseas	A	6	12
		B	9	24
	Not for carriage overseas	A	-	12
		B	6	24
Inspection with protective agent	A = Mineral oil			
Filling with protective agent	B = Corrosion protection oil			

Storage of more than six months

In case of storage of more than six months, the surface of the hydraulic cylinder must be coated or treated with corrosion protection oil. Unprotected parts like fitting surfaces or mechanical interfaces must be protected with corrosion protection oil.

- Protect spherical bearings and fitting surfaces from humidity.
- In case of storage with corrosion protection oil, completely empty the hydraulic cylinders before the commissioning.
- As deformations at the seals cannot be excluded, renew the seals.

In case of improper storage, seals may embrittle and the corrosion protection oil may resinify.

6.2.3 Inspection during the storage period

In order for the hydraulic cylinder to remain in perfect condition during the storage period, the following conditions have to be met:

- Subject the hydraulic cylinder to a careful inspection once per year. While doing so, observe in particular the following:
  - External conservation; visual inspection for damage and rust formation
  - Hydraulic fluid; control with regard to oxidation or acidification
  - Inspection and lubrication of spherical bearings that are not maintenance-free
  - Inspection of the preservation of fitting surfaces or mechanical interfaces
- Extend and retract the hydraulic cylinder several centimeters per year in order to prevent the seals from bonding. Depending on the results, you may have to take corrective measures.

In order to prevent damage at the seals, we recommend rotating the hydraulic cylinders by 90 °C every six weeks unless they are stored vertically.

6.2.4 Information on packed hydraulic cylinders

- If you open the packaging for control purposes, you have to close it again carefully.
- In case of packaging for carriage overseas, enclose a new drying agent.

7 Assembly

7.1 Unpacking

- Remove the hydraulic cylinder packaging.
- Dispose of the packaging material in accordance with the national regulations in your country and/or your company-internal specifications/procedures.

7.2 Installation conditions

Mounting surfaces at machines and systems must be designed so that any torsion of the hydraulic cylinder in the installed condition is avoided. The hydraulic cylinder must be installed so that unwanted lateral loads during operation are avoided. Stroke length, load and cylinder mounting must be observed in order to avoid bending and kinking in every stroke position (extract from: E DIN ISO 4413: 1990-10/6.2.2.3).

- Fasten the hydraulic cylinder so that the load acts axially on the center line of the hydraulic cylinder.
- Make sure that the hydraulic cylinder and particularly the piston rod are not damaged during installation.
  The counter bearings for spherical bearing, trunnion, foot and flange mounting must be able to absorb the occurring forces.
- When installing hydraulic cylinders and assemblies with spherical or plain bearings it has to be ensured that when installing the bolt, the bolt and/or the spherical or plain bearing is not damaged (if necessary, cool the bolt when installing it).
- Design the bolts for cylinder mounting according to the forces to be expected. Only use the genuine bolts when using accessories like clevis brackets etc.

We recommend limiting the swivel angles / tilting angles at the spherical bearings on the customer side in order to prevent the undesired action of forces on mounting elements.

In the fastening of the hydraulic cylinder at the system, the following enumeration must be kept to a minimum (extract from: E DIN ISO 4413: 1990-10/6.2.2):

- Excessive deformation of the hydraulic cylinders due to pushing or pulling load
- Introduction of lateral or bending loads
- Swiveling velocities in the trunnion assembly requiring continuous external lubrication

- Make sure that the "A - piston chamber" and "B - annulus area" line connections are not interchanged when connecting the hydraulic cylinders.

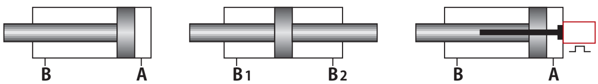


Fig. 8: Installation conditions

7.3 Assembling hydraulic cylinders

WARNING

Uncontrolled and dangerous machine movements!

Risk of injury or damage to property!

- Depressurize the corresponding part of the system before mounting the hydraulic cylinder. Make sure that the system is mechanically unloaded, if necessary.

- When assembling swivel heads or other customer connection elements at the hydraulic elements, screw the swivel head to the stop.

The connection elements must not be used to set installation differences.

- Remove the protective device like e.g. screw plugs only when establishing the corresponding connection.

7.3.1 Installing hydraulic cylinders in the system

To the lifting and moving during installation of the hydraulic cylinder into the system / machine, the same rules apply as already described under chapter 6.1.2 "Transport using lifting gear".

- During installation into the machine / system remember that damage a the hydraulic cylinder particularly at piston rods and mounting areas may reduce the functionality / standstill period.
- When installing hydraulic cylinders and assemblies with spherical or plain bearings, you must moreover ensure that when installing the bolt, the bolt and/ or the spherical or plain bearing is not damaged (if necessary, cool the bolt when installing it).

7.3.2 Hydraulically connecting the hydraulic cylinder

The hydraulic connection has to be established according to the specifications of the hydraulic diagram.

7.3.3 Connecting the electric supply

WARNING

Improper electrical connection in explosive areas!

Risk of explosion!

- Carry out the electrical connections in the system properly and carefully.
- The equipotential bonding must be connected.

The electrical connection of components that might already be available like end switches or position transducers must comply with the specification of the electric circuit diagram.

8 Commissioning

8.1 First commissioning

- Before the installation, clean the lines and all connection surfaces from dirt, scales, chips, etc. For that purpose, use industrial residue-free wipes. Particularly welded pipes must be blank on the inside and flushed.
- Observe the installation instructions of the fitting manufacturer.
  - Fittings with a soft seal at the screw-in stud are recommended (pipe thread ISO 228-1, metric thread ISO 261).
  - Sealants like hemp and kit are not admissible as they may cause pollution and thus malfunctions.
  - Hose lines must satisfy all applicable European and/or international standards.
- Check the system for tightness.
- The connection lines should be dimensioned in accordance with the performance data in the circuit diagram.

8.1.1 Filling hydraulic cylinders with hydraulic oil and bleeding them

WARNING

Uncontrolled and dangerous machine movements!

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

- Do not screw out the complete bleed valve.
- Only set the ventilation by adjusting the bleeding bolt.
- The bleeding bolt may only be adjusted, however not removed.

CAUTION

Contact with hydraulic fluid!

Health hazard / impairment of health, e.g. eye injuries, skin lesions, intoxication upon inhalation!

- Avoid contact with hydraulic fluids.
- When dealing with hydraulic fluids, you must imperatively observe the safety instructions of the lubricant manufacturer.
- Use your personal protective equipment (like e.g. safety goggles, protective gloves, suitable working clothes, safety boots).
- If nevertheless, hydraulic fluid comes into contact with the eyes or gets into the bloodstream or is swallowed, please consult a doctor immediately.

The basic pollution of the hydraulic fluid filled in must not exceed the maximum admissible cleanliness class according to ISO 4406 (c) class 20/18/15. The cleanliness classes specified for the components (like valves) must be adhered to in hydraulic systems.

If you are not sure how your hydraulic cylinder is to be filled and bled, please contact the Bosch Rexroth service or your local Rexroth sales organization: www.boschrexroth.com

For filling and bleeding the hydraulic cylinder proceed as follows (the starting point is a retracted hydraulic cylinder in horizontal position):

1. Provide for an easily readable circuit diagram of the entire system.
2. The oil leaking during the bleeding process must be collected in a corresponding container.
3. Open the bleed screw on the piston rod side (at the cylinder head) of the depressurized hydraulic cylinder (see following figures).
4. If there is a threaded coupling, you can bleed the hydraulic cylinder by connecting a corresponding hose to the coupling (the threaded coupling has an internal check valve).
5. Set the hydraulic system so that the pressure at the hydraulic cylinder does not exceed approx. 5 bar.
6. Switch the hydraulic system on.
7. Switch the control valves so that the hydraulic cylinder wants to retract at very low velocities (pressure at the piston rod side). The annulus on the piston rod side of the hydraulic cylinder is now filled with oil and the existing air exits via the bleed port or the threaded coupling.
8. As soon as the oil does not contain air any more, i.e. it exits free from bubbles, the hydraulic accumulator has been sufficiently bled.

   This is, however, only true if the bleeding point is at the highest point.

9. Then, switch off the hydraulic system and close the bleed screw.
10. After bleeding the hydraulic fluid on the piston rod side of the hydraulic cylinder, bleed the bottom side in the same way.
11. Afterwards, the hydraulic cylinder is ready for operation.

   – Now only operate the hydraulic cylinder with low pressure until the hydraulic system is completely bled.
   – Observe the fluid level in the container and top up, if necessary.

Filling and bleeding hydraulic cylinders with safety bleeding

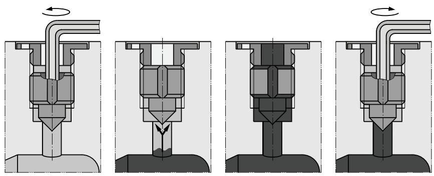


Fig. 9: Filling and bleeding hydraulic cylinders with safety bleeding

1. Opening: Screw out the bleeding bolt maximally to the stop, to the safety plug screw using a hexagon wrench.
2. Filling: Fill the hydraulic cylinder with oil; air and oil exit.
3. Bleeding: The air has been completely removed from the hydraulic cylinder if the oil exits without bubbles.
4. Closing: Tighten the bleeding bolt to the internal stop using a hexagon wrench until no more oil leaks.

Filling and bleeding hydraulic cylinders with internal hexagon bleed screw

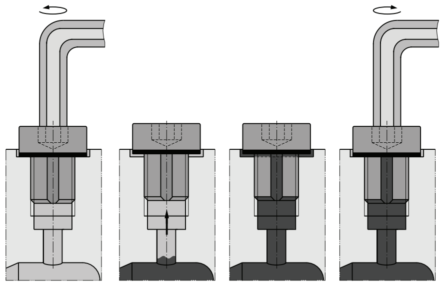


Fig. 10: Filling and bleeding hydraulic cylinders with internal hexagon bleed screw

1. Opening: Screw out the internal hexagon bleed screw half a rotation using a hexagon wrench.
2. Filling: Fill the hydraulic cylinder with oil; air and oil exit.
3. Bleeding: The air has been completely removed from the hydraulic cylinder if the oil exits without bubbles.
4. Closing: Screw in the internal hexagon bleed screw using a hexagon wrench. Close it in an oil-tight form. Observe the torque!

Filling and bleeding hydraulic cylinders with check valve

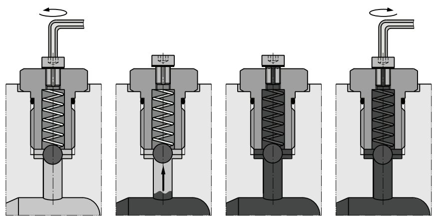


Fig. 11: Filling and bleeding hydraulic cylinders with check valve

1. Opening: Screw out the internal hexagon bleed screw at the check valve half a rotation using a hexagon wrench.
2. Filling: Fill the hydraulic cylinder with oil; air and oil exit.
3. Bleeding: The air has been completely removed from the hydraulic cylinder if the oil exits without bubbles.
4. Closing: Close the internal hexagon bleed screw at the check valve in an oil-tight form using a hexagon wrench. Observe the torque!

Filling and bleeding hydraulic cylinders with threaded coupling

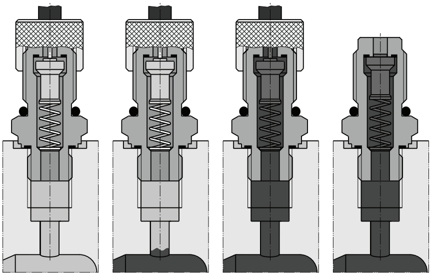


Fig. 12: Filling and bleeding hydraulic cylinders with threaded coupling

1. Connect the pressure tapping hose: Screw off the end cap of the threaded coupling and screw the pressure tapping hose with fitting onto the threaded coupling to the stop.
2. Filling: Fill the hydraulic cylinder with oil. Air and oil exit and are discharged via the pressure tapping hose.
3. Bleeding: The air has been completely removed from the hydraulic cylinder if the oil exits without bubbles.
4. Closing: When you screw off the pressure tapping hose, the spring presses the valve poppet back onto its seat. Screw the end cap of the threaded coupling on again in order to protect the device from dirt and damage.

8.1.2 Commissioning the hydraulic cylinder

After the hydraulic cylinder has been installed into the system, the system has been filled with the correct hydraulic fluid and the hydraulic cylinder has been bled correctly, you can commission the hydraulic cylinder.

Observe the product-specific and system-specific operating instructions.

Problems in the commissioning

Identical hydraulic cylinders may show different functions or malfunctions after the installation into a machine due to machine-specific conditions (weights, velocities, friction, electrical control, command value specification, etc.).

8.1.3 Setting the end position cushioning

WARNING

Uncontrolled and dangerous machine movements!

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

- Do not screw out the complete throttle valve.
- Only set the throttle valve by adjusting the throttling pin.

Regarding the adjustable end position cushioning it has to be noted that the full cushioning capacity can only be achieved when the throttle valve is closed.

In this connection, you must always observe the information of the valid data sheets. The information of the data sheet is specified on the hydraulic cylinder's name plate (see section "5.3 Identification of the product") or on the Internet at:

www.boschrexroth.com/ICS

Hydraulic cylinders are supplied with greatest effect of the end position cushioning, i.e. the throttling pin of the throttle valves is screwed to the stop and closes the oil channel of the adjustable end position cushioning. By unscrewing the throttling pin, the velocity in the area of the end position cushioning is increased.

Observe the higher end stop velocity!

Adjustable end position cushioning with secured throttling pin

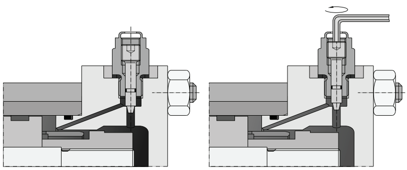


Fig. 13: Adjustable end position cushioning with secured throttling pin

- In order to change the factory setting of the end position cushioning, screw out the throttling pin using a hexagon wrench until the desired cushioning behavior is achieved. Due to the securization, the throttling pin cannot be screwed out of the throttle valve completely.

Adjustable end position cushioning with locked throttling pin

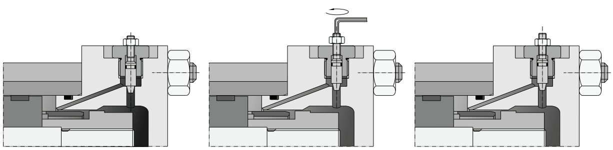


Fig. 14: Adjustable end position cushioning with locked throttling pin

- Loosen the throttle valve lock nut using a suitable tool (ring or open-end wrench) and screw the throttling pin out using a hexagon wrench until the desired cushioning behavior is achieved.
- Then tighten the throttle valve lock nut. The throttling pin is positioned by tightening the lock nut.

8.2 Flushing the system / hydraulic cylinders

When flushing the system, the hydraulic cylinder must be separated from the system.

When installing the hydraulic cylinder into the machine (amending components, line systems and drives), it has to be ensured that the maximum admissible cleanliness class (see section 8.1.1 "Filling hydraulic cylinders with hydraulic oil and bleeding them") for the entire system is not exceeded.

As many different situations are imaginable due to different installation situations, hydraulic functions of the hydraulic cylinder or the hydraulic system options, please observe section 8.1.1 "Filling hydraulic cylinders with oil and bleeding them".

8.3 Re-commissioning after extended standstill

- In the re-commissioning, observe the commissioning instructions (see section 8 "Commissioning").

9 Operation

Information on operating the hydraulic cylinder can only be provided in connection with the machine or system.

- For this information, please refer to the operating instructions of the machine manufacturer.

Operating parameters, function and logics of the hydraulic cylinder are available to hydraulic experts in the relevant valid data sheets and the relevant valid product-specific documentation (see chapter 16 "Technical data").

10 Maintenance and repair

According to DIN 31051, maintenance means all measures for maintaining and restoring as well as for determining and evaluating the actual condition of technical systems.

The tasks are divided into three partial areas:

- Maintenance: Measures for maintaining the target condition
- Inspection: Measures for determining and evaluating the actual condition
- Repair: Measures for restoring the target condition

Due to these measures, the functionality of the hydraulic system and the hydraulic cylinders can be ensured.

Rexroth hydraulic systems and Rexroth hydraulic cylinders have the structural prerequisites for high functionality (operational safety, service life). They only require little maintenance work. The latter is, however, indispensable in order to ensure functionality.

Experience has shown that 70 % of the malfunctions and damage in hydraulic systems and hydraulic cylinders are indirectly caused by the hydraulic fluids. Consequently, the primary inspection and maintenance task is the examination and completion of measures to maintain the functionality (condition, cleanliness class) of the hydraulic fluid.

Ensure that no lubricants enter the hydraulic circuit.

10.1 Cleaning and care (maintenance)

- ▶ Ensure absolute cleanliness in all works.
- ▶ Before loosening fittings and components, clean the external environment using industrial residue-free wipes.
- ▶ Cover all openings with protective caps in order to prevent dirt from penetrating the system.

10.2 Inspection

Bosch Rexroth recommends documenting the inspection results

- So that considering functionality and economy, the inspection and maintenance intervals can be adjusted to the actual operating conditions.
- So that by comparing the documented values, you can identify faults at an early point in time.

10.3 Maintenance schedule

- ▶ For the scope and time intervals of maintenance and inspection works, please refer to the system manufacturer's maintenance schedule.

10.4 Maintenance

Normally, hydraulic cylinders are almost maintenance-free after the commissioning. After a new system has been commissioned, regular checks are necessary in order to determine whether the hydraulic cylinder functions perfectly. During these checks, you must particularly watch out for the following:

- Possible oil leaks at the oil ports
- Check with regard to "rubbing marks" or mechanical damage at the surface of the stroke-related piston rod running surfaces. Rubbing marks may be an indication of a polluted hydraulic system or of inadmissible traverse loads on the hydraulic cylinder.
- Damage to the coatings
- Possible leakage at the cylinder head or cylinder bottom
- Extreme temperatures and pollution shorten the hydraulic cylinder's service life. You should therefore provide for regular maintenance of the entire hydraulic system. For reference to the specific requirements of the hydraulic cylinder on the operating and ambient temperatures as well as the oil cleanliness please refer to the corresponding data sheet (see chapter 16 "Technical data"). For possible additional requirements, please refer to the installation and maintenance instructions of the hydraulic system and the data sheets of the hydraulic fluids used.
- The replacement intervals for wear parts like e.g. seals, guide sleeves and guide rings depend on the relevant application, the operating conditions, temperatures, etc. and on the medium quality. No fixed time has been determined for the exchange of these wear parts.
- Leakage in the area of the piston rod and the cylinder head is an indication of the necessity to exchange the wear parts.
- According to the operating requirements, the lubrication intervals for self-aligning clevis, trunnion, etc. must already be determined in the project planning of the hydraulic cylinder. The lubrication intervals are contained in the system manufacturer's maintenance schedule.

WARNING

Risk of ignition with hydraulic cylinders with EX marking due to insufficient maintenance or repair!

Danger to life! Risk of injury!

▶ Check regularly that the dust layer thickness of dust accumulations on the hydraulic cylinder stays below 5 mm or is regularly removed so that there is no risk of ignition in the explosive area.

▶ Check regularly that the equipotential bonding at the hydraulic cylinder remains functional and connected at all times; otherwise, there is a risk of ignition due to electrostatic charging.

▶ Check after repair and maintenance works that the equipotential bonding at the hydraulic cylinder is connected before operation in explosive areas.

10.4.1 Piston rod maintenance

In order to prevent corrosion at the piston rod, the piston rod should always be retracted during standstill times.

When using hydraulic fluids in hydraulic cylinders like e.g. HFD-R (phosphoric acid ester), HFA (oil-water emulsion) or HFC (water glycol), the following works have to be completed within the scope of the maintenance:

General

- The piston rod must always be covered by a protective oil film. Ensure compatibility of the medium used.
- In areas with high humidity or strongly fluctuating conditions (e.g. temperature fluctuations or outdoor installation), check the protective oil film every week. In areas with moderate conditions, the protective oil film can be checked every month.

The protective oil film is necessary in order to guarantee corrosion protection of the exposed piston rod. In this connection, the following preventative maintenance is to be completed:

Preventative piston rod maintenance

1. If possible, the preventative maintenance work should be completed in a dry environment.
   - Using fresh water loosen and remove all salt, sand and machining residues as well other pollution from the piston rod.
   - Do not use steam cleaners or high-pressure water jets.
2. The preventative maintenance can only be completed with a clean and dry piston rod. If there is not sufficient time in order to let the piston rod dry completely, let it dry as long as possible before the maintenance. Repeat the maintenance as long as you have sufficient time.
3. Soak an industrial residue-free wipe with protection oil of low viscosity. Using the cloth, apply the protection oil to the entire piston rod.

Immediate maintenance for hydraulic cylinders and piston rods after contact with chemicals

After contact with chemicals, an immediate maintenance cycle has to be completed as fast as possible. The immediate maintenance comprises the following works:

1. Loosen and remove all chemical residues using a suitable cleaning agent.
2. Perform the work steps of the preventative maintenance.

Maintenance frequency

The preventative maintenance described here should be completed before the first commissioning of the hydraulic cylinder or after standstill times.

10.5 Replacing wear parts

In case of questions or doubt, please contact Bosch Rexroth or your local Rexroth sales organization in any case.

Opening the hydraulic cylinder will invalidate the warranty claim.

10.6 Repair

Bosch Rexroth offers a wide range of repair services for your hydraulic cylinder. Please send any enquiry to your nearest Bosch Rexroth service center or directly contact the headquarters. For the addresses, please refer to www.boschrexroth.com.

10.7 Spare parts

NOTICE

Malfunction of the machine due to the use of incorrect spare parts!

Damage to property!

- Only use components listed in the product-specific documentation (parts list).
- Only use new seals with the required resistance to media.
- As the sealing material may differ despite being of identical appearance, the material number should be checked.

In case of questions or doubt, please contact Bosch Rexroth or your local Rexroth sales organization in any case.

- Please send any enquiry to your nearest Bosch Rexroth service center or directly contact the headquarters. For the addresses, please refer to www.boschrexroth.com.
- Please provide the following information when ordering spare parts:
  - Material number and order number of the hydraulic cylinder (name plate)
  - Item number of the relevant component according to the parts list

11 Decommissioning

11.1 Preparing for decommissioning

WARNING

High operating pressure in the hydraulic cylinder and in the system!

Risk of injury or damage to property caused by parts flying around or oil leakage during operation!

- Switch off all force-transmitting components and ports (electric, pneumatic, hydraulic) according to the manufacturer's instructions and secure them against restarting. If possible, remove the main fuse of the system.
- Depressurize accumulators that might exist on the oil side.
- Unload the hydraulic cylinder from external forces.

When decommissioning and removing the hydraulic cylinder from the hydraulic system, the following must be observed:

1. For safety reasons, you must not loosen any lines, connections and components as long as the system is under pressure. Lower loads in advance, unload the pressure accumulator, switch off pumps and secure the system against re-activation.
2. You must provide collecting tanks that are large enough to accommodate the total oil volume.

11.2 Decommissioning the hydraulic cylinder

- Drain the oil into the collecting tank provided.
- In this connection, ensure complete draining of the lines and actuators.
- If necessary, carry out bleeding measures.

11.3 Preparing disassembly

Before starting the works at the hydraulic cylinder, take the following measures:

- Provide for an easily readable assembly drawing / spare parts list.
- Provide for clean, professional tools and a clean workplace.
- Due to the tolerances when lifting the hydraulic cylinder, anticipate a weight of the hydraulic cylinder exceeding the one specified in the drawing or in the data sheets by 10 %.
- During the removal of the hydraulic cylinder, no dirt must penetrate the hydraulic system. Seal the connection points using steel plugs, flange covers or special plastic plugs suitable for that purpose.
- Make sure that the hydraulic cylinder and particularly the piston rod are not damaged.
- Use a stable support for putting down the hydraulic cylinder and the removed parts.

11.4 Disassembling the hydraulic cylinder

To the lifting and moving during removal of the hydraulic cylinder from the system/ machine, the same rules apply as already described under chapter 6.1 "Transporting hydraulic cylinders".

11.5 Preparing the hydraulic cylinder for storage/ further use

- For storing the hydraulic cylinder for later re-use, complete the necessary steps according to chapter 6.2 “Storing hydraulic cylinder”.

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12 Disassembly and exchange

12.1 Preparing disassembly

Before starting the disassembly of the hydraulic cylinder, the general conditions according to section 11 "Decommissioning" have to be met. Provide for good preparation.

In order for the hydraulic cylinder spare parts to be exchanged, the cylinder has to be disassembled.

12.2 Disassembling the hydraulic cylinder

For disassembly, you should proceed as follows:

- Drain the hydraulic fluid from the hydraulic cylinder that is still installed to the largest possible extent. The hydraulic cylinder can be completely drained as soon as it has been removed.
- Disassemble the cylinder head.
  - Pull the cylinder head off the pipe and drain the remaining hydraulic fluid from the pipe.
  - Then pull the piston rod out of the hydraulic cylinder using lifting strings, if necessary.
  - Put the piston rod on especially prepared blocks preventing the piston rod from rolling away (wooden blocks, prism-shaped squared timber or blocks with soft, rotating support, without pollution).
- If necessary, remove the locking device between cylinder eye and piston rod and plug the wrench into the provided bore or area. Put a lifting sling around the cylinder eye so that it gets caught when it is loosened from the piston rod. Now rotate the piston rod using the wrench until the cylinder eye loosens from the piston rod.
- Fasten the lifting slings at the cylinder head and slowly push it off the piston rod (if it is difficult to push the cylinder head on the piston rod, you must rotate the latter slowly).
- Remove the seals and clean the cylinder head carefully using a de-greasing agent (from old glue residues, dust particles, etc.). Also clean the piston rod carefully as any dirt particle may damage the seal during the assembly. Do not forget to clean the piston rod thread, the cylinder eyes and the protective cover.

12.3 Exchanging components

In case of questions or doubt, please contact Bosch Rexroth or your local Rexroth sales organization in any case: www.boschrexroth.com

13 Disposal

- Dispose of the individual materials according to the legal provisions. Particular attention is necessary when disposing of components with hydraulic fluid residues.
- Observe the disposal information in the hydraulic fluid safety data sheet.
- When disposing of electric and electronic components (e.g. position measurement systems, proximity switches) comply with the country-specific legal provisions and regulations.

13.1 Environmental protection

Careless disposal of the hydraulic cylinder, its components and the oil can lead to environmental pollution. Please observe the following points:

- Dispose of the product/components in accordance with the national regulations in your country and/or your company-internal specifications.
- Dispose of oil according to the legal provisions and moreover observing the safety data sheet of the hydraulic medium used.

14 Extension and conversion

You will be considered responsible for any extensions to or conversions of the product.

Declarations become invalid

If you undertake any extensions to or conversions of the product marketed by Bosch Rexroth, this means you are changing the condition of the product as supplied. Any statements made by Bosch Rexroth regarding this product will then become invalid.

Please send any queries you may have to your nearest Bosch Rexroth service center or directly to the headquarters. For the addresses, please refer to: www. boschrexroth.com

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15 Troubleshooting

15.1 How to proceed for troubleshooting

Troubleshooting is primarily the exchange of the defective components.

Only replace the components mentioned in the parts list (spare parts list) by new, interchangeable and tested components in original equipment quality.

Regarding the repair of the defective hydraulic cylinder, please contact the nearest Bosch Rexroth service center or directly the headquarters. For the addresses, please refer to www.boschrexroth.com.

After remedy of the actual damage, you should imperatively remove the causes and/or consequential damage as well. After a component failure caused by wear, you must for example flush the system and clean and/or change the oil.

Table 15: Troubleshooting

Error	Possible cause of fault	Troubleshooting
Stick-slip effect	Air in the hydraulic cylinder	▶ Bleed the hydraulic cylinder, see section 8.1.1 "Filling hydraulic cylinders with hydraulic oil and bleeding them".
	Seals are worn	▶ Initiate the exchange of the seals, see section 10.5 "Replacing wear parts"
	Introduced radial forces on piston rod and hydraulic cylinder	▶ In this connection, observe section 7.2 “Installation conditions".
Leakage at the piston rod side	Traces of wear at the piston rod surface	▶ Initiate the exchange of the piston rod, see section 12.3 "Exchanging components".
	Piston rod seals are worn	▶ Initiate the exchange of the seals, see section 12.3 "Exchanging components".
Leakage at line connections	Fittings are loose	▶ Tighten the fittings firmly.
	Defective sealing element	▶ Exchange the sealing elements at the fitting.
Hydraulic cylinder has no cushioning effect/moves hard into the end position	The end position cushioning setting does not comply with the requirements	▶ Set the adjustable end position cushioning, see section 8.1.3 "Setting the end position cushioning".

16 Technical data

In this connection, please refer to the valid data sheets and the valid product-specific documentation (parts lists) for hydraulic cylinders.

For the valid data sheets, please refer to: www.boschrexroth.com/ICS

17 Appendix

17.1 Address directory

Please refer to www.boschrexroth.com for addresses of foreign subsidiaries.

Bosch Rexroth AG
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General product information on hydraulic products

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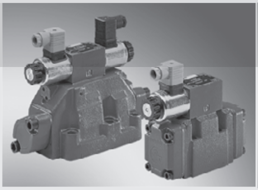

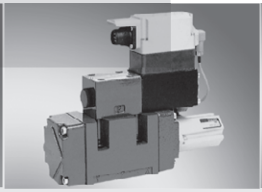

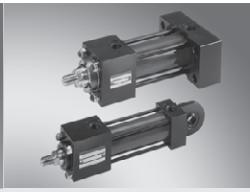

DE Ihre Sprache? – Siehe Rückseite!
EN Your language? – See back page!
FR Votre langue ? – Voir au dos !
IT La vostra lingua? – Vedi retro!
FI Kohdekielet? – Katso takankatta!
ES ¿Su idioma? – ¡Vea al dorso!
NL Uw taal? – Zie achterzijde!
SV Ditt sprak? – Se omslagets baksida!
PT O seu idioma? – Consulte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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

⚠ CAUTION

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 datasheet 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.

⚠ WARNING

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*.

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- 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

⚠ DANGER

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

⚠ CAUTION

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.

⚠ DANGER

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.

⚠ CAUTION

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.

⚠ DANGER

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:

⚠ CAUTION

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 mm^2/s).

4.2 Ambient conditions

4.2.1 Use in potentially explosive atmospheres

⚠ DANGER

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.

⚠ DANGER

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

DANGER

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 °C, the rate of ageing doubles for each 10 °C.

1

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 [mm^2/s]. Many manufacturers still provide their information in centiStoke [cSt], the equivalent of [mm^2/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 mm^2/s at 40 °C.

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

Medium temperature	Viscosity
3 °C	800 mm^2/s
8 °C	500 mm^2/s
25 °C	100 mm^2/s
60 °C	20 mm^2/s
77 °C	12 mm^2/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.

⚠ CAUTION

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

⚠ CAUTION

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

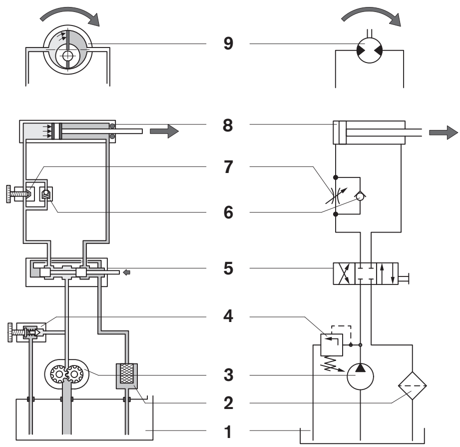
A component that converts the energy of the hydraulic fluid into mechanical energy (e.g. motor, cylinder).

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	Energy control
5	Directional valve	
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.

1

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*.

⚠ CAUTION

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.

⚠ CAUTION

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

CAUTION

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.

1

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

⚠ DANGER

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.

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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*.

    ⚠ CAUTION

    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.

⚠ CAUTION

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*).

⚠ DANGER

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 precharge 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.

⚠ DANGER

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

⚠ DANGER

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

⚠ DANGER

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:

⚠ DANGER

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.

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.

⚠ CAUTION

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.
- 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.

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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 • specified pressure • opening pressure • pressure difference before and after the object under test
Visual inspection	–	Checks for • all components securely seated • damage • wear • leakage (formation of oil droplets) • presence of all warning and informative signs
Touch inspection	–	Checks for • unusual local vibrations
Temperature inspection	Temperature measuring instrument	Checks for • unusual local temperature zones
Acoustic inspection	–	Checks for • changes in running noise of the unit • changes in flow noise • changes in operating noise in the unit and valve control.

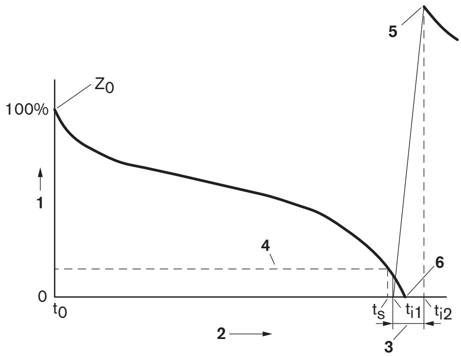
12.3.2 Location of testing and measuring points

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.

⚠ DANGER

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.

1

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

⚠ DANGER

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*.

⚠ DANGER

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

DANGER

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.

WARNING

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.

WARNING

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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DE	Bestellinformation für deutsche Produktinformation:	RD 07008
EN	Ordering Information for Product Information in English:	RE 07008
FR	Information de commande pour la notice française Informations générales sur les produits :	RF 07008
IT	Informazioni d'ordine per le informazioni tedesche sul prodotto:	RI 07008
ES	Información para el pedido de la información del producto en español:	RS 07008
FI	Tilaustiedot - suomenkieliset tuotetiedot:	RSF 07008
NL	Bestelinformatie voor Nederlandse productinformatie:	RNL 07008
SV	Beställningsnummer för svensk produktinformation:	RSK 07008
PT	Informação dos dados de encomenda para informação de produto alemã:	RP 07008
DA	Bestillingsinformationer vedr. dansk produktinformation:	RDK 07008
EL	Πληροφορίερ παραγγελίαρ για τιρ γερμανικέρ πληροφορίερ προϊϋντορ:	RGR 07008

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The data specified above only serve to describe the product.
No statements concerning a certain condition or suitability for a certain application can be derived from our information. The given information does not release the user from the obligation of own judgement and verification. It must be remembered that our products are subject to a natural process of wear and aging.

Installation, commissioning and maintenance of hydraulic systems

RE 07900/10.06
Replaces: 08.06

1. General

1.1 Long service life and functional reliability of hydraulic systems and their components depend on correct handling.

Ensure trouble-free operation by observing the following points:

– The specific installation and operating instructions for the relevant components

– Special instructions in individual cases

– Technical data in the data sheet.

In addition, we would like to draw your attention to the following regulations:

– German standard "Hydraulic systems" DIN 24346

– ISO standard ISO 4413

2. Installation

2.1 Preparatory work for the installation

– Sauberkeit der Anlage gewährleisten!

• For the surroundings:

Keep power units, line connections and components clean or clean them (e.g. pickling after, for example, processes have been carried out that involve heat, i.e. welding, hot bending, etc.)!

• For hydraulics fluids:

Take care of contamination and humidity; contamination from the environment must not enter the tanks! Fill oil tanks only through filters, preferably system filters or portable filter stations with fine filters.
Internal protective coatings, if any, must be resistant to the hydraulic fluid used!

• For parts taken from stock:

The storage of parts that were not filled or treated with anti-corrosion fluid can lead to the formation of resin. Solve the resin using a grease solvent and renew the lubricating film.

– Check to see that all of the parts required for the installation are available!

– Take note of any transport damage!

2.2 Carrying out the montage

– Use lifting lugs and transport facilities!

– Do not apply force to prevent transverse forces and tension on pipes and components. The valve mounting surfaces must be perfectly even. The fixing screws must be tightened evenly at the specified torque.

Take care that pipes are adequately fixed!

– When selecting pipes, hoses and fittings/flanges, observe the correct pressure stage (wall thickness, material). Use only seamless precision steel pipes.

- Do not use hemp or putty as sealing materials! This may cause contamination and thus malfunction.
- To prevent external leakage, observe the installation instructions of the pipe fittings' manufacturer. We recommend the use of fittings with elastic seals.
- Make sure that hoses are properly laid! Rubbing and abutting of the lines must be prevented.
- Provide the correct hydraulic fluids
  - Mineral oils:
    HLP hydraulic oils according to DIN 51524 part 2 are generally suitable for standard systems and components.
  - Fast bio-degradable hydraulic fluids:
    VDMA 24568.

    For these fluids, the system and components must be matched.
  - Hardly inflammable hydraulic fluids:
    VDMA 24317. For these fluids, the system and components must be matched. (Before filling in the special media, check, whether the system is compatible with the intended fluid.)

The following points must be observed in accordance with the relevant requirements:
- Viscosity of the hydraulic fluid
- Operating temperature range
- Type of seals used on the components fitted

3. Commissioning

When the installation has been carried out correctly, proceed with commissioning and functional testing.

3.1 Preparations for trial run
- Tank cleaned?
- Lines cleaned and properly installed?
- Fittings, flanges tightened?
- Lines and components correctly connected in line with installation drawings and circuit diagram?

Is the accumulator filled with nitrogen? Fill in nitrogen until the pre-charge pressure p0 as specified in the cicuit di agram is reached. (On the fluid side the system must be pressureless!). It is recommended that the gas pre-charge pressure is marked on the accumulator itself (e.g. self-adhesive label) and in the hydraulic circuit so that a comparative check is possible, if required.

⚠ **Caution!** Use only nitrogen as pre-charge gas!

Accumulators must comply with the safety regulations valid at the place of installation.
- Are the drive motor and pump properly installed and aligned?
- Is the drive motor correctly connected?
- Are filters with the prescribed filter rating used?
- Are filters fitted in the correct direction of flow?
- Has the specified hydraulic fluid filled up to the upper marking?

As the hydraulic fluids often do not comply with the required cleanliness, the fluids must be filled through a filter. The absolute filter rating of the filling filter should be at least that of the filters installed in the system.

3.2 Trial run
- For safety reasons, only personnel of the machine manufacturer and, if required, maintenance and operating personnel should be present.
- All pressure relief valves, pressure reducing valves, pressure controllers of pumps must be unloaded. An exemption to this are TÜV-set valves.
- Open isolator valves completely!
- Switch the system on briefly and check whether the direction of rotation of the drive motor matches the prescribed direction of rotation of the pump.
- Check the position of the directional valves and, if necessary, move the spool to the required position.
- Set the control spool to by-pass.
- Open suction valves of the pump. If required for design reasons, fill pump housing with hydraulic fluids to prevent bearings and parts of the rotary group from running dry.
- If a pilot oil pump is provided, commission it[1].
- Start up the pump, swivel it from its zero position and listen for any noises.
- Swivel the pump slightly out (ca. 5°)[1].
- Bleed the system
  Carefully loosen fittings or bleed screws at high points in the system. When the escaping fluid is free from bubbles, then the filling process is completed. Re-tighten fittings.
- Flush the system; if possible, short-circuit actuators. Flush the system until the filters remain clean; check the filters!
  With servo-systems, the servo-valves must be removed and replaced by flushing plates or direction valves of the same size. Short-circuit the actuators. During flushing, the hydraulic fluid in the complete hydraulic system should reach temperatures that are at least as high as later during operation. Change the filter elements as required.
  Flushing continues until the required minimum cleanliness is reached. This can only be achieved by continuous monitoring using a particle counter.
- Check the system functions under no-load conditions, if possible, by hand; cold-test the electrohydraulic control.
- When the operating temperature has been reached, test the system under load; slowly increase the pressure.
- Monitor control and instrumentation equipment!
- Check the housing temperature of hydraulic pumps and hydraulic motors.
- Listen for noises!
- Check the hydraulic fluid level; if required, top up!

[1] As far as possible with the control elements fitted; otherwise, start up at full displacement. In conjunction with combustion engines, start up at idle speed.

– Check the setting of pressure relief valves by loading or braking the system.
– Inspect the system for leaks.
– Switch off the drive.
– Retighten all fittings, even if there is no evidence of leakage.

⚠ **Caution!** Only tighten fittings when the system is depressurised!

– Is the pipe fixing adequate, even under changing pressure loads?
– Are the fixing points at the correct positions?
– Are the hoses laid so that they do not chamfer, even under pressure load?
– Check the fluid level.
– Test the system for all functions. Compare measured values with the permissible or specified data (pressure, velocity. Adjust further control components).
– Jerky movements indicate, amongst other things, the presence of air in the system. By briefly swivelling the pump in one or both directions with the actuator being loaded or braked, it is possible to eliminate certain air pockets. The system is completely bled when all functions are performed jerk-free and smoothly and the sur face of the hydraulic fluid level is free from foam. Experience has shown that foaming should have ceased one hour after start-up at the latest.
– Check the temperature.
– Switch off the drive.
– Remove filter elements (off-line and full-flow filters) and inspect them for residues. Clean filter elements or replace them, if required. Paper or glass fibre elements **cannot** be cleaned.
– If further contamination is found, additional flushing is required to prevent premature failure of the system components.
– All the adjustments made are to be recorded in an acceptance report.

3.3 Commissioning of fast running systems

Such system can often not be commissioning using the normal measuring instruments (such as pressure gauges, thermometers, electrical multimeters, etc.) and standard tools. Optimization is also not possible.
These systems include, for example, forging presses, plastics injection moulding machines, special machine tools, rolling tools, crane controls, machines with electro-hydraulic closed-loop control systems.
Commissioning and optimization of these systems often require more comprehensive measuring equipment to allow several measurements to be taken at a time (e.g. several pressures, electrical signals, travel, velocities, flows, etc.).

3.4 The most common faults occurring during commissioning

Apart from servicing, commissioning is very decisive for the service life and functional reliability of a hydraulic system.

For this reason, faults during commissioning must be avoided as far as possible.

The most common faults are:
– The fluid tank is not inspected.
– The hydraulic fluid is not filtered before being filled in.
– The installation is not checked before commissioning (subsequent conversion with loss of fluid!).
– System components are not bled.
– Pressure relief valves are set only slightly higher than the operating pressure (closing pressure differential is not observed).
– Pressure controllers of hydraulic pumps are set higher or to the same pressure as the pressure relief valve.
– The flushing time of servo systems is not adhered to.
– Abnormal pump noise is ignored (cavitation, leaking suction lines, too much air in the hydraulic fluid).
– Transversal loads on cylinder piston rods are not observed (installation error!).
– Hydraulic cylinders are not bled (damage to seals!)
– Limit switches are set too low.
– The switching hysteresis of pressure switches is not taken into account when settings are made.
– Hydraulic pump and hydraulic motor housings are not filled with hydraulic fluid prior to commissioning.
– Settings are not documented.
– Adjustment spindles are not secured or sealed.
– Unnecessary personnel present during commissioning of the system.

4. Maintenance

According to DIN 31 051 the term “maintenance” includes the following fields of activity:

– Inspection

Measures to recognise and assess the actual situation, i.e. recognise how and why the so-called wear reserve continues to decrease.

– Maintenance

Measures to preserve the nominal conditions, i.e. to take precautions in order that the reduction in the wear reserve during the useful life is kept as low as possible.

– Repair

Measures to restore the nominal condition, i.e. compensate for reduction in performance and restore the wear reserve.

Maintenance measures must be planned and taken in accordance with the operating time, the consequences of a failure and the required availability.

4.1 Inspection

The individual points to be inspected should be summarised for a specific system in so-called inspection lists in order that the inspections can be carried out adequately by employees with different qualification levels.

Important points of inspection are:
– Checking the hydraulic fluid level in the tank.
– Checking the heat exchanger (air, water) for effectiveness.

– Checking the system for external leakage (visual inspection).
– Checking the hydraulic fluid temperature during operation.
– Checking pressures
– Amount of leakage
– Checking the cleanliness of the hydraulic fluid

⚠ **Caution!**

Visual inspections can only give an approximation (clouding of the hydraulic fluid, darker appearance than at the time of filling, sediments in the fluid tank).

If conventional particle counting is impossible, the following three methods can be used for establishing the fluid cleanliness:

- Particle counts using electronic counting and sorting equipment.
- Microscopic examination.
- Gravimetric establishment of solids by means of finest filtration of a certain fluid volume (e.g. 100 ml) and weighing of the filter paper before and after the filtration process. This allows the establishment of the amount of solid particles in mg/l.

– Check the contamination of filters. A visual inspection of deep filters, which are widely used today, is **no** longer possible.
– Analyse the chemical properties of the hydraulic fluid.
– Check the temperature at points where bearings are located.
– Check the generation of noise.
– Test performance and velocity.
– Inspect pipes and hoses.

⚠ **Caution!**

Damaged pipes and hoses must be immediately replaced.

– Inspect accumulator stations.

4.2 Maintenance

In practice, inspection, maintenance and repair work is not as strictly separated as the definitions may suggest. Servicing is often done in conjunction with inspections.

For safety reason, pipe fittings, connections and components **must not** be loosened or removed as long as the system is pressurised.

Important service work is:

– Create a maintenance book

We recommend that a maintenance book is created to lay down the parts to be inspected.

– Check the hydraulic fluid level
- continuously during commissioning
- shortly after commissioning
- later, at weekly intervals

– Inspect filters
- during commissioning every two to three hours and, if necessary, replace them.
- daily during the first week and replace them as required.
- After one week, the filters should be cleaned as required.
- Maintenance of suction filters:

  Suction filters require particularly thorough servicing. After the running-in period, they must be inspected at least once a week and cleaned, if necessary.

– Service the system fluid
- Maintenance intervals depend on the following operating factors:
  - Hydraulic fluid condition (e.g. water in oil, strongly aged oil)
  - Operating temperature and oil fill

  We recommend that the fluid be changed in dependence upon an oil analysis. With systems whose oil is not analysed at regular intervals the fluid should be replaced every 2000 to 4000 operating hours at the latest.
- Drain the system fluid at operating temperature and change it.
- Severely aged or contaminated system fluid **cannot** be improved by adding new fluid!
- Only fill in oil via filters that have at least the same separation capacity as the filters installed in the system, or use a system filter.
- Take samples of the system fluid to have the type, size and amount of particles analysed in the lab. Record the results.

– Check the accumulator for its pre-charge pressure; for this, the accumulator must be depressurised on the fluid side.

⚠ **Caution!**

Work on systems that include accumulators may only be carried out after the fluid pressure was unloaded.

Welding or soldering work or any mechanical work on accumulators is not permitted.

Improper repairs can lead to severe accidents. Repairs on hydraulic accumulator may therefore only be carried out by Rexroth Service service personnel.

– The operating temperature must be measured. An increase in the operating temperature indicates increasing friction and leakage.
– Leakage in the pipework

Leakage, especially with underfloor piping, represents, apart from loss of fluid, a risk for equipment and concrete floors.

For safety reasons, sealing work on the pipes may only be carried out when the system is depressurised. Leakage at points that are sealed with soft seals (O-rings, form seal rings, etc.) **cannot** be eliminated by tightening as these sealing elements are either destroyed or hardened. Sealing can only be achieved by replacing the sealing elements.

– Check main and pilot pressure
  - Check interval: One week
  - Document pressure corrections in the maintenance book.
  - Frequent pressure adjustments indicate, among other things, wear of the pressure relief valve.

4.3 Repair

Locate and eliminate malfunction and damage.

– Fault localisation

A precondition for system repairs is successful, i.e. systematic fault search.

This requires in any case detailed knowledge of the structure and the operating principle of the individual components as well as of the entire system. The required documentation should be available and easily accessible.

The most important measuring instruments (thermometer, electrical multimeter, industrial stethoscope, stop watch, rpm counter, etc.) should also be available in the vicinity of the system, especially in the case of large systems.

– Fault correction

When carrying out any work, observe strictest cleanliness. Before loosening fittings, clean the surrounding area.

Generally, defective components should not be repaired on site, since for the proper repair, the required tooling and the required cleanliness are usually not given on site. On site, only complete components should be changed whenever possible, in order

- to keep the time for which the opened system is exposed to ambient influences to a minimum,
- to keep the fluid loss as low as possible,
- to ensure the shortest possible downtime through the use of overhauled and tested components.

After failed components are located, it is essential to check whether the entire system or parts of the system have been contaminated by broken parts or larger amounts of abraded metal.

4.4 Repair and major overhaul of hydraulic components

Generally, it can be said that only the component manufacturer can carry out major overhauls in the most efficiently and reliably (same quality standard, trained personnel, test facilities, warranty, etc.).

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Rexroth
Bosch Group

Hydraulic fluids based on mineral oils and related hydrocarbons

RE 90220/05.12 1/16
Replaces: 05.10

Application notes and requirements for Rexroth hydraulic components

Hydraulic fluids

Title	**Hydraulic fluids based on mineral oils and related hydrocarbons**	Environmentally acceptable hydraulic fluids	Fire-resistant, water-free hydraulic fluids	Fire-resistant, water-containing hydraulic fluids
Standard	**DIN 51524**	ISO 15380	ISO 12922	ISO 12922
Data sheets	**RE 90220**	RE 90221	RE 90222	RE 90223 (in preparation)
Classification	**HL HLP HLPD HVLP HLPD and more**	HEPG HEES partially saturated HEES saturated HEPR HETG	HFDR HFDU (ester base) HFDU (glycol base) and more	HFC HFB HFAE HFAS

Contents

1 Basic information

1.1 General instructions

The hydraulic fluid is the common element in any hydraulic component and must be selected very carefully. Quality and cleanliness of the hydraulic fluid are decisive factors for the operational reliability, efficiency and service life of a system.

Hydraulic fluids must conform, be selected and used in accordance with the generally acknowledged rules of technology and safety provisions. Reference is made to the country-specific standards and directives (in Germany the directive of the Employer's Liability Insurance Association BGR 137).

This data sheet includes recommendations and regulations concerning the selection, operation and disposal of hydraulic fluids based on mineral oils and related hydrocarbons in the application of Rexroth hydraulic components.

The individual selection of hydraulic fluid or the choice of classification are the responsibility of the operator.

It is the responsibility of the user to ensure that appropriate measures are taken for safety and health protection and to ensure compliance with statutory regulations. The recommendations of the lubricant manufacturer and the specifications given in the safety data sheet are to be observed when using hydraulic fluid.

This data sheet does not absolve the operator from verifying the conformity and suitability of the respective hydraulic fluid for his system. He is to ensure that the selected fluid meets the minimum requirements of the relevant fluid standard during the whole of the period of use.

Other regulations and legal provisions may also apply. The operator is responsible for their observance, e.g. EU directive 2004/35/EG and their national implementations. In Germany the Water Resources Act (WHG) is also to be observed.

We recommend that you maintain constant, close contact with lubricant manufacturers to support you in the selection, maintenance, care and analyses.

When disposing of used hydraulic fluids, apply the same care as during use.

1.2 Scope

This data sheet must be observed when using hydraulic fluids based on mineral oils and related hydrocarbons in Bosch Rexroth hydraulic components.

Please note that the specifications of this data sheet may be restricted further by the specifications given in the product data sheets for the individual components.

The use of the individual hydraulic fluids in accordance with the intended purpose can be found in the safety data sheets or other product description documents of the lubricant manufacturers. In addition, each use is to be individually considered.

Rexroth hydraulic components may only be operated with hydraulic fluids based on mineral oils and related hydrocarbons according to DIN 51524 if specified in the respective component data sheet or if Rexroth approval for use is furnished.

Notes:
In the market overview RE 90220-01, hydraulic fluid based on mineral oil are described which, according to the information of the lubricant manufacturer, feature the respective parameters of the current requirements standard DIN 51524 and other parameters which are of relevance for suitability in connection with Rexroth components.

These specifications are not checked or monitored by Bosch Rexroth. The list in the market overview does not therefore represent a recommendation on the part of Rexroth or approval of the respective hydraulic fluid for use with Rexroth components and does not release the operator from his responsibility regarding selection of the hydraulic fluid.

Bosch Rexroth will accept no liability for its components for any damage resulting from failure to comply with the notes below.

1.3 Safety instructions

Hydraulic fluids can constitute a risk for persons and the environment. These risks are described in the hydraulic fluid safety data sheets. The operator is to ensure that a current safety data sheet for the hydraulic fluid used is available and that the measures stipulated therein are complied with.

2 Solid particle contamination and cleanliness levels

Solid particle contamination is the major reason for faults occurring in hydraulic systems. It may lead to a number of effects in the hydraulic system. Firstly, single large solid particles may lead directly to a system malfunction, and secondly small particles cause continuous elevated wear.

For hydraulic fluids, the cleanliness level is given as a three-digit numerical code in accordance with ISO 4406. This numerical code denotes the number of particles present in a hydraulic fluid for a defined quantity. Moreover, foreign solid matter is not to exceed a mass of 50 mg/kg (gravimetric examination according to ISO 4405).

In general, compliance with a minimum cleanliness level of 20/18/15 in accordance with ISO 4406 or better is to be maintained in operation. Special servo valves demand improved cleanliness levels of at least 18/16/13. A reduction in cleanliness level by one level means half of the quantity of particles and thus greater cleanliness. Lower numbers in cleanliness levels should always be striven for and extend the service life of hydraulic components. The component with the highest cleanliness requirements determines the required cleanliness of the overall system. Please also observe the specifications in table 1: "Cleanliness levels according to ISO 4406" and in the respective data sheets of the various hydraulic components.

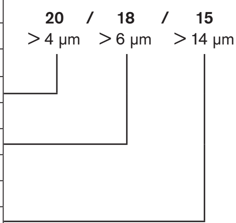
Hydraulic fluids frequently fail to meet these cleanliness requirements on delivery. Careful filtering is therefore required during operation and in particular, during filling in order to ensure the required cleanliness levels. Your lubricant manufacturer can tell you the cleanliness level of hydraulic fluids as delivered. To maintain the required cleanliness level over the operating period, you must use a reservoir breather filter. If the environment is humid, take appropriate measures, such as a breather filter with air drying or permanent off-line water separation.

Note: the specifications of the lubricant manufacturer relating to cleanliness levels are based on the time at which the container concerned is filled and not on the conditions during transport and storage.

Further information about contamination with solid matter and cleanliness levels can be found in brochure RE 08016.

Table 1: Cleanliness levels according to ISO 4406

Particles per 100 ml		Scale number
More than	Up to and including	
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64000	130,000	17
32000	64000	16
16000	32000	15
8000	16000	14
4000	8000	13
2000	4000	12
1000	2000	11
500	1000	10
250	500	9
130	250	8
64	130	7
32	64	6



3 Selection of the hydraulic fluid

The use of hydraulic fluids based on mineral oils for Rexroth hydraulic components is based on compliance with the minimum requirements of DIN 51524.

3.1 Selection criteria for the hydraulic fluid

The specified limit values for all components employed in the hydraulic system, for example viscosity and cleanliness level, must be observed with the hydraulic fluid used, taking into account the specified operating conditions.

Hydraulic fluid suitability depends, amongst others, on the following factors:

3.1.1 Viscosity

Viscosity is a basic property of hydraulic fluids. The permissible viscosity range of complete systems needs to be determined taking account of the permissible viscosity of all components and it is to be observed for each individual component.

The viscosity at operating temperature determines the response characteristics of closed control loops, stability and damping of systems, the efficiency factor and the degree of wear.

We recommend that the optimum operating viscosity range of each component be kept within the permissible temperature range. This usually requires either cooling or heating, or both. The permissible viscosity range and the necessary cleanliness level can be found in the product data sheet for the component concerned.

If the viscosity of a hydraulic fluid used is above the permitted operating viscosity, this will result in increased hydraulic-mechanical losses. In return, there will be lower internal leakage losses. If the pressure level is lower, lubrication gaps may not be filled up, which can lead to increased wear. For hydraulic pumps, the permitted suction pressure may not be reached, which may lead to cavitation damage.

If the viscosity of a hydraulic fluid is below the permitted operating viscosity, increased leakage, wear, susceptibility to contamination and a shorter component life cycle will result.

3.1.2 Viscosity-temperature behavior

For hydraulic fluids, the viscosity temperature behavior (V-T behavior) is of particular importance. Viscosity is characterized in that it drops when the temperature increases and rises when the temperature drops; see Fig. 1 "Viscosity temperature chart for HL, HLP, HLPD (VI 100)". The interrelation between viscosity and temperature is described by the viscosity index (VI).

The viscosity temperature diagram in Fig. 1 is extrapolated in the < 40 °C range. This idealized diagram is for reference purposes only. Measured values can be obtained from your lubricant manufacturer and are to be preferred for design purposes.

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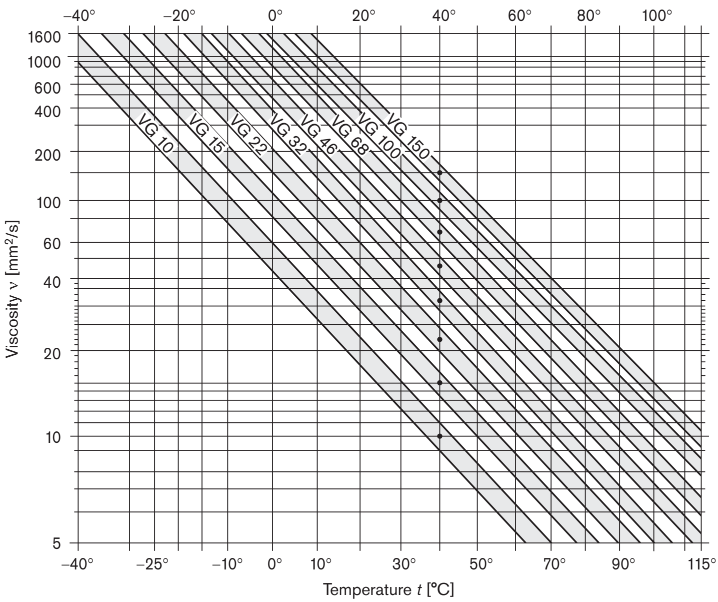
Fig. 1: Viscosity-temperature chart for HL, HLP, HLPD (VI 100, double logarithmic representation)



3.1.3 Wear protection capability

Wear protection capability describes the property of hydraulic fluids to prevent or minimize wear within the components. The wear protection capability is described in DIN 51524-2,-3 via test procedures "FZG gear test rig" (ISO 14635-1) and "Mechanical test in the vane pump" (ISO 20763). From ISO VG 32 DIN 51524-2,-3 prescribes a rating of at least 10 (FZG test). At present, the FZG test cannot be applied to viscosity classes < ISO VG 32.

3.1.4 Material compatibility

The hydraulic fluid must not negatively affect the materials used in the components. Compatibility with coatings, seals, hoses, metals and plastics is to be observed in particular. The fluid classifications specified in the respective component data sheets are tested by the manufacturer with regard to material compatibility. Parts and components not supplied by us are to be checked by the user.

Table 2: Known material incompatibilities

Classification	Incompatible with:
HLxx classifications	with EPDM seals
Zinc- and ash/free hydraulic fluids	with bronze-filled PTFE seals

3.1.5 Aging resistance

The way a hydraulic fluid ages depends on the thermal, chemical and mechanical stress to which it is subjected. Aging resistance can be greatly influenced by the chemical composition of the hydraulic fluids.

High fluid temperatures (e.g. over 80 °C) result in a approximate halving of the fluid service life for every 10 °C temperature increase and should therefore by avoided. The halving of the fluid service life results from the application of the Arrhenius equation (see Glossary).

Table 3: Reference values for temperature-dependent aging of the hydraulic fluid

Reservoir temperature	Fluid life cycle
80 °C	100 %
90 °C	50 %
100 °C	25 %

Hydraulic fluids based on mineral oils and related hydrocarbons are tested with 20% water additive during testing of aging resistance according to ISO 4263-1.

The calculated fluid service life is derived from the results of tests in which the long-term characteristics are simulated in a short period of time by applying more arduous conditions (condensed testing). This calculated fluid service life is not to be equated to the fluid service life in real-life applications.

Table 3 is a practical indicator for hydraulic fluids with water content < 0.1%, cf. chapter 4.10. "Water".

3.1.6 Air separation ability (ASA)

The air separation ability (ASA) describes the property of a hydraulic fluid to separate undissolved air. Hydraulic fluids contain approx. 7 to 13 percent by volume of dissolved air (with atmospheric pressure and 50 °C). Hydraulic fluids always contain dissolved air. During operation, dissolved air may be transformed into undissolved air, leading to cavitation damages. Fluid classification, fluid product, reservoir size and design must be coordinated to take into account the dwell time and ASA value of the hydraulic fluid. The air separation capacity depends on the viscosity, temperature, basic fluid and aging.
It cannot be improved by additives.

According to DIN 51524 for instance, an ASA value ≤ 10 minutes is required for viscosity class ISO VG 46, 6 minutes are typical, lower values are preferable.

3.1.7 Demulsifying ability and water solubility

The capacity of a hydraulic fluid to separate water at a defined temperature is known as the demulsifying ability. ISO 6614 defines the demulsifying properties of hydraulic fluids.

For larger systems with permanent monitoring, a demulsifying fluid with good water separation capability (WSC) is recommended. The water can be drained from the bottom of the reservoir. In smaller systems (e.g. in mobile machines), whose fluid is less closely monitored and where water contamination into the hydraulic fluid, for instance through air condensation, cannot be ruled out completely, an HLPD fluid is recommended.

The demulsifying ability up to ISO-VG 100 is given at 54 °C, and at 82 °C for fluids with higher viscosity.

Water emulsifying HLPD hydraulic fluids have no, or a very poor, demulsifying ability.

3.1.8 Filterability

Filterability describes the ability of a hydraulic fluid to pass through a filter, removing solid contaminants. The hydraulic fluids used require a good filterability, not just when new, but also during the whole of their service life. Depending on the basic fluid used and the additives (VI enhancers) there are great differences here.

The filterability is a basic prerequisite for cleanliness, servicing and filtration of hydraulic fluids. Filterability is tested with the new hydraulic fluid and after the addition of 0.2 % water. The underlying standard (ISO 13357-1/-2) stipulates that filterability must have no negative effects on the filters or the hydraulic fluid, see chapter 4 "Hydraulic fluids in operation".

3.1.9 Corrosion protection

Hydraulic fluids should not just prevent corrosion formation on steel components, they must also be compatible with non-ferrous metals and alloys. Corrosion protection tests on different metals and metal alloys are described in DIN 51524. Hydraulic fluids that are not compatible with the materials listed above must not be used, even if they are compliant with ISO 51524.

Rexroth components are usually tested with HLP hydraulic fluids or corrosion protection oils based on mineral oils before they are delivered.

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3.1.10 Additivation

The properties described above can be modified with the help of suitable additives. A general distinction is made for fluids between heavy metal-free and heavy metal-containing (generally zinc) additive systems. Both additive systems are most often incompatible with each other. The mixing of these fluids must be avoided even if the mixing ratio is very low. See chapter 4, "Hydraulic fluids in operation".

Increasing additivation generally leads to deteriorated air separation ability (ASA) and water separation capability (WSC) of the hydraulic fluid. According to the present state of knowledge, all hydraulic fluids described in this document, independently of the actual additivation, can be filtered using all filter materials with all known filtration ratings ≥ 1 μm without filtering out effective additives at the same time.

Bosch Rexroth does not prescribe any specific additive system.

3.2 Classification and fields of application

Table 4: Classification and fields of application

Classification	Features	Typical field of application	Notes
HL fluids according to DIN 51524-1 VI = 100	Hydraulic fluids predominantly only with additives for oxidation and corrosion protection, but no specific additives for wear protection in case of mixed friction	HL fluids can be used in hydraulic systems that do not pose any requirements as to wear protection.	HL fluids may be used only for components whose product data sheet specifically allows HL fluids. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. Hydraulic fluids that only comply with the requirements of classes HL and HR in accordance with ISO 11158 without proving that DIN 51524-1 is also met may be used only with written approval of Bosch Rexroth AG. Observe restrictions as to pressure, rotation speed etc.
HLP fluids according to DIN 51524-2 VI = 100	Hydraulic fluid with corrosion, oxidation and verified wear protection additives	HLP fluids are suitable for most fields of application and components provided the temperature and viscosity provisions are observed.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. For the viscosity classes VG10, VG15 and VG22, DIN 51524 defines no requirements as to wear protection (DIN 51354 part 2 and DIN 51389 part 2). Beyond the requirements of DIN 51524 part 2, we require the same base oil type, identical refining procedure, identical additivation and identical additivation level across all viscosity classes.

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Table 4: Classification and fields of application (continued from page 7)

Classification	Features	Typical field of application	Notes
HVLP fluids according to DIN 51524-3 VI > 140	HLP hydraulic fluid with additional improved viscosity temperature behavior	HVLP fluids are used in systems operated over a wide temperature range.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. The same notes and restrictions as defined for HLP fluids apply accordingly. The effect on Rexroth components (e.g. compatibility with material seals, wear resistance capacity) may differ when using related hydrocarbons instead of mineral oils, cf. Table 6, line 8. When using HVLP fluids, the viscosity may change on account of the shear of the long-chain VI enhancers. The viscosity index, high at the start, decreases during operation. This needs to be taken into account when selecting the hydraulic fluid. The only value at present that can be used to assess viscosity changes in operation is the result of the test in accordance with DIN 51350 part 6. Please note that there are practical applications that create a much higher shear load on such fluids than can be achieved by this test. Up to VI < 160, we recommend a maximum permitted viscosity drop of 15 %, viscosity at 100 °C. The viscosity limits given by Bosch Rexroth for its components are to be observed for all operating conditions, even after the hydraulic fluids have sheared. HVLP fluids should be used only if required by the temperature ranges of the application.
HLPD fluids according to DIN 51524-2, HVLPD fluids in accordance with DIN 51524-3	HLP and HVLP hydraulic fluid with additional detergent and or dispersant additives	HLPD and HVLPD fluids are used in systems where deposits as well as solid or liquid contamination need to be kept temporarily suspended	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. Some of these fluids are able to absorb significant quantities of water (> 0.1 %). This may have negative implications for the wear protection and the aging properties of the fluid. The wetting ability of these fluids varies largely depending on the product. Therefore it is not correct to say that they are generally all very well able to prevent stick-slip. In individual cases where higher water contamination is to be expected (such as in steelworks or under humid conditions), the use of HLPD/HVLPD fluids cannot be recommended as the emulsified water does not settle in the reservoir but is evaporated in heavily loaded positions. For such cases, we recommend using HLP hydraulic fluids with particularly good demulsifying ability. The water collected at the reservoir bottom is to be drained regularly. If HLPD/HVLPD fluids are used, contamination does not settle. It rather remains suspended and needs to be filtered out or removed by appropriate draining systems. For this reason, the filter area must be increased. HLPD/HVLPD fluids may contain additives that in the long run are incompatible with plastics, elastomers and non-ferrous metals. Furthermore, these additives may lead to the premature clogging of hydraulic filters. Therefore, test the filterability and the selection of the filter material in consultation with the filter manufacturer.

4 Hydraulic fluids in operation

4.1 General

The properties of hydraulic fluids can change continually during storage and operation.

Please note that the fluid standard DIN 51524 merely describes minimum requirements for hydraulic fluids in new condition at the time of filling into the bins. The operator of a hydraulic system must ensure that the hydraulic fluid remains in a utilizable condition throughout its entire period of use.

Deviations from the characteristic values are to be clarified with the lubricant manufacturer, the test labs or Bosch Rexroth.

Please note the following aspects in operation.

4.2 Storage and handling

Hydraulic fluids must be stored correctly in accordance with the instructions of the lubricant manufacturer. Avoid exposing the containers to lengthy periods of direct heat. Containers are to be stored in such a way that the risk of any foreign liquid or solid matter (e.g. water, foreign fluids or dust) ingression into the inside of the container can be ruled out. After taking hydraulic fluids from the containers, these are immediately to be properly resealed.

Recommendation:

- Store containers in a dry, roofed place
- Store barrels on their sides
- Clean reservoir systems and machine reservoirs regularly

4.3 Filling of new systems

Usually, the cleanliness levels of the hydraulic fluids as delivered do not meet the requirements of our components. Hydraulic fluids must be filtered using an appropriate filter system to minimize solid particle contamination and water in the system.

As early as possible during test operation, new systems should be filled with the selected hydraulic fluid so as to reduce the risk of accidentally mixing the fluids (see chapter 4.5 "Mixing and compatibility of different hydraulic fluids"). Changing the hydraulic medium at a later point represents significant additional costs (see following chapter).

4.4 Hydraulic fluid changeover

Changeovers, in particular between hydraulic fluids with heavy metal-free and heavy metal-containing (generally zinc) additives, frequently lead to malfunctions, see chapter 3.1.10 "Additivation".

In the case of changeovers of the fluid in hydraulic systems, it is important to ensure compatibility of the new hydraulic fluid with the remainder of the previous hydraulic fluid. We recommend obtaining a written performance guarantee from the manufacturer or supplier of the new hydraulic fluid. The quantity of old fluid remaining should be minimized. Mixing hydraulic fluids should be avoided, see following chapter.

For information on changing over hydraulic fluids with different classifications please refer to VDMA 24314, VDMA 24569 and ISO 15380 appendix A.

Bosch Rexroth will not accept liability for any damage to its components resulting from inadequate hydraulic fluid change-overs!

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4.5 Mixing and compatibility of different hydraulic fluids

If hydraulic fluids from different manufacturers or different types from the same manufacturer are mixed, gelling, silting and deposits may occur. These, in turn, may cause foaming, impaired air separation ability, malfunctions and damage to the hydraulic system.

If the fluid contains more than 2 % of another fluid then it is considered to be a mixture. Exceptions apply for water, see chapter 4.10 "Water".

Mixing with other hydraulic fluids is not generally permitted. This also includes hydraulic fluids with the same classification and from the market overview RE 90220-01. If individual lubricant manufacturers advertise miscibility and/or compatibility, this is entirely the responsibility of the lubricant manufacturer.

Bosch Rexroth customarily tests all components with mineral oil HLP before they are delivered.

Note: With connectible accessory units and mobile filtering systems, there is a considerable risk of non-permitted mixing of the hydraulic fluids!

Rexroth will not accept liability for any damage to its components resulting from mixing hydraulic fluids!

4.6 Re-additivation

Additives added at a later point in time such as colors, wear reducers, VI enhancers or anti-foam additives, may negatively affect the performance properties of the hydraulic fluid and the compatibility with our components and therefore are not permissible.

Rexroth will not accept liability for any damage to its components resulting from re-additivation!

4.7 Foaming behavior

Foam is created by rising air bubbles at the surface of hydraulic fluids in the reservoir. Foam that develops should collapse as quickly as possible.

Common hydraulic fluids in accordance with DIN 51524 are sufficiently inhibited against foam formation in new condition. On account of aging and adsorption onto surfaces, the defoamer concentration may decrease over time, leading to a stable foam.

Defoamers may be re-dosed only after consultation with the lubricant manufacturer and with his written approval.

Defoamers may affect the air separation ability.

4.8 Corrosion

The hydraulic fluid is to guarantee sufficient corrosion protection of components under all operating conditions, even in the event of impermissible water contamination.

During storage and operation, hydraulic fluid based on mineral oils with anti-corrosion additives protect components against water and "acidic" oil degradation products.

4.9 Air

Under atmospheric conditions, the hydraulic fluid contains dissolved air. In the negative pressure range, for instance in the suction pipe of the pump or downstream of control edges, this dissolved air may transform into undissolved air. The undissolved air content represents a risk of cavitation and of the diesel effect. This results in material erosion of components and increased hydraulic fluid aging.

With the correct measures, such as suction pipe and reservoir design, and an appropriate hydraulic fluid, air intake and separation can be positively influenced.

See also chapter 3.1.7 "Air separation ability (ASA)".

4.10 Water

Water contamination in hydraulic fluids can result from direct ingress or indirectly through condensation of water from the air due to temperature variations.

Water in the hydraulic fluid may result in wear or direct failure of hydraulic components. Furthermore, a high water content in the hydraulic fluid negatively affects aging and filterability and increases susceptibility to cavitation.

Undissolved water can be drained from the bottom of the reservoir. Dissolved water can be removed only by using appropriate measures. If the hydraulic system is used in humid conditions, preventive measures need to be taken, such as an air dehumidifier at the reservoir vent. During operation, the water content in all hydraulic fluids, determined according to the "Karl Fischer method" (see chapter 6 "Glossary") for all hydraulic fluids must constantly be kept below 0.1% (1000 ppm). To ensure a long service life of both hydraulic fluids and components, Bosch Rexroth recommends that values below 0.05% (500 ppm) are permanently maintained.

To ensure a long service life for the hydraulic fluids and the components, we recommend that values below 0.05 % (500 ppm) are permanently maintained. Detergent and or dispersant hydraulic fluids (HLPD / HVLPD) are able to absorb (and keep suspended) more water. Prior to using these hydraulic fluids, please contact the lubricant manufacturer.

4.11 Fluid servicing, fluid analysis and filtration

Air, water, operating temperature influences and solid matter contamination will change the performance characteristics of hydraulic fluids and cause them to age.

To preserve the usage properties and ensure a long service life for hydraulic fluid and components, the monitoring of the fluid condition and a filtration adapted to the application requirements (draining and degassing if required) are indispensable.

The effort is higher in the case of unfavorable usage conditions, increased stress for the hydraulic system or high expectations as to availability and service life, see chapter 2 "Solid particle contamination and cleanliness level".

When commissioning a system, please note that the required minimum cleanliness level can frequently be attained only by flushing the system. Due to severe start-up contamination, it may be possible that a fluid and/or filter replacement becomes necessary after a short operating period (< 50 operating hours).

The hydraulic fluid must be replaced in regular intervals and tested by the lubricant manufacturer or recognized, accredited test labs. **We recommend a reference analysis after commissioning.**

The minimum data to be tested for analyses are:

- Viscosity at 40 °C and 100 °C
- Neutralization number NN (acid number AN)
- Water content (Karl-Fischer method)
- Particle measurement with evaluation according to ISO 4406 or mass of solid foreign substances with evaluation to EN 12662
- Element analysis (RFA (EDX) / ICP, specify test method)
- Comparison with new product or available trend analyses
- Assessment / evaluation for further use
- Also recommended: IR spectrum

Compared to the pure unused hydraulic fluid, the changed neutralization number NN (acid number AN) indicates how many aging products are contained in the hydraulic fluid. This value must be kept as low as possible. As soon as the trend analysis notes a significant increase in the acid number, the lubricant manufacturer should be contacted.

In case of warranty, liability or guarantee claims to Bosch Rexroth, service verification and/or the results of fluid analyses are to be provided.

5 Disposal and environmental protection

Hydraulic fluids based on mineral oil and related hydrocarbons are hazardous for the environment. They are subject to a special disposal obligation.

The respective lubricant manufacturers provide specifications on environmentally acceptable handling and storage. Please ensure that spilt or splashed fluids are absorbed with appropriate adsorbents or by a technique that prevents it contaminating water courses, the ground or sewerage systems.

It is also not permitted to mix fluids when disposing of hydraulic fluids. Regulations governing the handing of used oils stipulate that used oils are not to mixed with other products, e.g. substances containing halogen. Non-compliance will increase disposal costs. Comply with the national legal provisions concerning the disposal of the corresponding hydraulic fluid. Comply with the local safety data sheet of the lubricant manufacturer for the country concerned.

6 Other hydraulic fluids based on mineral oil and related hydrocarbons

Table 6: Other hydraulic fluids based on mineral oils and related hydrocarbons

Serial number	Hydraulic fluids	Features / Typical field of application / Notes
1	Hydraulic fluids with classification HL, HM, HV according to ISO 11158	– Can be used without confirmation provided they are listed in the respective product data sheet and are compliant with DIN 51524. Conformity with DIN 51524 must be verified in the technical data sheet of the fluid concerned. For classification see Table 4: "Hydraulic fluid classification". – Fluids **only** classified in accordance with ISO 11158 may be used only with prior written approval of Bosch Rexroth AG.
2	Hydraulic fluids with classification HH, HR, HS, HG according to ISO 11158	– May not be used.
3	Hydraulic fluids with classification HL, HLP, HLPD, HVLP, HVLPD to DIN 51502	– DIN 51502 merely describes how fluids are classified / designated on a national level. – It contains no information on minimum requirements for hydraulic fluids. – Hydraulic fluids standardized according to DIN 51502 can be used without confirmation provided they are listed in the respective product data sheet and are compliant with DIN 51524. Conformity with DIN 51524 must be verified in the technical data sheet of the fluid concerned. For classification see Table 4: "Hydraulic fluid classification".
4	Hydraulic fluids with classification HH, HL, HM, HR, HV, HS, HG according to ISO 6743-4	– ISO 6743-4 merely describes how fluids are classified / designated on an international level. It contains no information on minimum requirements for hydraulic fluids. – Hydraulic fluids standardized according to ISO 6743 -4 can be used without confirmation provided they are listed in the respective product data sheet and are compliant with DIN 51524. Conformity with DIN 51524 must be verified in the technical data sheet of the fluid concerned. For classification see table 4: "Classification and fields of application".
5	Lubricants and regulator fluids for turbines to DIN 51515-1 and -2	– Turbine oils can be used after confirmation and with limited performance data. – They usually offer lower wear protection than mineral oil HLP. Classification of turbine oils to DIN 51515-1 comparable to HL, turbine oils to DIN 51515-2 comparable to HLP. – Particular attention must be paid to material compatibility!
6	Lube oils C, CL, CLP in accordance with DIN 51517	– Lube oils in acc. with DIN 51517 can be used after confirmation and with limited performance data. They are mostly higher-viscosity fluids with low wear protection. Classification: CL similar to HL fluids and CLP similar to HLP fluids. – Particular attention must be paid to material compatibility, specifically with non-ferrous metals!
7	Fluids to be used in pharmaceutical and foodstuff industries, in acc. with FDA / USDA / NSF H1	– There are medical white oils and synthetic hydrocarbons (PAO). – Can only be used after consultation and approval for use in the specific application, even if they are compliant with DIN 51524. – May be used only with FKM seals. – Other fluids used in pharmaceutical and foodstuff industries may be used only after confirmation. – Attention is to be paid to material compatibility in accordance with the applicable food law. **Caution!** Fluids used in pharmaceutical and foodstuff industries should not be confused with environmentally acceptable fluids!

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Table 6: Other hydraulic fluids based on mineral oils and related hydrocarbons
(continued from page 12)

Serial number	Hydraulic fluids	Features / Typical field of application / Notes
8	Hydraulic fluids of classes HVLP and HVLPD based on related hydrocarbons	– Can only be used after consultation and approval for use in the specific application, even if they are compliant with DIN 51524. – Lower pour point than HLP – Other wetting (polarity)
9	Automatic Transmission Fluids (ATF)	– ATF are operating fluids for automatic gearboxes in vehicles and machines. In special cases, ATFs are also used for certain synchronous gearboxes and hydraulic systems comprising gearboxes. – To be used only after confirmation! – Some of these fluids have poor air separation abilities and modified wear properties. – Check material compatibility and filterability!
10	Multi-purpose oil (MFO) – Industry	– Multi-purpose oils (industry) combine at least two requirements for a fluid, for instance metal machining and hydraulics. – To be used only after confirmation! – Please pay particular attention to air separation ability, modified wear properties and the reduced material life cycle. – Check material compatibility and filterability!
11	Multi-purpose oils (MFO) – Mobil UTTO, STOU	– Multi-purpose oils combine requirements for wet brakes, gearboxes, motor oil (STOU only) and hydraulics. – Fluids of the types: – UTTO (= universal tractor transmission oil) and – STOU (= Super Tractor super tractor universal oil) – To be used only after confirmation! – Please pay particular attention to shear stability, air separation ability and modified wear properties. – Check material compatibility and filterability!
12	Single-grade engine oils 10W, 20W, 30W	– To be used only after confirmation! – Please pay particular attention to the air separation ability and filtering ability.
13	Multi-grade engine oils 0Wx-30Wx	– To be used only after confirmation! – Please pay particular attention to air separation ability, changes in wear protection capability, viscosity changes during operation, material compatibility, dispersant and detergent properties and filterability. **Caution!** Multi-grade engine oils have been adapted to specific requirements in combustion engines and are suitable for use in hydraulic systems only to a limited extent.
14	Hydraulic fluids for military applications to MIL 13919 or H 540, MIL 46170 or H 544, MIL 5606 or H 515, MIL 83282 or H 537, MIL 87257	– To be used only after confirmation! – Please pay particular attention to air separation ability, changes in wear protection capability, viscosity changes during operation, material compatibility, water separation capability and filterability. **Caution!** Hydraulic fluids for military applications do not meet the current requirements for high-quality hydraulic fluids and are suitable for use only to a limited degree.
15	Motor vehicle transmission oils	– Motor vehicle transmission oil can be used after confirmation and with limited performance data. – Pay particular attention to wear protection, material compatibility, specifically with non-ferrous metals, as well as viscosity!

Continued on page 14

Table 6: Other hydraulic fluids based on mineral oils and related hydrocarbons
(continued from page 13)

Serial number	Hydraulic fluids	Features / Typical field of application / Notes
16	Diesel, test diesel in acc. with DIN 4113	– Diesel / test diesel has poorer wear protection capabilities and a very low viscosity (< 3 mm^2/s). – May be used only with FKM seals – Please note their low flash point! – To be used only after confirmation and with limited performance data!
17	Hydraulic fluids for roller processes	– Hydraulic fluids for roller processes have lower wear protection capabilities than mineral oil HLP and a lower viscosity – Please note their low flash point! – Hydraulic fluids for roller processes with limited performance data can be used only after confirmation.
18	Fluids for power steering, hydro-pneumatic suspension, active chassis etc.	– Can only be used after consultation and approval for use in the specific application, even if they are compliant with DIN 51524. – Please note the low viscosity! – In most cases they have poor water separation capability – Check the material compatibility!

7 Glossary

Additivation
Additives are chemical substances added to the basic fluids to achieve or improve specific properties.

Aging
Hydraulic fluids age due to oxidation (see chapter 3.1.5 "Aging resistance"). Liquid and solid contamination acts as a catalyzer for aging, meaning that it needs to be minimized as far as possible by careful filtration.

API classification
Classification of basic fluids by the **A**merican **P**etroleum **I**nstitute (API) – the largest association representing the US oil and gas industry.

Arrhenius equation
The quantitative relation between reaction rate and temperature is described by an exponential function, the Arrhenius equation. This function is usually visualized within the typical temperature range of the hydraulic system. For a practical example, see chapter 3.1.5 "Aging resistance".

Related hydrocarbons
Related hydrocarbons are hydrocarbon compounds that are not classified as API class 1, 2 or 5.

Basic fluids
In general, a hydraulic fluid is made up of a basic fluid, or base oil, and chemical substances, the so-called additives. The proportion of basic fluid is generally greater than 90%.

Demulsifying
Ability of a fluid to separate water contamination quickly; achieved with careful selection of base oil and additives.

Detergent
Ability of certain additives to emulsify part of the water contamination in the oil or to hold it in suspension until it has evaporated with increasing temperature. Larger water quantities, in contrast (above approx. 2 %), are separated immediately.

Dispersant
Ability of certain additives to keep insoluble liquid and solid contamination in suspension in the fluid.

Diesel effect
If hydraulic fluid that contains air bubbles is compressed quickly, the bubbles are heated to such a degree that a self-ignition of the air-gas mix may occur. The resultant temperature increase may lead to seal damage and increased aging of the hydraulic fluid.

Hydraulic fluids based on mineral oils
Hydraulic fluids based on mineral oils are made from petroleum (crude oil).

ICP (atomic emission spectroscopy)
The ICP procedure can be used to determine various wear metals, contamination types and additives. Practically all elements in the periodic system can be detected with this method.

Karl Fischer method
Method to determine the water content in fluids. Indirect coulometric determination procedure in accordance with DIN EN ISO 12937 in connection with DIN 51777-2. Only the combination of both standards will assure adequately accurate measured values.

Cavitation
Cavitation is the creation of cavities in fluids due to pressure reduction below the saturated vapour pressure and subsequent implosion when the pressure increases. When the cavities implode, extremely high acceleration, temperatures and pressure may occur temporarily, which may damage the component surfaces.

Neutralization number (NN)
The neutralization number (NN) or acid number (AN) specifies the amount of caustic potash required to neutralize the acid contained in one gram of fluid.

Pour point
The lowest temperature at which the fluid still just flows when cooled down under set conditions. The pour point is specified in the lubricant manufacturers' technical data sheets as a reference value for achieving this flow limit.

RFA (wavelength dispersive x-ray fluorescence analysis)
Is a procedure to determine nearly all elements in liquid and solid samples with nearly any composition. This analysis method is suitable for examining additives and contamination, delivering fast results.

Shearing/shear loss
Shearing of molecule chains during operation can change the viscosity of hydraulic fluids with long chain VI enhancers. The initially high viscosity index drops. This needs to be taken into account when selecting the hydraulic fluid.

The only value at present that can be used to assess viscosity changes in operation is the result of the test in accordance with DIN 51350 part -6. Please note that there are practical applications that create a much higher shear load on such hydraulic fluids than can be achieved by this test.

Stick-slip effect (sliding)
Interaction between a resilient mass system involving friction (such as cylinder + oil column + load) and the pressure increase at very low sliding speeds. The static friction of the system is a decisive value here. The lower it is, the lower the speed that can still be maintained without sticking. Depending on the tribologic system, the stick-slip effect may lead to vibrations generated and sometimes also to significant noise emission. In many cases, the effect can be attenuated by replacing the lubricant.

Viscosity
Viscosity is the measure of the internal friction of a fluid to flow. It is defined as the property of a substance to flow under tension. Viscosity is the most important characteristic for describing the load-bearing capacity of a hydraulic fluid.

Kinematic viscosity is the ratio of the dynamic viscosity and the density of the fluid; the unit is mm^2/s. Hydraulic fluids are classified by their kinematic viscosity into ISO viscosity classes. The reference temperature for this is 40 °C.

Viscosity index (VI)
Refers to the viscosity temperature behavior of a fluid.
The lower the change of viscosity in relation the temperature, the higher the VI.

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Rexroth
Bosch Group

Environmentally acceptable hydraulic fluids

RE 90221/05.12 1/14
Replaces: 05.10

Application notes and requirements for Rexroth hydraulic components

Hydraulic fluids

Title	Hydraulic fluids based on mineral oils and related hydrocarbons	**Environmentally acceptable hydraulic fluids**	Fire-resistant, water-free hydraulic fluids	Fire-resistant, water-containing hydraulic fluids
Standard	DIN 51524	**ISO 15380**	ISO 12922	ISO 12922
Data sheets	RE 90220	**RE 90221**	RE 90222	RE 90223 (in preparation)
Classification	HL HLP HLPD HVLP HLPD and more	**HEPG** **HEES partially satu-rated** **HEES saturated** **HEPR** **HETG**	HFDR HFDU (ester base) HFDU (glycol base) and more	HFC HFB HFAE HFAS

Contents

1 Basic information

1.1 General instructions

The hydraulic fluid is the common element in any hydraulic component and must be selected very carefully. Quality and cleanliness of the hydraulic fluid are decisive factors for the operational reliability, efficiency and service life of a system.

Hydraulic fluids must conform, be selected and used in accordance with the generally acknowledged rules of technology and safety provisions. Reference is made to the country-specific standards and directives (in Germany the directive of the Employer's Liability Insurance Association BGR 137).

This data sheet includes recommendations and regulations concerning the selection, operation and disposal of environmentally compatible hydraulic fluids in the application of Rexroth hydraulic components.

The individual selection of hydraulic fluid or the choice of classification are the responsibility of the operator.

It is the responsibility of the user to ensure that appropriate measures are taken for safety and health protection and to ensure compliance with statutory regulations. The recommendations of the lubricant manufacturer and the specifications given in the safety data sheet are to be observed when using hydraulic fluid.

This data sheet does not absolve the operator from verifying the conformity and suitability of the respective hydraulic fluid for his system. He is to ensure that the selected fluid meets the minimum requirements of the relevant fluid standard during the whole of the period of use.

Other regulations and legal provisions may also apply. The operator is responsible for their observance, e.g. EU directive 2004/35/EG, 2005/360/EG and their national implementation. In Germany the Water Resources Act (WHG) is also to be observed.

We recommend that you maintain constant, close contact with lubricant manufacturers to support you in the selection, maintenance, care and analyses.

When disposing of used hydraulic fluids, apply the same care as during use.

Environmentally acceptable hydraulic fluids have been used successfully for many years. In some countries, the use of environmentally acceptable hydraulic fluids is already prescribed in ecologically sensitive areas (e.g. forestry, locks, weirs).

Environmentally acceptable hydraulic fluids may only be used in the pharmaceutical and food industry subject to required certification to FDA/USDA/NSF **H1**.

1.2 Environmental compatibility

There is no unambiguous legal definition for environmentally acceptable hydraulic fluids as different testing procedures can be applied for biological degradation and toxicity.

According to ISO 15380 the definition of "environmentally acceptable" is as follows: Humans, animals, plants, air and soil must not be endangered. With regard to hydraulic fluids in an unused condition in the bin this mainly means:

– biological degradation at least 60 % (according to ISO 14593 or ISO 9439)
– acute fish toxicity at least 100 mg/l (according to ISO 7346-2)
– acute daphnia toxicity at least 100 mg/l (according to ISO 5341)
– acute bacteria toxicity at least 100 mg/l (according to ISO 8192)

The same amount of care should be taken when handling environmentally acceptable hydraulic fluids as for mineral oils, leakage from the hydraulic system should be avoided. Environmentally acceptable hydraulic fluids are designed so that in the event of accidents and leakage,less permanent environmental damage is caused than by mineral oils, see also chapter 5 "Disposal and environmental protection".

In comparison to mineral oil HLP/HVLP , the biological degradation of environmentally acceptable hydraulic fluids may change fluid aging, see chapter 3.1.5 "Aging resistance", 3.1.6. "Biological degradation" and 4 "Hydraulic fluids in operation".

1.3 Scope

This data sheet must be applied when using environmentally acceptable hydraulic fluids with Rexroth hydraulic components. The specifications of this data sheet may be further restricted by the specification given in the data sheets for the individual components.

The use of the individual environmentally acceptable hydraulic fluids in accordance with the intended purpose can be found in the safety data sheets or other product description documents of the lubricant manufacturers. In addition, each use is to be individually considered.

Rexroth hydraulic components may only be operated with environmentally acceptable hydraulic fluids according to ISO 15380 if specified in the respective component data sheet or if a Rexroth approval for use is furnished.

The manufacturers of hydraulic systems must adjust their systems and operating instructions to the environmentally acceptable hydraulic fluids.

Notes:
In the market overview RE 90221-01, environmentally acceptable hydraulic fluids based on mineral oil are described which, according to the information of the lubricant manufacturer, feature the respective parameters of the current requirements standard ISO 15380 and other parameters which are of relevance for suitability in connection with Rexroth components.

These specifications are not checked or monitored by Bosch Rexroth. The list in the market overview does not therefore represent a recommendation on the part of Rexroth or approval of the respective hydraulic fluid for use with Rexroth components and does not release the operator from his responsibility regarding selection of the hydraulic fluid.

Bosch Rexroth will accept no liability for its components for any damage resulting from failure to comply with the notes below.

1.4 Safety instructions

Hydraulic fluids can constitute a risk for persons and the environment. These risks are described in the hydraulic fluid safety data sheets. The operator is to ensure that a current safety data sheet for the hydraulic fluid used is available and that the measures stipulated therein are complied with.

2 Solid particle contamination and cleanliness levels

Solid particle contamination is the major reason for faults occurring in hydraulic systems. It may lead to a number of effects in the hydraulic system. Firstly, single large solid particles may lead directly to a system malfunction, and secondly small particles cause continuous elevated wear.

For mineral oils, the cleanliness level of environmentally acceptable hydraulic fluids is given as a three-digit numerical code in accordance with ISO 4406. This numerical code denotes the number of particles present in a hydraulic fluid for a defined quantity. Moreover, foreign solid matter is not to exceed a mass of 50 mg/kg (gravimetric examination according to ISO 4405).

In general, compliance with a minimum cleanliness level of 20/18/15 in accordance with ISO 4406 or better is to be maintained in operation. Special servo valves demand improved cleanliness levels of at least 18/16/13. A reduction in cleanliness level by one level means half of the quantity of particles and thus greater cleanliness. Lower numbers in cleanliness levels should always be striven for and extend the service life of hydraulic components. The component with the highest cleanliness requirements determines the required cleanliness of the overall system. Please also observe the specifications in table 1: "Cleanliness levels according to ISO 4406" and in the respective data sheets of the various hydraulic components.

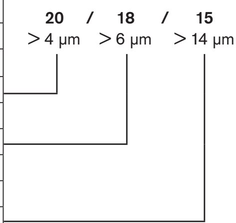
Hydraulic fluids frequently fail to meet these cleanliness requirements on delivery. Careful filtering is therefore required during operation and in particular, during filling in order to ensure the required cleanliness levels. Your lubricant manufacturer can tell you the cleanliness level of hydraulic fluids as delivered. To maintain the required cleanliness level over the operating period, you must use a reservoir breather filter. If the environment is humid, take appropriate measures, such as a breather filter with air drying or permanent off-line water separation.

Note: the specifications of the lubricant manufacturer relating to cleanliness levels are based on the time at which the container concerned is filled and not on the conditions during transport and storage.

Further information about contamination with solid matter and cleanliness levels can be found in brochure RE 08016.

Table 1: Cleanliness levels according to ISO 4406

Particles per 100 ml		Scale number
More than	Up to and including	
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64000	130,000	17
32000	64000	16
16000	32000	15
8000	16000	14
4000	8000	13
2000	4000	12
1000	2000	11
500	1000	10
250	500	9
130	250	8
64	130	7
32	64	6



3 Selection of the hydraulic fluid

Environmentally acceptable hydraulic fluids for Bosch Rexroth hydraulic components are assessed on the basis of their fulfillment of the minimum requirements of ISO 15380.

3.1 Selection criteria for the hydraulic fluid

The specified limit values for all components employed in the hydraulic system, for example viscosity and cleanliness level, must be observed with the hydraulic fluid used, taking into account the specified operating conditions.

Hydraulic fluid suitability depends, amongst others, on the following factors:

3.1.1 Viscosity

Viscosity is a basic property of hydraulic fluids. The permissible viscosity range of complete systems needs to be determined taking account of the permissible viscosity of all components and it is to be observed for each individual component.

The viscosity at operating temperature determines the response characteristics of closed control loops, stability and damping of systems, the efficiency factor and the degree of wear.

We recommend that the optimum operating viscosity range of each component be kept within the permissible temperature range. This usually requires either cooling or heating, or both. The permissible viscosity range and the necessary cleanliness level can be found in the product data sheet for the component concerned.

If the viscosity of a hydraulic fluid used is above the permitted operating viscosity, this will result in increased hydraulic-mechanical losses. In return, there will be lower internal leakage losses. If the pressure level is lower, lubrication gaps may not be filled up, which can lead to increased wear. For hydraulic pumps, the permitted suction pressure may not be reached, which may lead to cavitation damage.

If the viscosity of a hydraulic fluid is below the permitted operating viscosity, increased leakage, wear, susceptibility to contamination and a shorter life cycle will result.

Please ensure that the permissible temperature and viscosity limits are observed for the respective components. This usually requires either cooling or heating, or both.

3.1.2 Viscosity-temperature behavior

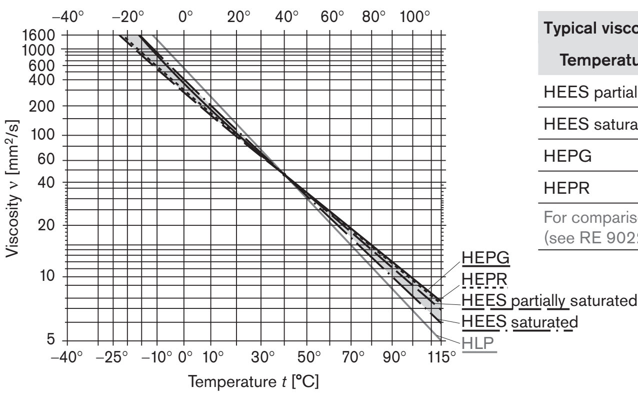
For hydraulic fluids, the viscosity temperature behavior (V-T behavior) is of particular importance. Viscosity is characterized in that it drops when the temperature increases and rises when the temperature drops. The interrelation between viscosity and temperature is described by the viscosity index (VI).

If exposed to the cold for several days, viscosity may rise significantly (HETG and HEES). After heating, the characteristic values as specified on the data sheet are restored. Please ask your lubricant manufacturer for the " Flow capacity after 7 days at low temperature" (ASTM D 2532) of fluid classifications HETG and partially saturated HEES.

All known environmentally acceptable hydraulic fluids have better viscosity temperature behavior than mineral oil HLP and generally feature greater shear stability than HVLP mineral oils. This should be taken into consideration when selecting hydraulic fluid for the required temperature range. A lower viscosity level can frequently be used to save any drive power during a cold start and avoid viscosity being too low at higher temperatures. The required viscosity and temperature limits in the product data sheets are to be observed in all operating conditions.

Depending on the basic fluid types/classes, VI indices can be achieved of 140–220, see Fig. 1: "Examples: V-T diagrams in comparison to HLP (reference values)" and Table 4: "Classification and fields of application of environmentally acceptable hydraulic fluids".

Fig. 1: Examples V-T diagrams in comparison to HLP (reference values, double-logarithmic representation)



Typical viscosity data [mm²/s]			
Temperature	–20 °C	40 °C	100 °C
HEES partially saturated	1250	46	9
HEES saturated	2500	46	8
HEPG	2500	46	10
HEPR	1400	46	10
For comparison HLP (see RE 90220)	4500	46	7

Detailed V-T diagrams may be obtained from your lubricant manufacturer for their specific products.

3.1.3 Wear protection capability

Wear protection capability describes the property of hydraulic fluids to prevent or minimize wear within the components. The wear protection capability is described in ISO 15380 via test procedures"FZG gear test rig" (ISO 14635-1) and "Mechanical test in the vane pump" (ISO 20763). From ISO VG 32, ISO 15380 prescribes a rating of at least 10 (FZG test). At present, the FZG test cannot be applied to viscosity classes < ISO VG 32. The wear protection capability of environmentally acceptable hydraulic fluids in relation to the two test procedures is comparable to that of mineral oil HLP/HVLP.

3.1.4 Material compatibility

The hydraulic fluid must not negatively affect the materials used in the components. Compatibility with coatings, seals, hoses, metals and plastics is to be observed in particular. The fluid classifications specified in the respective component data sheets are tested by the manufacturer with regard to material compatibility. Parts and components not supplied by us are to be checked by the user.

Table 2: Known material incompatibilities

Classification	Incompatible with:
HE... general	One-component color coatings, lead, galvanized zinc coatings, some non-ferrous metals, seals made of NBR. In some cases, the latter show major increases in volume when impermissibly aged hydraulic fluids come into contact with the material. NBR is only permitted by prior consent, please observe the customary seal and tube replacement intervals. Do not use any hydrolysis/susceptible polyurethane qualities. **Note** Please check seals and coatings of control cabinets, outer coatings of hydraulic components and accessories (connectors, cables, control cabinets) for resistance to vapors issuing from hydraulic fluids.
HETG/HEES	Zinc, some non-ferrous alloys with zinc
HEPG	Steel/aluminum tribocontacts, paper filters, polymethylmethacrylate (PMMA), NBR **Note** Check plastics for resistance

The material incompatibilities mentioned here do not automatically result in function problems. However the elements of the materials are found in the hydraulic fluids after use. The biological degradation of hydraulic fluids is negatively influenced.

3.1.5 Aging resistance

The way an environmentally acceptable hydraulic fluids ages depends on the thermal, chemical and mechanical stress to which it is subjected. The influence of water, air, temperature and contamination may be significantly greater than for mineral oils HLP/HVLP. Aging resistance can be greatly influenced by the chemical composition of the hydraulic fluids .

High fluid temperatures (e.g. over 80 °C) result in a approximate halving of the fluid service life for every 10 °C temperature increase and should therefore by avoided. The halving of the fluid service life results from the application of the Arrhenius equation (see Glossary).

Table 3: Reference values for temperature-dependent aging of the hydraulic fluid

Reservoir temperature	Fluid life cycle
80 °C	100 %
90 °C	50 %
100 °C	25 %

A modified aging test (without adding water) is prescribed for fluid classifications HETG and HEES. Hydraulic fluids with HEPG and HEPR classification are subjected to the identical test procedure as mineral oils (with 20 % water added). The calculated fluid service life is derived from the results of tests in which the long-term characteristics are simulated in a short period of time by applying more arduous conditions (condensed testing). This calculated fluid service life is not to be equated to the fluid service life in real-life applications.

Table 3 is a practical indicator for hydraulic fluids with water content < 0.1%, cf. chapter 4.10. "Water".

3.1.6 Biological degradation

Environmentally acceptable hydraulic fluids are ones which degrade biologically much faster than mineral oils. Biological degradation is a biochemical transformation effected by micro-organisms resulting in mineralization. For environmentally acceptable hydraulic fluids that make reference to ISO 15380, biological degradation according to ISO 14593 or ISO 9439 must be verified. 60% minimum degradation is defined as limit value. Proof of biological degradation is furnished for the new, unmixed, ready-formulated hydraulic fluids. Aged or mixed hydraulic fluids are less able to degrade biologically. Biological degradation outside the defined test procedure is subject to a variety of natural influences. The key factors are temperature, humidity, contamination, fluid concentration, type and quantity of micro-organisms. Environmentally acceptable hydraulic fluids require no extended maintenance in comparison to mineral oils, please observe chapter 4 "Hydraulic fluids in operation".

3.1.7 Air separation ability (ASA)

The air separation ability (ASA) describes the property of a hydraulic fluid to separate undissolved air. Hydraulic fluids always contain dissolved air. During operation, dissolved air may be transformed into undissolved air, leading to cavitation damages. Fluid classification, fluid product, reservoir size and design must be coordinated to take into account the dwell time and ASA value of the hydraulic fluid. The air separation capacity depends on the viscosity, temperature, basic fluid and aging. It cannot be improved by additives.

According to ISO 15380, for instance, an ASA value ≤ 10 minutes is required for viscosity class ISO VG 46, 6 minutes are typical, lower values are preferable.

3.1.8 Demulsifying ability and water solubility

The capacity of a hydraulic fluid to separate water at a defined temperature is known as the demulsifying ability. ISO 6614 defines the demulsifying properties of hydraulic fluids.

Fluids classified HETG, HEES and HEPR separate from water. HETG and HEES hydraulic fluids have a different water separation ability to mineral oil HLP/HVLP. At 20 °C, in comparison to mineral oil HLP/HVLP, a multiple (> factor 3) of water can separate in the hydraulic fluid. Water solubility is also more temperature-dependent than for mineral oils. With regard to water solubility, HEPR hydraulic fluids behave like HVLP hydraulic fluids (see RE 90220). In the majority of cases, HEPG-classified fluids HEPG dissolve water completely , see chapter "4.10 Water".

3.1.9 Filterability

Filterability describes the ability of a hydraulic fluid to pass through a filter, removing solid contaminants. The hydraulic fluids used require a good filterability, not just when new, but also during the whole of their service life. Depending on the different basic fluids (glycols, saturated and partially saturated ester oils, hydrocrack oils, polyalpha olefins, triglycerides) and additives (VI enhancers), there are great differences here.

The filterability is a basic prerequisite for cleanliness, servicing and filtration of hydraulic fluids. Rexroth therefore requires the same degree of filterability of environmentally acceptable hydraulic fluids as for mineral oils HLP/HVLP to DIN 51524. As ISO 15380 does not comment on the filterability of hydraulic fluids, filterability comparable to that of mineral oils HLP/HVLP must be requested of lubricant manufacturers.

Filterability is tested with the new hydraulic fluid and after the addition of 0.2 % water. The underlying standard (ISO 13357-1/-2) stipulates that filterability must have no negative effects on the filters or the hydraulic fluid, see chapter 4 "Hydraulic fluids in operation".

3.1.10 Corrosion protection

Hydraulic fluids should not just prevent corrosion formation on steel components, they must also be compatible with non-ferrous metals and alloys. Corrosion protection tests on different metals and metal alloys are described in ISO 15380. Hydraulic fluids that are not compatible with the materials listed above must not be used, even if they are compliant with ISO 15380.

Rexroth components are usually tested with HLP hydraulic fluids or corrosion protection oils based on mineral oils before they are delivered.

3.1.11 Additivation

The properties described above can be modified with the help of suitable additives. Environmentally acceptable hydraulic fluids should never contain heavy metals. According to the present state of knowledge, all hydraulic fluids, regardless of additivation, can be filtered with all customary filter materials in all known filtration ratings (≥ 0.8 μm), without filtering out effective additives at the same time.

Bosch Rexroth does not prescribe any specific additive system.

3.2 Classification and fields of application

Table 4: Classification and fields of application

Classification	Features	Typical field of application	Notes
HEPG according to ISO 15380 Density at 15 °C: typically > 0.97 kg/dm³ VI: typical > 170	Basic fluid, glycols	Systems on exposed water courses (locks, weirs, dredgers)	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Very good viscosity/temperature characteristics, shear stability – Resistant to aging – Incompatible with mineral oil (exceptions must be confirmed by the lubricant manufacturer) – Can be water-soluble – Can be mixed with water – Very good wear protection properties – A higher implementation temperature with the same viscosity in comparison to mineral oil is to be expected – Due to the higher density in comparison to HLP, lower suction pressures are to be anticipated for pumps. Reduce the maximum speed as required and optimize suction conditions. – Classified as insignificantly water-endangering (water hazard class WGK 1) – Prior to commissioning, contact the lubricant manufacturer, as the components are tested with mineral oil HLP/corrosion protection oil.
HEES partially saturated according to ISO 15380 Density at 15 °C: typically 0.90–0.93 kg/dm³ VI: typical > 160 Iodine count < 90	Basic fluid: Ester based on renewable raw materials, synthetic esters, mixtures of various esters, mixtures with polyalphaolefines (< 30%)	Suitable for most fields of application and components.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Preferred use of FKM seals. Please enquire for shaft seal rings and implementation temperatures under –15 °C. – In operation, a higher temperature in comparison to mineral oil HLP/HVLP is to be expected given identical design and viscosity – Limit lower (depending on viscosity class) and upper implementation temperatures (maximum 80 °C due to aging) – Good viscosity/temperature characteristics, shear stability. – Good corrosion protection, if correspondingly additivized – Mostly classed as insignificantly water-endangering (water hazard class WGK 1), in some cases as not water-endangering – High dirt dissolving capacity on fluid changeovers – In unfavorable operating conditions (high water content, high temperature), HEES on ester basis have a tendency to hydrolysis. The acidic organic decomposition products can chemically attack materials and components.

Continued on page 9

Table 4: Classification and fields of application (continued from page 8)

Classification	Features	Typical field of application	Notes
HEES saturated according to ISO 15380 Density at 15 °C: typically 0.90–0.93 kg/dm³ VI: typical 140–160 Iodine count <15	Basic fluid: Ester based on renewable raw materials, synthetic esters, mixtures of various esters, mixtures with polyalphaolefines (< 30%)	Suitable for most fields of application and components. Saturated HEES should be preferred over partially saturated HEES and HETG for components and systems exposed to high stress levels.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Preferred use of FKM seals. Please enquire for shaft seal rings and implementation temperatures under –15 °C. – In operation, a higher temperature in comparison to mineral oil HLP/HVLP is to be expected given identical design and viscosity – Good viscosity/temperature characteristics, shear stability – Good corrosion protection, if correspondingly additivized – Mostly classed as insignificantly water-endangering (water hazard class WGK 1), in the case of low viscosity classes (up to ISO VG 32) also classed as not water-endangering – High dirt dissolving capacity on fluid changeovers
HEPR according to ISO 15380 Density at 15 °C: typically 0.87 kg/dm³ VI : typical 140–160	Basic fluid: synthetically manufactured hydrocarbons (polyalpha olefins PAO) partly mixed with esters (< 30 %)	Suitable for most fields of application and components. HEPR should be preferred over partially saturated HEES and HETG for components and systems exposed to high stress levels.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Behaves similarly to HVLP- hydraulic fluids, individual products comply with ISO 15380 HEPR and DIN 51524-3 HVLP – Preferred use of FKM seals. Please enquire for shaft seal rings and implementation temperatures under –15 °C. – Good viscosity-temperature behavior – Classified as insignificantly water-endangering (water hazard class WGK 1) **Note:** Note shear stability (see chapter 4.11 "Fluid servicing, fluid analysis and filtration" and chapter 6 "Glossary")
HETG according to ISO 15380 Density at 15 °C: typically 0.90-0.93 kg/dm³ VI: typical > 200 Iodine count > 90	Basic fluid: vegetable oils and triglycerides	Not recommended for Rexroth components!	Practical requirements are frequently not fulfilled by hydraulic fluids in this classification. Use only permissible after consultation. – Viscosity is not stable over time – Very fast fluid aging, very hydrolysis-susceptible (please observe neutralization number) – Tendency to gumming, gelling and setting. – Limit the lower (depending on viscosity class) and upper implementation temperatures (see chapter 3.1.5) – Only limited material compatibility – Filterability problems at water ingress – High dirt dissolving capacity on fluid changeovers – Mostly classed as not water-endangering

1

4 Hydraulic fluids in operation

4.1 General

The properties of hydraulic fluids can change continually during storage and operation.

Please note that the fluid standard ISO 15380 merely describes minimum requirements for hydraulic fluids in new condition at the time of filling into the bins. The operator of a hydraulic system must ensure that the hydraulic fluid remains in a utilizable condition throughout its entire period of use.

Deviations from the characteristic values are to be clarified with the lubricant manufacturer, the test labs or Bosch Rexroth.

Bosch Rexroth will accept no liability for damage to its components within the framework of the applicable liability legislation insofar as the latter is due to non-observance of the following instructions.

Please note the following aspects in operation.

4.2 Storage and handling

Hydraulic fluids must be stored correctly in accordance with the instructions of the lubricant manufacturer. Avoid exposing the containers to lengthy periods of direct heat. Containers are to be stored in such a way that the risk of any foreign liquid or solid matter (e.g. water, foreign fluids or dust) ingression into the inside of the container can be ruled out. After taking hydraulic fluids from the containers, these are immediately to be properly resealed.

Recommendation:

- Store containers in a dry, roofed place
- Store barrels on their sides
- Clean reservoir systems and machine reservoirs regularly

4.3 Filling of new systems

Usually, the cleanliness levels of the hydraulic fluids as delivered do not meet the requirements of our components. Hydraulic fluids must be filtered using an appropriate filter system to minimize solid particle contamination and water in the system.

As early as possible during test operation, new systems should be filled with the selected hydraulic fluid so as to reduce the risk of accidentally mixing fluids (see chapter 4.5 "Mixing and compatibility of different hydraulic fluids"). Changing the hydraulic medium at a later point represents significant additional costs (see following chapter).

4.4 Hydraulic fluid changeover

In particular with the changeover from mineral oils to environmentally acceptable hydraulic fluids, but also from one environmentally acceptable hydraulic fluids to another, there may be interference (e.g. incompatibility in the form of gelling, silting, stable foam or reduced filterability or filter blockage).

In the case of changeovers of the fluid in hydraulic systems, it is important to ensure compatibility of the new hydraulic fluid with the remains of the previous hydraulic fluid. Bosch Rexroth recommends obtaining verification of compatibility from the manufacturer or supplier of the new hydraulic fluid. The quantity of old fluid remaining should be minimized. Mixing hydraulic fluids should be avoided, see following chapter.

For information on changing over hydraulic fluids with different classifications, please refer to VDMA 24314, VDMA 24569 and ISO 15380 appendix A.

Bosch Rexroth will not accept liability for any damage to its components resulting from inadequate hydraulic fluid change-overs!

4.5 Mixing and compatibility of different hydraulic fluids

If hydraulic fluids from different manufacturers or different types from the same manufacturer are mixed, gelling, silting and deposits may occur. These, in turn, may cause foaming, impaired air separation ability, malfunctions and damage to the hydraulic system.

If the fluid contains more than 2 % of another fluid then it is considered to be a mixture. Exceptions apply for water, see chapter 4.10 "Water".

Mixing with other hydraulic fluids is not generally permitted. This also includes hydraulic fluids with the same classification and from the market overview RE 90221-01. If individual lubricant manufacturers advertise miscibility and/or compatibility, this is entirely the responsibility of the lubricant manufacturer.

Bosch Rexroth customarily tests all components with mineral oil HLP before they are delivered.

Note: With connectible accessory units and mobile filtering systems, there is a considerable risk of non-permitted mixing of the hydraulic fluids!

Rexroth will not accept liability for any damage to its components resulting from mixing hydraulic fluids!

4.6 Re-additivation

Additives added at a later point in time such as colors, wear reducers, VI enhancers or anti-foam additives, may negatively affect the performance properties of the hydraulic fluid and the compatibility with our components and therefore are not permissible.

Rexroth will not accept liability for any damage to its components resulting from re-additivation!

4.7 Foaming behavior

Foam is created by rising air bubbles at the surface of hydraulic fluids in the reservoir. Foam that develops should collapse as quickly as possible.

Common hydraulic fluids in accordance with ISO 15380 are sufficiently inhibited against foam formation in new condition. On account of aging and adsorption onto surfaces, the defoamer concentration may decrease over time, leading to a stable foam.

Defoamers may be re-dosed only after consultation with the lubricant manufacturer and with his written approval.

Defoamers may affect the air separation ability.

4.8 Corrosion

The hydraulic fluid is to guarantee sufficient corrosion protection of components under all operating conditions, even in the event of impermissible water contamination.

Environmentally acceptable hydraulic fluids are tested for corrosion protection in the same way as mineral oil HLP/HVLP. When used in practice other corrosion mechanisms are revealed in detail and in individual cases, for the most part in contact with non-ferrous and white alloys.

4.9 Air

Under atmospheric conditions the hydraulic fluid contains dissolved air. In the negative pressure range, for instance in the suction pipe of the pump or downstream of control edges, this dissolved air may transform into undissolved air. The undissolved air content represents a risk of cavitation and of the diesel effect. This results in material erosion of components and increased hydraulic fluid aging.

With the correct measures, such as suction pipe and reservoir design, and an appropriate hydraulic fluid, air intake and separation can be positively influenced.

See also chapter 3.1.7 "Air separation ability (ASA)".

4.10 Water

Water contamination in hydraulic fluids can result from direct ingress or indirectly through condensation of water from the air due to temperature variations.

HEPG dissolves water completely. This means that any water that has ingressed into the system cannot be drained off in the sump of the reservoir.

In the case of hydraulic fluids classed HETG, HEES and HEPR undissolved water can be drained off from the reservoir sump, the remaining water content is however too high to ensure that the maximum permissible water limit values are observed in the long term.

Water in the hydraulic fluid can result in wear or direct failure of hydraulic components. Furthermore, a high water content in the hydraulic fluid negatively affects aging and filterability and increases susceptibility to cavitation. During operation, the water content in all hydraulic fluids, determined according to the "Karl Fischer method" (see chapter 6 "Glossary") for all environmentally acceptable hydraulic fluids must constantly be kept below 0.1% (1000 ppm). To ensure a long service life of both hydraulic fluids and components, Bosch Rexroth recommends that values below 0.05% (500 ppm) are permanently maintained.

Due to the higher water solubility (except for HEPR) in comparison to mineral oil HLP/HVLP it is urgently advised that precautions be taken when using environmentally acceptable hydraulic fluids, such as a dehumidifier on the reservoir ventilation.

Water content has an affect particularly in the case of HETG and partially saturated HEES in that it accelerates aging (hydrolysis) of the hydraulic fluid and biological degradation, see chapter 4.11 "Fluid servicing, fluid analysis and filtration".

4.11 Fluid servicing, fluid analysis and filtration

Air, water, operating temperature influences and solid matter contamination will change the performance characteristics of hydraulic fluids and cause them to age.

To preserve the usage properties and ensure a long service life for hydraulic fluid and components, the monitoring of the fluid condition and a filtration adapted to the application requirements (draining and degassing if required) are indispensable.

The effort is higher in the case of unfavorable usage conditions, increased stress for the hydraulic system or high expectations as to availability and service life, see chapter 2 "Solid particle contamination and cleanliness levels".

When commissioning a system, please note that the required minimum cleanliness level can frequently be attained only by flushing the system. Due to severe start-up contamination, it may be possible that a fluid and/or filter replacement becomes necessary after a short operating period (< 50 operating hours).

The hydraulic fluid must be replaced at regular intervals and tested by the lubricant manufacturer or recognized accredited test labs. **We recommend a reference analysis after commissioning.**

The minimum data to be tested for analyses are:

- Viscosity at 40 °C and 100 °C
- Neutralization number NN (acid number AN)
- Water content (Karl-Fischer method)
- Particle measurement with evaluation according to ISO 4406 or mass of solid foreign substances with evaluation to EN 12662
- Element analysis (RFA (EDX) / ICP, specify test method)
- Comparison with new product or available trend analyses
- Assessment / evaluation for further use
- Also recommended: IR spectrum"

Differences in the maintenance and upkeep of environmentally acceptable hydraulic fluids with the corresponding suitability characteristics (as required in market overview RE 90221-01) in comparison to mineral oil HLP/HVLP are not necessary. Attention is however drawn to the note in chapter 1.3.

After changing over hydraulic fluids it is recommended that the filters be replaced again after 50 operating hours as fluid aging products may have detached themselves ("self-cleaning effect").

Compared to the pure unused hydraulic fluid the changed neutralization number NN (acid number AN) indicates how many aging products are contained in the hydraulic fluid. This difference must be kept as low as possible. As soon as the trend analysis notes a significant increase in the values, the lubricant manufacturer should be contacted.

A higher viscosity than that of new materials indicates that the hydraulic fluid has aged. Evaluation by the test lab or lubricant manufacturers is however authoritative, whose recommendation should be urgently observed.

On systems where the possibility of water contamination cannot be completely ruled out (also condensation), it should be ensured via the hydraulic system circuit that fluid aging products are not accumulating in individual areas of the hydraulic system, but are being removed from the system in a controlled manner via the filtration system. This should be ensured via suitable hydraulic circuits (e.g. flushing circuit) or system manufacturer's operating instructions/specifications.

In case of warranty, liability or guarantee claims to Bosch Rexroth, service verification and/or the results of fluid analyses are to be provided.

5 Disposal and environmental protection

All environmentally acceptable hydraulic fluids, are like mineral oil-based hydraulic fluids, subject to special disposal obligations.

The respective lubricant manufacturers provide specifications on environmentally acceptable handling and storage. Please ensure that spilt or splashed fluids are absorbed with appropriate adsorbents or by a technique that prevents it contaminating water courses, the ground or sewerage systems.

It is also not permitted to mix fluids when disposing of hydraulic fluids. Regulations governing the handing of used oils stipulate that used oils are not to mixed with other products, e.g. substances containing halogen. Non-compliance will increase disposal costs. Comply with the national legal provisions concerning the disposal of the corresponding hydraulic fluid. Comply with the local safety data sheet of the lubricant manufacturer for the country concerned.

6 Glossary

Additivation
Additives are chemical substances added to the basic fluids to achieve or improve specific properties.

Aging
Hydraulic fluids age due to oxidation (see chapter 3.1.5 "Aging resistance"). Liquid and solid contamination acts as a catalyzer for aging, meaning that it needs to be minimized as far as possible by careful filtration. Please refer to Hydrolysis.

Arrhenius equation
The quantitative relation between reaction rate and temperature is described by an exponential function, the Arrhenius equation. This function is usually visualized within the typical temperature range of the hydraulic system. For a practical example, see chapter 3.1.5 "Aging resistance".

Basic fluids
In general, a hydraulic fluid is made up of a basic fluid, or base oil, and chemical substances, the so-called additives. The proportion of basic fluid is generally greater than 90%.

Diesel effect
If hydraulic fluid that contains air bubbles is compressed quickly, the bubbles are heated to such a degree that a self-ignition of the air-gas mix may occur. The resultant temperature increase may lead to seal damage and increased aging of the hydraulic fluid.

Saturated esters
Esters differ by the number of C atoms (chain length) and position of the bonds between the C atoms. Saturated esters do not have double/multiple bonds between C atoms and are therefore more resistant to aging than partially saturated esters.

Partially saturated esters
In contrast to saturated esters, partially saturated esters have double/multiple bonds between C atoms. Rexroth defines partially saturated esters as unsaturated bonds and mixtures of esters with unsaturated and saturated bonds. Esters with unsaturated bonds are produced on the basis of renewable raw materials.

Depending on their number and position, these unsaturated bonds between the C atoms are instable. These bonds can detach themselves and form new bonds, thus changing the properties of those liquids (an aging mechanism). One of the underlying requirements for inclusion in the market overview RE 90221-01 is an aging stability characteristic. Attention is however drawn to the note in chapter 1.3.

Hydrolysis
Hydrolysis is the splitting of a chemical bond through the reaction with water under the influence of temperature.

ICP (atomic emission spectroscopy)
The ICP procedure can be used to determine various wear metals, contamination types and additives. Practically all elements in the periodic system can be detected with this method..

Iodine count
The iodine count is a yardstick for the quantity of single and multiple unsaturated bonds between C atoms in the basic fluid. A low iodine count indicates that the hydraulic fluid contains few unsaturated bonds and is thus considerably more resistant to aging than a hydraulic fluid with a high iodine count. A statement about the position at which these multiple bonds are located and about how "stable" they are against influencing factors cannot be derived simply by stating the iodine count.

Karl Fischer method
Method to determine the water content in fluids. Indirect coulometric determination procedure in accordance with DIN EN ISO 12937 in connection with DIN 51777-2. Only the combination of both standards will assure adequately accurate measured values. For hydraulic fluids based on glycol, DIN EN ISO 12937 is to be applied in conjunction with DIN 51777-1.

Cavitation
Cavitation is the creation of cavities in fluids due to pressure reduction below the saturated vapour pressure and subsequent implosion when the pressure increases. When the cavities implode, extremely high acceleration, temperatures and pressure may occur temporarily, which may damage the component surfaces.

Neutralization number (NN)
The neutralization number (NN) or acid number (AN) specifies the amount of caustic potash required to neutralize the acid contained in one gram of fluid.

Pour point
The lowest temperature at which the fluid still just flows when cooled down under set conditions. The pour point is specified in the lubricant manufacturers' technical data sheets as a reference value for achieving this flow limit.

RFA (wavelength dispersive x-ray fluorescence analysis)
Is a procedure to determine nearly all elements in liquid and solid samples with nearly any composition. This analysis method is suitable for examining additives and contamination, delivering fast results.

Shearing/shear loss
Shearing of molecule chains during operation can change the viscosity of hydraulic fluids with long chain VI enhancers. The initially high viscosity index drops. This needs to be taken into account when selecting the hydraulic fluid.

The only value at present that can be used to assess viscosity changes in operation is the result of the test in accordance with DIN 51350 part -6. Please note that there are practical applications that create a much higher shear load on such hydraulic fluids than can be achieved by this test.

Stick-slip
Interaction between a resilient mass system involving friction (such as cylinder + oil column + load) and the pressure increase at very low sliding speeds. The static friction of the system is a decisive value here. The lower it is, the lower the speed that can still be maintained without sticking. Depending on the tribologic system, the stick-slip effect may lead to vibrations generated and sometimes also to significant noise emission. In many cases, the effect can be attenuated by replacing the lubricant.

Viscosity
Viscosity is the measure of the internal friction of a fluid to flow. It is defined as the property of a substance to flow under tension. Viscosity is the most important characteristic for describing the load-bearing capacity of a hydraulic fluid.

Kinematic viscosity is the ratio of the dynamic viscosity and the density of the fluid; the unit is mm^2/s. Hydraulic fluids are classified by their kinematic viscosity into ISO viscosity classes. The reference temperature for this is 40 °C.

Viscosity index (VI)
Refers to the viscosity temperature behavior of a fluid. The lower the change of viscosity in relation the temperature, the higher the VI.

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Rexroth
Bosch Group

Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

Application notes and requirements for Rexroth hydraulic components

Hydraulic fluids

Title	Hydraulic fluids based on mineral oils and related hydrocarbons	Environmentally acceptable hydraulic fluids	**Fire-resistant, water-free hydraulic fluids**	Fire-resistant, water-containing hydraulic fluids
Standard	DIN 51524	ISO 15380	**ISO 12922**	ISO 12922
Data sheets	RE 90220	RE 90221	**RE 90222**	RE 90223 (in preparation)
Classification	HL HLP HLPD HVLP HLPD and more	HEPG HEES partially saturated HEES saturated HEPR HETG	**HFDR HFDU (ester base) HFDU (glycol base) and more**	HFC HFB HFAE HFAS

Contents

1 Basic information

1.1 General instructions

The hydraulic fluid is the common element in any hydraulic component and must be selected very carefully. Quality and cleanliness of the hydraulic fluid are decisive factors for the operational reliability, efficiency and service life of a system.

Hydraulic fluids must conform, be selected and used in accordance with the generally acknowledged rules of technology and safety provisions. Reference is made to the country-specific standards and directives (in Germany the directive of the Employer's Liability Insurance Association BGR 137).

This data sheet includes recommendations and regulations concerning the selection, operation and disposal of fire-resistant, water-free hydraulic fluids in the application of Rexroth hydraulic components.

The individual selection of hydraulic fluid or the choice of classification are the responsibility of the operator.

It is the responsibility of the user to ensure that appropriate measures are taken for safety and health protection and to ensure compliance with statutory regulations. The recommendations of the lubricant manufacturer and the specifications given in the safety data sheet are to be observed when using hydraulic fluid.

This data sheet does not absolve the operator from verifying the conformity and suitability of the respective hydraulic fluid for his system. He is to ensure that the selected fluid meets the minimum requirements of the relevant hydraulic fluid standard during the whole of the period of use.

The currently valid standard for fire-resistant hydraulic fluids is the ISO 12922. In addition, other, more detailed documents, guidelines, specifications and legislation may also be valid. The operator is responsible for ensuring that such regulations are observed, for example:

– 7th Luxembourg Report: Luxembourg, April 1994, Doc. No. 4746/10/91 EN "Requirements and tests applicable to fire-resistant hydraulic fluids for hydrostatic and hydrokinetic power transmission and control"
– VDMA 24314 (1981-11): "Changing hydraulic fluids – guidelines"
– VDMA 24317 (2005-11): "Fire-resistant hydraulic fluids – minimum technical requirements"
– FM Approval Standard 6930 (2009-04): "Flammability Classification of Industrial Fluids" (only available in English)
– DIN Technical Report CEN/TR 14489 (2006-01): "Selection guidelines for protecting safety, health and the environment"

We recommend that you maintain constant, close contact with lubricant manufacturers to support you in the selection, maintenance, care and analyses.

When disposing of used hydraulic fluids, apply the same care as during use.

1.2 Fire resistance

There is no clear legal definition of fire-resistant hydraulic fluids. There are great differences regarding fire resistance. The selection is the sole responsibility of the system operator with respect to requirements (application, construction and design of the system, hottest source in the system, necessary fire protection).

Different test procedures are applied for evaluating fire resistance.

Fire resistance test procedure according to ISO 12922:

– Ignition properties of spray according to ISO 15029-1 (Spray flame persistence – hollow-cone nozzle method)
– Ignition properties of spray according to ISO 15029-2 (Stabilized flame heat release)
– Wick flame persistence of fluids according to ISO 14935 (average flame persistence)
– Determination of the flammability characteristics of fluids in contact with hot surfaces, ignition process according to ISO 20823 (ignition temperature, flame spread)

In general, fire-resistant hydraulic fluids are distinguished between **water-containing** fire-resistant and **water-free** fire-resistant hydraulic fluids. Water-containing fire-resistant hydraulic fluids are described in RE 90223.

Water-free, fire-resistant hydraulic fluid means hydraulic fluids with a water-proportion of 0.1% by volume ("Karl Fischer method", see chapter 6 "Glossary"), measured at the time of filling in the transport container.

In Europe water-free, fire-resistant hydraulic fluids are not approved for use in underground coal mining. The classification HFDU is no longer included in the VDMA 24317: 2005.

Note
In contrast to water-containing fluids, all water-free, fire-resistant hydraulic fluids have a flash point and a fire point. Specific parameters for flash point and fire point can be found in the technical and/or safety data sheet for the hydraulic fluid concerned.

Just as much care should be taken when working with fire-resistant hydraulic fluids are with other hydraulic fluids, e.g. mineral oils. A leak from the hydraulic system must be avoided. The best and most cost-effective protection against fire and explosion is to prevent leakage with meticulous service, maintenance and care of the hydraulic system.

1.3 Scope

This data sheet must be applied when using water-free, fire-resistant hydraulic fluids with Rexroth hydraulic components. The specifications of this data sheet may be further restricted by the specifications given in data sheets for the individual components concerned.

The use of the individual water-free, fire-resistant hydraulic fluids in accordance with the intended purpose can be found in the safety data sheets or other product description documents of the lubricant manufacturers. In addition, each use is to be individually considered.

Rexroth hydraulic components may only be operated with water-free, fire-resistant hydraulic fluids according to ISO 12922 if specified in the respective component data sheet or if a Rexroth approval for use is furnished.

The manufacturers of hydraulic systems must adjust their systems and operating instructions to the water-free, fire-resistant hydraulic fluids.

Bosch Rexroth will accept no liability for its components for any damage resulting from failure to comply with the notes below.

1.4 Safety instructions

Hydraulic fluids can constitute a risk for persons and the environment. These risks are described in the hydraulic fluid safety data sheets. The operator is to ensure that a current safety data sheet for the hydraulic fluid used is available and that the measures stipulated therein are complied with.

2 Solid particle contamination and cleanliness levels

Solid particle contamination is the major reason for faults occurring in hydraulic systems. It may lead to a number of effects in the hydraulic system. Firstly, single large solid particles may lead directly to a system malfunction, and secondly small particles cause continuous elevated wear.

For mineral oils, the cleanliness level of water-free, fire-resistant hydraulic fluids is given as a three-digit numerical code in accordance with ISO 4406. This numerical code denotes the number of particles present in a hydraulic fluid for a defined quantity. Moreover, foreign solid matter is not to exceed a mass of 50 mg/kg (gravimetric examination according to ISO 4405).

In general, compliance with a minimum cleanliness level of 20/18/15 in accordance with ISO 4406 or better is to be maintained in operation. Special servo valves demand improved cleanliness levels of at least 18/16/13. A reduction in cleanliness level by one level means half of the quantity of particles and thus greater cleanliness. Lower numbers in cleanliness levels should always be striven for and extend the service life of hydraulic components. The component with the highest cleanliness requirements determines the required cleanliness of the overall system. Please also observe the specifications in table 1: "Cleanliness levels according to ISO 4406" and in the respective data sheets of the various hydraulic components.

Hydraulic fluids frequently fail to meet these cleanliness requirements on delivery. Careful filtering is therefore required during operation and in particular, during filling in order to ensure the required cleanliness levels. Your lubricant manufacturer can tell you the cleanliness level of hydraulic fluids as delivered. To maintain the required cleanliness level over the operating period, you must use a reservoir breather filter. If the environment is humid, take appropriate measures, such as a breather filter with air drying or permanent off-line water separation.

Note: the specifications of the lubricant manufacturer relating to cleanliness levels are based on the time at which the container concerned is filled and not on the conditions during transport and storage.

Further information about contamination with solid matter and cleanliness levels can be found in brochure RE 08016.

Table 1: Cleanliness levels according to ISO 4406

Particles per 100 ml		Scale number
More than	Up to and including	
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64000	130,000	17
32000	64000	16
16000	32000	15
8000	16000	14
4000	8000	13
2000	4000	12
1000	2000	11
500	1000	10
250	500	9
130	250	8
64	130	7
32	64	6

20 / 18 / 15
$> 4\ \mu m$ $> 6\ \mu m$ $> 14\ \mu m$

3 Selection of the hydraulic fluid

Water-free, fire-resistant hydraulic fluids for Bosch Rexroth hydraulic components are assessed on the basis of their fulfillment of the minimum requirements of ISO 12922.

3.1 Selection criteria for the hydraulic fluid

The specified limit values for all components employed in the hydraulic system, for example viscosity and cleanliness level, must be observed with the hydraulic fluid used, taking into account the specified operating conditions.

Hydraulic fluid suitability depends, amongst others, on the following factors:

3.1.1 Viscosity

Viscosity is a basic property of hydraulic fluids. The permissible viscosity range of complete systems needs to be determined taking account of the permissible viscosity of all components and it is to be observed for each individual component.

The viscosity at operating temperature determines the response characteristics of closed control loops, stability and damping of systems, the efficiency factor and the degree of wear.

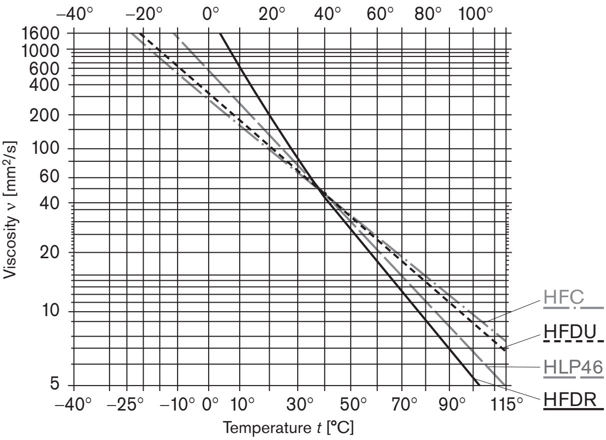
We recommend that the optimum operating viscosity range of each component be kept within the permissible temperature range. This usually requires either cooling or heating, or both. The permissible viscosity range and the necessary cleanliness level can be found in the product data sheet for the component concerned.

If the viscosity of a hydraulic fluid used is above the permitted operating viscosity, this will result in increased hydraulic-mechanical losses. In return, there will be lower internal leakage losses. If the pressure level is lower, lubrication gaps may not be filled up, which can lead to increased wear. For hydraulic pumps, the permitted suction pressure may not be reached, which may lead to cavitation damage.

If the viscosity of a hydraulic fluid is below the permitted operating viscosity, increased leakage, wear, susceptibility to contamination and a shorter component life cycle will result.

Please ensure that the permissible temperature and viscosity limits are observed for the respective components. This usually requires either cooling or heating, or both.

Fig. 1: Examples V-T diagrams for water-free, fire-resistant hydraulic fluids in comparison to HLP and HFC (reference values, double-logarithmic representation)



Typical viscosity data [mm²/s] at temperature	0 °C	40 °C	100 °C
HFDR	2500	43	5,3
HFDU (ester base)	330	46	9,2
HFDU (glycol base)	350	46	8,7
For comparison HLP (see RE 90220)	610	46	7
For comparison HFC (see RE 90223)	280	46	

Detailed V-T diagrams may be obtained from your lubricant manufacturer for their specific products. Descriptions of the individual classifications can be found in chapter 3.2 and in Table 4.

3.1.2 Viscosity-temperature behavior

For hydraulic fluids, the viscosity temperature behavior (V-T behavior) is of particular importance. Viscosity is characterized in that it drops when the temperature increases and rises when the temperature drops. The interrelation between viscosity and temperature is described by the viscosity index (VI).

For cold testing over a period of several days, the viscosity of ester-based HFDU can increase greatly. After heating, the characteristic values as specified on the data sheet are restored. Please ask your lubricant manufacturer for the "Flow capacity after seven days at low temperature" (ASTM D 2532) for the fluid classification ester-based HFDU .

HFDU fluid based on ester and glycol have better viscosity/temperature characteristics than mineral oil HLP (see Fig. 1). This should be taken into consideration when selecting hydraulic fluid for the required temperature range. The viscosity and temperature limits required in the product data sheets are to be observed in all operating conditions.

Note
For ambient temperatures below 0 °C, fire-resistant, **water-containing** hydraulic fluids of classification HFC are to be preferred because they observe the component-related viscosity ranges and because the have better pour points (see RE 90223).

3.1.3 Wear protection capability

Wear protection capability describes the property of hydraulic fluids to prevent or minimize wear within the components. The wear protection capability is described in ISO 12922 via test procedures"FZG gear test rig" (ISO 14635-1) and "Mechanical test in the vane pump" (ISO 20763). The wear protection capability of water-free, fire-resistant hydraulic fluids in relation to the two test procedures is comparable to that of mineral oil HLP/HVLP.

3.1.4 Material compatibility

The hydraulic fluid must not negatively affect the materials used in the components. Compatibility with coatings, seals, hoses, metals and plastics is to be observed in particular. The fluid classifications specified in the respective component data sheets are tested by the manufacturer with regard to material compatibility. Parts and components not supplied by us are to be checked by the user.

Table 2: Known material incompatibilities

Classification	Incompatible with:
HFD in general	Seals, plastics and coatings of control cabinets, outer coatings of hydraulic components and accessory components (connectors, wiring harnesses, control cabinets) are to be tested for stability. **Note:** hydraulic fluid vapors can also lead to incompatibility!
HFDR	Individual component color coating, lead, galvanic zinc-plating, in part non-ferrous metals with zinc, tin and aluminum in a tribological system. Sealing elements made of NBR. In some cases, the latter show major increases in volume when impermissibly aged hydraulic fluids come into contact with the material. Do not use any hydrolysis/susceptible polyurethane qualities.
HFDU based on ester	Single-component color coatings, lead, galvanized zinc coatings, in part non-ferrous metals with zinc, tin, seals made of NBR. In some cases, the latter show major increases in volume when impermissibly aged hydraulic fluids come into contact with the material. Do not use any hydrolysis/susceptible polyurethane qualities.
HFDU based on glycol	Single-component color coatings, steel/aluminum tribocontacts, paper filters, polymethylmethacrylate (PMMA). The compatibility of NBR is to be examined for individual case.

The material incompatibilities mentioned here do not automatically result in function problems. However the elements of the materials are found in the hydraulic fluids after use. The material incompatibilities described here may lead to accelerated aging of the hydraulic fluid and to reduced fire resistance.

3.1.5 Aging resistance

The way a water-free, fire-resistant hydraulic fluid ages depends on the thermal, chemical and mechanical stress to which it is subjected. The influence of water, air, temperature and contamination may be significantly greater than for mineral oils HLP/HVLP. Aging resistance can be greatly influenced by the chemical composition of the hydraulic fluids.

High fluid temperatures (e.g. over 80 °C) result in a approximate halving of the fluid service life for every 10 °C temperature increase and should therefore by avoided. The halving of the fluid service life results from the application of the Arrhenius equation (see Glossary).

Table 3: Reference values for temperature-dependent aging of the hydraulic fluid

Reservoir temperature	Fluid life cycle
80 °C	100 %
90 °C	50 %
100 °C	25 %

A modified aging test (ISO 4263-3 or ASTM D943 – without the addition of water) is specified for fluid classification HFDU. Fluid classification HFDR is described with a special procedure with respect to oxidation stability (EN 14832) and oxidation service life (ISO 4263-3). The calculated fluid service life is derived from the results of tests in which the long-term characteristics are simulated in a short period of time by applying more arduous conditions (condensed testing). This calculated fluid service life is not to be equated to the fluid service life in real-life applications.

Table 3 is a practical indicator for hydraulic fluids with water content < 0.1%, cf. chapter 4.10. "Water".

3.1.6 Environmentally acceptable

HFDU fluids based on ester and glycol are hydraulic fluids which may also be classified as environmentally acceptable. The main criteria for fire-resistant, water-free hydraulic fluids are the leak-free, technically problem-free use and the necessary fire resistance. Environmentally acceptable is merely a supplementary criterion. Notes on environmentally compatible hydraulic fluids can be found in RE 90221.

3.1.7 Air separation ability (ASA)

The air separation ability (ASA) describes the property of a hydraulic fluid to separate undissolved air. Hydraulic fluids always contain dissolved air. During operation, dissolved air may be transformed into undissolved air, leading to cavitation damages. Fluid classification, fluid product, reservoir size and design must be coordinated to take into account the dwell time and ASA value of the hydraulic fluid. The air separation capacity depends on the viscosity, temperature, basic fluid and aging. It cannot be improved by additives.

According to ISO 12922 for instance, an ASA value ≤ 15 minutes is required for viscosity class ISO VG 46, practical values on delivery are < 10 minutes, lower values are preferable.

3.1.8 Demulsifying ability and water solubility

The capacity of a hydraulic fluid to separate water at a defined temperature is known as the demulsifying ability. ISO 6614 defines the demulsifying properties of hydraulic fluids.

The fluid classifications HFDU based on ester and HFDR separate water, but HFD hydraulic fluids have a different water separation ability to mineral oil HLP/HVLP. At 20 °C, in comparison to mineral oil HLP/HVLP, a multiple (> factor 3) of water can separate in the hydraulic fluid. Water solubility is also more temperature-dependent than for mineral oils. The fluid classification HFDU based on glycol usually dissolves water completely, see chapter "4.10 Water".

3.1.9 Filterability

Filterability describes the ability of a hydraulic fluid to pass through a filter, removing solid contaminants. The hydraulic fluids used require a good filterability, not just when new, but also during the whole of their service life. This can differ greatly depending on the different basic fluids (glycols, esters) and additives (VI enhancers, anti-fogging additives).

The filterability is a basic prerequisite for cleanliness, servicing and filtration of hydraulic fluids. Rexroth therefore requires the same degree of filterability of water-free, fire-resistant hydraulic fluids as for mineral oils HLP/HVLP to DIN 51524.
As ISO 12922 does not comment on the filterability of hydraulic fluids, filterability comparable to that of mineral oils HLP/HVLP must be requested of lubricant manufacturers.

Filterability is tested with the new hydraulic fluid and after the addition of 0.2 % water. The underlying standard (ISO 13357-1/-2) stipulates that filterability must have no negative effects on the filters or the hydraulic fluid, see chapter 4 "Hydraulic fluids in operation".

3.1.10 Corrosion protection

Hydraulic fluids should not just prevent corrosion formation on steel components, they must also be compatible with non-ferrous metals and alloys. Corrosion protection tests on different metals and metal alloys are described in ISO 12922.

Rexroth components are usually tested with HLP hydraulic fluids or corrosion protection oils based on mineral oils before they are delivered.

3.1.11 Additivation

The properties described above can be modified with the help of suitable additives.
Bosch Rexroth does not prescribe any specific additive system.

3.2 Classification and fields of application

Table 4: Classification and fields of application

Classification	Features	Typical field of application	Notes
HFDU (glycol-based) according to ISO 12922 Density at 15 °C: typically > 0.97 kg/dm³ VI: typical > 170 The classification "HFDU" is no longer listed in the current standard sheet VDMA 24317.	Base fluid: Glycols	Mobile systems with high thermal loading	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Very good viscosity/temperature characteristics, shear stability – Resistant to aging – Can be water-soluble – Can be mixed with water – Very good wear protection properties – A higher implementation temperature with the same viscosity in comparison to mineral oil is to be expected – Due to the higher density in comparison to HLP, lower suction pressures are to be anticipated for pumps. Reduce the maximum speed as required and optimize suction conditions. – Prior to commissioning, contact the lubricant manufacturer, as the components are tested with mineral oil HLP/corrosion protection oil. – Incompatible with mineral oil (exceptions must be confirmed by the lubricant manufacturer).
HFDU (ester-based) according to ISO 12922 Density at 15 °C: typically 0.90-0.93 kg/dm³ VI: typical > 160 Iodine count < 90 The classification "HFDU" is no longer listed in the current standard sheet VDMA 24317.	Base fluid: Ester based on regenerative raw materials, synthetic ester and mixtures of different esters Because of the fire resistance, HFDU hydraulic fluids based on ester are usually partially saturated esters	Suitable for most fields of application and components.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Preferred use of FKM seals. Please enquire about shaft seal rings and implementation temperatures under −15 °C. – Note shear stability (see chapter 4.11 "Fluid servicing, fluid analysis and filtration" and chapter 6 "Glossary") – Fire resistance is not stable over time – In operation, a higher temperature in comparison to mineral oil HLP/HVLP is to be expected given identical design and viscosity. Please check ATEX approvals for hydraulic components. – Limit the lower (see chapter 3.1.2) and upper implementation temperatures (see chapter 3.1.5) – Good viscosity-temperature behavior – Usually classified as insignificantly water-endangering (water hazard class WGK 1) – High dirt dissolving capacity on fluid changeovers – In unfavorable operating conditions (high water content, high temperature), HFDU on ester basis have a tendency to hydrolysis. The acidic organic decomposition products can chemically attack materials and components.

Classification	Features	Typical field of application	Notes
HFDR according to ISO 12922 Density at 15 °C: typically 1.1 kg/dm³ VI : typical 140–160	Base fluid: phosphoric acid ester	Turbine control systems	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Classified as hazardous materials (for transportation and storage) – Hazardous working material – Water-endangering (Water hazard class 2 – WGK2) – Develops toxic vapors in case of fire – Preferred use of FKM, and possibly PTFE seals. Please enquire for shaft seal rings and implementation temperatures under −15 °C. – In operation, a higher temperature in comparison to mineral oil HLP/HVLP is to be expected given identical design and viscosity – Phosphoric acid esters display a tendency to hydrolysis when they come into contact with moisture. Under the influence of water/moisture, they become unstable or form highly aggressive, acidic components which could damage the hydraulic fluid and component beyond repair. – Poor viscosity/temperature characteristics – Due to the higher density in comparison to HLP, lower suction pressures are to be anticipated for pumps. Reduce the maximum speed as required and optimize suction conditions. – In unfavorable operating conditions (high water content, high temperature), HFDR have a tendency to hydrolysis. The acidic inorganic decomposition products chemically attack materials and components.
HFDU (continued)	Based on triglycerides, mineral oils or related hydrocarbons	Not recommended for Rexroth components!	Hydraulic fluids based on polyalphaolefines are not recommended on account of their poor fire resistance. This classification can usually be identified from: density < 0.89; VI $<$ 140 to 160 Hydraulic fluids based on triglycerides are not recommended on account of their aging resistance. This classification can usually be identified from: density > 0.92; VI > 190; iodine count > 90 Consult your lubricant manufacturer or your Bosch Rexroth sales partner if the classification of a hydraulic fluid is not clear.
HFDS HFDT	Based on halogenated hydrocarbons or mixtures with halogenated hydrocarbons	Not approved for Rexroth components!	HFDS and HFDT have not been permitted to be manufactured or used since 1989 for environmental reasons.

4 Hydraulic fluids in operation

4.1 General

The properties of hydraulic fluids can change continually during storage and operation.

Please note that the fluid standard ISO 12922 merely describes minimum requirements for hydraulic fluids in new condition at the time of filling into the bins. The operator of a hydraulic system must ensure that the hydraulic fluid remains in a utilizable condition throughout its entire period of use.

Deviations from the characteristic values are to be clarified with the lubricant manufacturer, the test labs or Bosch Rexroth.

Bosch Rexroth will accept no liability for damage to its components within the framework of the applicable liability legislation insofar as the latter is due to non-observance of the following instructions.

Please note the following aspects in operation.

4.2 Storage and handling

Hydraulic fluids must be stored correctly in accordance with the instructions of the lubricant manufacturer. Avoid exposing the containers to lengthy periods of direct heat. Containers are to be stored in such a way that the risk of any foreign liquid or solid matter (e.g. water, foreign fluids or dust) ingression into the inside of the container can be ruled out. After taking hydraulic fluids from the containers, these are immediately to be properly resealed.

Recommendation:

- Store containers in a dry, roofed place
- Store barrels on their sides
- Clean reservoir systems and machine reservoirs regularly

4.3 Filling of new systems

Usually, the cleanliness levels of the hydraulic fluids as delivered do not meet the requirements of our components. Hydraulic fluids must be filtered using an appropriate filter system to minimize solid particle contamination and water in the system.

As early as possible during test operation, new systems should be filled with the selected hydraulic fluid so as to reduce the risk of accidentally mixing fluids (see chapter 4.5 "Mixing and compatibility of different hydraulic fluids"). Changing the hydraulic medium at a later point represents significant additional costs (see following chapter).

4.4 Hydraulic fluid changeover

Problems may be encountered in particular when changing over from water-containing, fire-resistant hydraulic fluid or mineral oils to water-free, fire-resistant hydraulic fluids (e.g. incompatibilities in the form of gelling, silting, stable foam, reduced filterability or filter blockage). This may also happen when changing products within the same classification.

In the case of changeovers of the fluid in hydraulic systems, it is important to ensure compatibility of the new hydraulic fluid with the remains of the previous hydraulic fluid. Bosch Rexroth recommends obtaining verification of compatibility from the manufacturer or supplier of the new hydraulic fluid. The quantity of old fluid remaining should be minimized. Mixing hydraulic fluids should be avoided, see following chapter.

Information about changing to a hydraulic fluid of a different classification can be found, for example, in VDMA 24314 and in ISO 7745. In addition, the information given in chapter 3.1.4 "Material compatibility" is also to be observed.

Bosch Rexroth will not accept liability for any damage to its components resulting from inadequate hydraulic fluid changeovers!

4.5 Mixing and compatibility of different hydraulic fluids

If hydraulic fluids from different manufacturers or different types from the same manufacturer are mixed, gelling, silting and deposits may occur. These, in turn, may cause foaming, impaired air separation ability, malfunctions and damage to the hydraulic system.

If the fluid contains more than 2 % of another fluid then it is considered to be a mixture. Exceptions apply for water, see chapter 4.10 "Water".

Mixing with other hydraulic fluids is not generally permitted. This includes hydraulic fluids with the same classification. If individual lubricant manufacturers advertise miscibility and/or compatibility, this is entirely the responsibility of the lubricant manufacturer.

Bosch Rexroth customarily tests all components with mineral oil HLP before they are delivered.

Note: With connectible accessory units and mobile filtering systems, there is a considerable risk of non-permitted mixing of the hydraulic fluids!

Rexroth will not accept liability for any damage to its components resulting from mixing hydraulic fluids!

4.6 Re-additivation

Additives added at a later point in time such as colors, wear reducers, VI enhancers or anti-foam additives, may negatively affect the performance properties of the hydraulic fluid and the compatibility with our components and therefore are not permissible.

Rexroth will not accept liability for any damage to its components resulting from re-additivation!

4.7 Foaming behavior

Foam is created by rising air bubbles at the surface of hydraulic fluids in the reservoir. Foam that develops should collapse as quickly as possible.

Common hydraulic fluids in accordance with ISO 12922 are sufficiently inhibited against foam formation in new condition. On account of aging and adsorption onto surfaces, the defoamer concentration may decrease over time, leading to a stable foam.

Defoamers may be re-dosed only after consultation with the lubricant manufacturer and with his written approval.

Defoamers may affect the air separation ability.

1

4.8 Corrosion

The hydraulic fluid is to guarantee sufficient corrosion protection of components under all operating conditions, even in the event of impermissible water contamination.

Water-free, fire-resistant hydraulic fluids are tested for corrosion protection in the same way as mineral oil HLP/HVLP. When used in practice other corrosion mechanisms are revealed in detail and in individual cases, for the most part in contact with non-ferrous and white alloys.

4.9 Air

Under atmospheric conditions the hydraulic fluid contains dissolved air. In the negative pressure range, for instance in the suction pipe of the pump or downstream of control edges, this dissolved air may transform into undissolved air. The undissolved air content represents a risk of cavitation and of the diesel effect. This results in material erosion of components and increased hydraulic fluid aging.

With the correct measures, such as suction pipe and reservoir design, and an appropriate hydraulic fluid, air intake and separation can be positively influenced.

See also chapter 3.1.7 "Air separation ability (ASA)".

4.10 Water

Water contamination in hydraulic fluids can result from direct ingress or indirectly through condensation of water from the air due to temperature variations.

HFDU hydraulic fluids on glycol basis are water-soluble or can be mixed with water. This means that any water that has ingressed into the system cannot be drained off in the sump of the reservoir.

In the case of HDFU hydraulic fluids on ester basis, undissolved water can be drained off from the reservoir sump, the remaining water content is however too high to ensure that the maximum permissible water limit values are observed in the long term.

With the fluid classification HFDR, the greater density of the ester means that the any water that has ingressed will be on the surface of the hydraulic fluid. This means that any water that has ingressed into the system cannot be drained off in the sump of the reservoir.

Water in the hydraulic fluid can result in wear or direct failure of hydraulic components. Furthermore, a high water content in the hydraulic fluid negatively affects aging and filterability and increases susceptibility to cavitation. During operation, the water content in all hydraulic fluids, determined according to the "Karl Fischer method" (see chapter 6 "Glossary") for all water-free, fire-resistant hydraulic fluids must constantly be kept below 0.1% (1000 ppm). To ensure a long service life of both hydraulic fluids and components, Bosch Rexroth recommends that values below 0.05% (500 ppm) are permanently maintained.

Due to the higher water solubility in comparison to mineral oil HLP/HVLP it is urgently advised that precautions be taken when using water-free, fire-resistant hydraulic fluids, such as a dehumidifier on the reservoir ventilation.

Water content has an affect particularly in the case of HEDU hydraulic fluid on ester basis and HFDR in that it accelerates aging (hydrolysis) of the hydraulic fluid and biological degradation, see chapter 4.11 "Fluid servicing, fluid analysis and filtration".

4.11 Fluid servicing, fluid analysis and filtration

Air, water, operating temperature influences and solid matter contamination will change the performance characteristics of hydraulic fluids and cause them to age.

To preserve the usage properties and ensure a long service life for hydraulic fluid and components, the monitoring of the fluid condition and a filtration adapted to the application requirements (draining and degassing if required) are indispensable.

The effort is higher in the case of unfavorable usage conditions, increased stress for the hydraulic system or high expectations as to availability and service life, see chapter 2 "Solid particle contamination and cleanliness levels".

When commissioning a system, please note that the required minimum cleanliness level can frequently be attained only by flushing the system. Due to severe start-up contamination, it may be possible that a fluid and/or filter replacement becomes necessary after a short operating period (< 50 operating hours).

The hydraulic fluid must be replaced at regular intervals and tested by the lubricant manufacturer or recognized accredited test labs. **We recommend a reference analysis after commissioning.**

The minimum data to be tested for analyses are:

- Viscosity at 40 °C and 100 °C
- Neutralization number NN (acid number AN)
- Water content (Karl-Fischer method)
- Particle measurement with evaluation according to ISO 4406 or mass of solid foreign substances with evaluation to EN 12662
- Element analysis (RFA (EDX) / ICP, specify test method)
- Comparison with new product or available trend analyses
- Assessment / evaluation for further use
- Also recommended: IR spectrum

No differences are needed in the maintenance and care of water-free, fire-resistant hydraulic fluids with the appropriate suitability parameters compared to HLP/HVLP mineral oils. Attention is however drawn to the note in chapter 1.3.

After changing over hydraulic fluids it is recommended that the filters be replaced again after 50 operating hours as fluid aging products may have detached themselves ("self-cleaning effect").

Compared to the pure unused hydraulic fluid the changed neutralization number NN (acid number AN) indicates how many aging products are contained in the hydraulic fluid. This difference must be kept as small as possible. The lubricant manufacturer should be contacted as soon as the trend analysis notes a significant increase in values.

A higher viscosity than that of new materials indicates that the hydraulic fluid has aged. Evaluation by the test lab or lubricant manufacturers is however authoritative, whose recommendation should be urgently observed.

On systems where the possibility of water contamination cannot be completely ruled out (also condensation), it should be ensured via the hydraulic system circuit that fluid aging products are not accumulating in individual areas of the hydraulic system, but are being removed from the system in a controlled manner via the filtration system. This should be ensured via suitable hydraulic circuits (e.g. flushing circuit) or system manufacturer's operating instructions/specifications.

In case of warranty, liability or guarantee claims to Bosch Rexroth, service verification and/or the results of fluid analyses are to be provided.

5 Disposal and environmental protection

All water-free, fire-resistant hydraulic fluids, are, like mineral oil-based hydraulic fluids, subject to special disposal obligations.

The respective lubricant manufacturers provide specifications on environmentally acceptable handling and storage. Please ensure that spilt or splashed fluids are absorbed with appropriate adsorbents or by a technique that prevents it contaminating water courses, the ground or sewerage systems.

It is also not permitted to mix fluids when disposing of hydraulic fluids. Regulations governing the handing of used oils stipulate that used oils are not to mixed with other products, e.g. substances containing halogen. Non-compliance will increase disposal costs. Comply with the national legal provisions concerning the disposal of the corresponding hydraulic fluid. Comply with the local safety data sheet of the lubricant manufacturer for the country concerned.

6 Glossary

Additivation
Additives are chemical substances added to the basic fluids to achieve or improve specific properties.

Aging
Hydraulic fluids age due to oxidation (see chapter 3.1.5 "Aging resistance"). Liquid and solid contamination acts as a catalyzer for aging, meaning that it needs to be minimized as far as possible by careful filtration. Please refer to Hydrolysis.

Arrhenius equation
The quantitative relation between reaction rate and temperature is described by an exponential function, the Arrhenius equation. This function is usually visualized within the typical temperature range of the hydraulic system. For a practical example, see chapter 3.1.5 "Aging resistance".

Basic fluids
In general, a hydraulic fluid is made up of a basic fluid, or base oil, and chemical substances, the so-called additives. The proportion of basic fluid is generally greater than 90%.

Diesel effect

If hydraulic fluid that contains air bubbles is compressed quickly, the bubbles are heated to such a degree that a self-ignition of the air-gas mix may occur. The resultant temperature increase may lead to seal damage and increased aging of the hydraulic fluid.

Partially saturated esters
In contrast to saturated esters, partially saturated esters have double/multiple bonds between C atoms. Rexroth defines partially saturated esters as unsaturated bonds and mixtures of esters with unsaturated and saturated bonds. Esters with unsaturated bonds are produced on the basis of renewable raw materials.

Depending on their number and position, these unsaturated bonds between the C atoms are instable. These bonds can detach themselves and form new bonds, thus changing the properties of those liquids (an aging mechanism). Attention is however drawn to the note in chapter 1.3.

Hydrolysis
Hydrolysis is the splitting of a chemical bond through the reaction with water under the influence of temperature.

ICP (atomic emission spectroscopy)
The ICP procedure can be used to determine various wear metals, contamination types and additives. Practically all elements in the periodic system can be detected with this method.

Iodine count
The iodine count is a yardstick for the quantity of single and multiple unsaturated bonds between C atoms in the basic fluid. A low iodine count indicates that the hydraulic fluid contains few unsaturated bonds and is thus considerably more resistant to aging than a hydraulic fluid with a high iodine count. A statement about the position at which these multiple bonds are located and about how "stable" they are against influencing factors cannot be derived simply by stating the iodine count.

Karl Fischer method
Method to determine the water content in fluids. Indirect coulometric determination procedure in accordance with DIN EN ISO 12937 in connection with DIN 51777-2. Only the combination of both standards will assure adequately accurate measured values. For hydraulic fluids based on glycol, DIN EN ISO 12937 is to be applied in conjunction with DIN 51777-1.

Cavitation
Cavitation is the creation of cavities in fluids due to pressure reduction below the saturated vapour pressure and subsequent implosion when the pressure increases. When the cavities implode, extremely high acceleration, temperatures and pressure may occur temporarily, which may damage the component surfaces.

Neutralization number (NN)
The neutralization number (NN) or acid number (AN) specifies the amount of caustic potash required to neutralize the acid contained in one gram of fluid.

Pour point
The lowest temperature at which the fluid still just flows when cooled down under set conditions. The pour point is specified in the lubricant manufacturers' technical data sheets as a reference value for achieving this flow limit.

RFA (wavelength dispersive x-ray fluorescence analysis)
Is a procedure to determine nearly all elements in liquid and solid samples with nearly any composition. This analysis method is suitable for examining additives and contamination, delivering fast results.

Shearing/shear loss
Shearing of molecule chains during operation can change the viscosity of hydraulic fluids with long chain VI enhancers and anti-fogging additives. The initially high viscosity index drops. This needs to be taken into account when selecting the hydraulic fluid.

The only value at present that can be used to assess viscosity changes in operation is the result of the test in accordance with DIN 51350 part -6. Please note that there are practical applications that create a much higher shear load on such hydraulic fluids than can be achieved by this test.

Viscosity
Viscosity is the measure of the internal friction of a fluid to flow. It is defined as the property of a substance to flow under tension. Viscosity is the most important characteristic for describing the load-bearing capacity of a hydraulic fluid.

Kinematic viscosity is the ratio of the dynamic viscosity and the density of the fluid; the unit is mm^2/s. Hydraulic fluids are classified by their kinematic viscosity into ISO viscosity classes. The reference temperature for this is 40 °C.

Viscosity index (VI)
Refers to the viscosity temperature behavior of a fluid. The lower the change of viscosity in relation the temperature, the higher the VI.

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The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification.

It must be remembered that our products are subject to a natural process of wear and aging.

Subject to change.

Cylinders

Designation	Type	Piston-Ø in mm	Series	Nominal pressure in bar	Data sheet	Page
Mill type cylinders						
Hydraulic cylinders for potentially explosive atmospheres	CDH2...X. / CGH2...X	40 ... 320	1X	250	17334-X	137

Hydraulic cylinders for potentially explosive atmospheres

RE 17334-X/07.12
Replaces: 10.07

Series CDH2...X. / CGH2...X.

Component series 1X
Nominal pressure 250 bar (25 MPa)

H4652_d

Overview of contents

Features

- Standards: DIN 24333, ISO 6022
- 6 mounting styles
- Piston Ø: 40 to 320 mm
- Piston rod Ø: 25 to 220 mm
- Stroke lengths up to 6 m

ATEX-components for potentially explosive atmospheres

What you have to know about the documentation for ATEX-Components.

The documentation for ATEX-Components are valid for Bosch Rexroth hydraulic cylinders in an explosion protected version and comprises of the following two parts to Material No. R901030440:

– Operating instructions 07100-B/03.11 for Hydraulic cylinders, Tie rod / mill type, Mill type for explosive areas
– Technical data sheet 17334-X

Further information concerning the correct use of hydraulic cylinders can be found in our publication „General product information for hydraulic products“ 07008.

Details regarding the explosion protection:

– Cylinders without position measuring system
  • Identification to RL 94/9/EG II 2G c T4
  • Identification to RL 94/9/EG II 2D c T135°C
  • Ambient temperature –20 °C ≤ Ta ≤ +80 °C
– Cylinders with position measuring system
  • Identification to RL 94/9/EG II 3G Ex e T4
  • Identification to RL 94/9/EG II 3D Ex tc T135°C
  • Ambient temperature –20 °C ≤ Ta ≤ +40 °C

Technical data (for applications outside these parameters, please consult us!)

Standards:
The installation dimensions of the cylinders and mounting styles meet the requirements of DIN 24333 and ISO 6022.

Nominal pressure: 250 bar
Static proof pressure: 375 bar
Higher operating pressures on request.

The specified operating pressures are only valid for applications with shock-free operation. If extreme loads occur, e.g. as happens in high sequence cycles, the fixings and piston rod thread connections need to be designed for durability (fatigue strength).

Installation: Optional

Pressure fluid / pressure fluid temperature range:
HL, HLP, HFD-R: –20 °C to +80 °C
HFA: +5 °C to +55 °C
Water glycole HFC on request

Viscosity range: 2.8 to 380 mm²/s

ISO cleanliness class
Maximum permissible degree of pressure fluid contamination is to ISO 4406 (c) class 20/18/15.

Stroke velocity: Up to 0.5 m/s (depending on the connection ports), higher stroke velocities on request

Bleed screw as standard: Secured against unscrewing

Undercoat: The hydraulic cylinders are, as standard, painted (colour tone gentian blue RAL 5010) with a max. thickness of 80 µm. Other colour tones on request.

Acceptance:
Each cylinder is tested to Bosch Rexroth standards and in agreement with ISO10100: 2001.

Safety notes:
For assembly, commissioning and maintenance cylinders, please take the operating guidelines stated in 07100-B into account!

Service and repair work may only be carried out by Bosch Rexroth AG and specifically trained personnel. No warranty claims will be accepted for damage resulting from assembly, maintenance and repair work not carried out by Bosch Rexroth AG.

Checklists for hydraulic cylinders:
Cylinders, the technical and/or operating data of which differ from the paramters given in the data sheet, can only be offered as special variants on request. For the preparation of offers, deviations of technical data and/or operating data must be described in the checklists for hydraulic cylinders (07200).

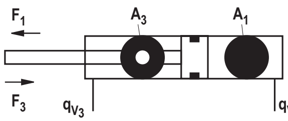
Diameter, weights

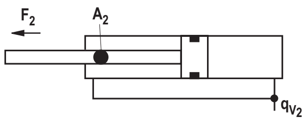
Piston	Piston rod	CD cylinder at 0 mm stroke length					Per 100 mm stroke length	CG cylinder at 0 mm stroke length			Per 100 mm stroke length
AL Ø mm	**MM** Ø mm	**MP3** 1) **MP5** 1) kg	**MP3** 2) **MP5** 2) kg	**MF3** **MF4** kg	**MT4** kg	**MS2** kg	kg	**MF3** kg	**MT4** kg	**MS2** kg	kg
40	**25/28**	7	12	9	9	9	0,9/1,0	10	10	10	1,3/1,5
50	**32/36**	12	19,5	14	13	13/14	1,3/1,5	16	16	16	1,9/2,3
63	**40/45**	20	29,5	21	21	21	2,3/2,6	25	25	25	3,3/3,8
80	**50/56**	32	42,5	35	34	35/36	3,2/3,6	41	40	41/42	4,7/5,5
100	**63/70**	51	64,5	54/55	54	55/56	5,2/5,7	63/64	63/64	64/65	7,6/8,8
125	**80/90**	95/96	114/115	96/97	99/100	98/99	8,2/9,2	113/115	115/117	114/116	12,1/14,2
140	**90/100**	131/132	157/158	132/133	136/137	137/138	10,7/11,9	155/156	158/160	159/161	15,7/18,1
160	**100/110**	185/186	220/221	184/186	197/199	206/207	12,6/13,9	217/220	231/233	239/242	18,8/21,4
180	**110/125**	255/258	303/304	253/256	264/267	274/277	14,7/16,8	294/300	305/311	314/320	22,1/26,5
200	**125/140**	349/352	405/406	332/335	350/353	363/366	19,0/21,5	359/365	377/383	389/396	28,6/33,5
220	**140/160**	527	625	512	546	518	27,1/30,9	604	638	610	39,1/46,7
250	**160/180**	673	795	640	677	650	32,7/36,9	761	798	772	48,5/56,9
280	**180/200**	976	1192	966	1020	918	44,2/48,8	1130	1183	1081	64,2/73,4
320	**200/220**	1251	1512	1172	1223	1174	55,2/60,4	1354	1405	1356	79,8/90,2

1) Weight without position measuring system
2) Weight with position measuring system

Areas, forces, flows

Piston	Piston rod	Area ratio	Areas Piston	Areas Rod	Areas Annulus	Force at 250 bar [1)] Pressure	Force at 250 bar [1)] Diff.	Force at 250 bar [1)] Pulling	Flow at 0,1 m/s [2)] Out	Flow at 0,1 m/s [2)] Diff.	Flow at 0,1 m/s [2)] In
AL Ø mm	**MM** Ø mm	φ A_1/A_3	A_1 cm^2	A_2 cm^2	A_3 cm^2	F_1 kN	F_2 kN	F_3 kN	q_{V1} l/min	q_{V2} l/min	q_{V3} l/min
40	**25** **28**	1,64 1,96	12,56	4,90 6,16	7,65 6,40	31,40	12,25 15,40	19,12 16,00	7,5	2,9 3,7	4,6 3,8
50	**32** **36**	1,69 2,08	19,63	8,04 10,18	11,59 9,45	49,10	20,12 25,45	28,98 23,65	11,8	4,8 6,1	7,0 5,7
63	**40** **45**	1,67 2,04	31,17	12,56 15,90	18,61 15,27	77,90	31,38 39,75	46,52 38,15	18,7	7,5 9,5	11,2 9,2
80	**50** **56**	1,66 1,96	50,26	19,63 24,63	30,63 25,63	125,65	49,07 61,55	76,58 64,10	30,2	11,8 14,8	18,4 15,4
100	**63** **70**	1,66 1,96	78,54	31,16 38,48	47,38 40,06	196,35	77,93 96,20	118,42 100,15	47,1	18,7 23,1	28,4 24,0
125	**80** **90**	1,69 2,08	122,72	50,24 63,62	72,48 59,10	306,75	125,62 159,05	181,13 147,70	73,6	30,14 38,2	43,46 35,4
140	**90** **100**	1,70 2,04	153,94	63,62 78,54	90,32 75,40	384,75	159,05 196,35	225,70 188,40	92,4	38,2 47,1	54,2 45,3
160	**100** **110**	1,64 1,90	201,06	78,54 95,06	122,50 106,00	502,50	196,35 237,65	306,15 264,85	120,6	47,1 57,0	73,5 63,6
180	**110** **125**	1,60 1,93	254,47	95,06 122,72	159,43 131,75	636,17	237,65 306,80	398,52 329,37	152,7	57,0 73,6	95,7 79,1
200	**125** **140**	1,64 1,96	314,16	122,72 153,96	191,44 160,20	785,25	306,80 384,90	478,45 400,35	188,5	73,6 92,4	114,9 96,1
220	**140** **160**	1,68 2,12	380,1	153,96 201,0	226,2 179,1	950,3	384,9 502,6	565,5 447,7	228,1	92,4 120,7	135,7 107,4
250	**160** **180**	1,69 2,08	490,8	201,0 254,4	289,8 236,4	1227,2	502,6 636,2	724,5 590,0	294,5	120,7 152,7	173,8 141,8
280	**180** **200**	1,70 2,04	615,7	254,4 314,1	361,3 301,6	1539,4	636,2 785,4	903,2 753,9	369,4	152,7 188,5	216,7 180,9
320	**200** **220**	1,64 1,90	804,2	314,1 380,1	490,1 424,2	2010,6	785,4 950,3	1225,2 1060,3	482,5	188,5 228,1	294,0 254,4





1) Theoretical force
(efficiency not taken into account)

2) Stroke velocity

Tolerances to ISO 6020-1

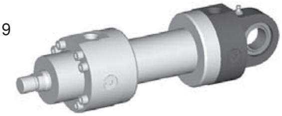
Installation dimensions	Y	PJ	WC	XC [2)]	XO [2)]	XS [1), 2)]	SS	XV [2)]	ZP [2)]	Stroke tolerances
Mounting style	all	all	MF3	MP3	MP5	MS2	MS2	MT4	MF4	
Stroke length	Tolerances									
≤ 1250	± 2	± 1,5	± 2	± 1,5	± 1,5	± 2	± 1,5	± 2	± 1,5	+ 2
> 1250 – ≤ 3150	± 4	± 3	± 4	± 3	± 3	± 4	± 3	± 4	± 3	+ 5
> 3150 – ≤ 8000	± 8	± 5	± 8	± 5	± 5	± 8	± 5	± 8	± 5	+ 8

1) Not standardised 2) Including the stroke length

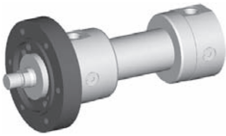
Mounting style overview

CDH2 MP3
See pages 6, 7

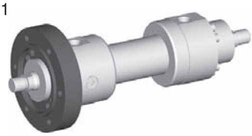
CDH2 MP5
See pages 8, 9



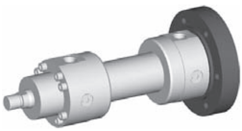
CDH2 MF3
siehe Seite 10, 11



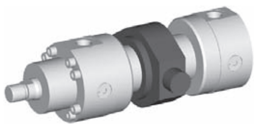
CGH2 MF3
See pages 10, 11



CDH2 MF4
See pages 12, 13

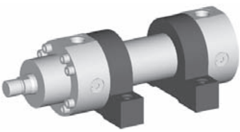


CDH2 MT4
See pages 14, 15

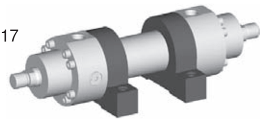


CGH2 MT4
See pages 14, 15

CDH2 MS2
See pages 16, 17



CGH2 MS2
See pages 16, 17



Ordering details

1) Only piston rod Ø 25 to 110 mm

2) Only piston rod Ø 25 to 140 mm

3) The trunnion can be located as required.
Dim. „XV" must always be stated in clear text in mm in case of an order.

4) Only piston Ø 40 to 200 mm

5) Only possible in conjuction with position measuring system „T“

6) Only piston Ø 63 to 200 mm

7) Only MF3; MT4; MS2; not standardised

8) Seal versions A, B is not possible
Piston rod version „H“ is not possible
End position damping possible from piston rod Ø 45 mm
CG version is not possible
Piston rod Ø 25 mm is not possible
Take the max. stroke lengths on page 21 into account

9) Only piston Ø 80 to 320 mm

10) Not possible for version MF4

11) Standard for seal versions M, T, S and piston Ø 220 to 320 mm
Not possible for seal versions A, B

12) For the CG version only one self-aligning clevis is fitted

13) For the CG version only one one rod end

14) Not standardised

15) Take the permissible stroke lengths on pages 32 to 34 into account

16) On request for cylinders with poisiton measuring system

Ordering details

	H2	/	/	/		1X/							

Differential cylinder = **CD**
Double rod cylinder 7) = **CG**

Series = **H2**

Mounting styles
Plain clevis at base 16) = **MP3**
Self-aligning clevis at base 16) = **MP5**
Round flange at head = **MF3**
Round flange at base = **MF4**
Trunnions 3) = **MT4**
Foot mounting 14) = **MS2**

Piston Ø (40 to 320 mm)
See page 2

Piston rod Ø (25 to 220 mm)
See page 2

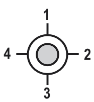
Stroke length in mm 15)

Protection type for the ATEX version
Design safety = **XC**
(for cylinders without position measuring system)
Increased safety = **XE**
(for cylinders with position measuring system)

Component series
10 to 19 unchanged installation and connection dimensions = **1X**

Connection ports/version
to ISO 1179-1 (Pipe thread 228/1) = **B**
to ISO 9974-1 (Metric thread ISO 261) = **M**
Flange porting pattern to ISO 6162-1 Tab.2 Type 1 (≙ SAE 3000 PSI) 6), 10) = **F**
Flange porting pattern to ISO 6162-2 Tab.2 Type 1 (≙ SAE 6000 PSI) 9), 10) = **D**
Flange porting pattern to ISO 6164 Tab.1 4), 10) = **K**
Flange porting pattern to ISO 6164 Tab.2 10) = **H**

Connection port/position at head and base = **1** = **2** = **3** = **4**



Viewed on the piston rod

Piston rod version
Hard chromium plated = **C**
Hardened and hard chromium plated 1) = **H**
Nickel plated and hard chromium plated 2) = **N**

Option 2
B = Flange grease nipple
C = 5) Analogue output 4-20 mA
F = 5), 16) Analogue output 0-10 V
Y = 13) Enter piston rod extention LY in clear text in mm
W = Without option

Option 1
A = Screwed coupling, both sides
F = 11) Guide rings
T = 8) Position measuring system (magnetostrictive) **without** plug-in connector Plug-in connector – separate order, see page 23
W = Without option

Seal version
Suitable for mineral oil HL, HLP and HFA
M = Standard seal system
T = Servo quality/reduced friction
A = Chevron seal kits
Suitable for phosphate ester HFD-R
S = Servo quality/reduced friction
B = Chevron seal kits

End position cushioning
U = Without
D = 4) Both sides, self-aligning clevis
E = Both sides, adjustable

Piston rod end
H = Thread for self-aligning clevis CGKD
F = 12) With mounted self-aligning clevis CGKD

2

Ordering examples:

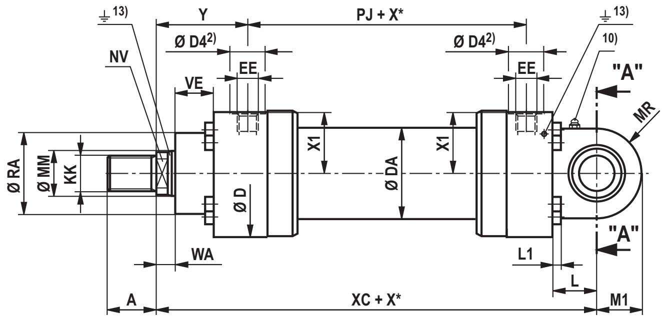
CDH2 MT4/63/45/350XC1X/B1CHDMWW, XV = 300 mm

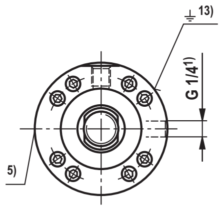
CDH2 MP5/80/56/500XC1X/B1CHDMWW

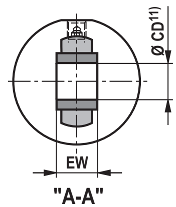
CGH2 MF3/100/70/500XC1X/B1CHUMWW

Plain clevis at base MP3

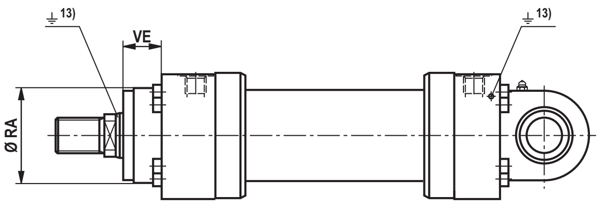
CDH2 MP3







CDH2 MP3: for seal versions „A", „B" and AL-Ø 160-320 mm



Dimensions MP3 (dimensions in mm)

AL Ø	MM Ø	KK	A	NV	D	DA	D4 2)	EE 4)	EE 4)	Y	PJ	X1	WA	XC
40 6)	**25/28**	M20x1,5	28	19/22	88	52	34	G1/2	M22x1,5	83	120	41	18	282
50	**32/36**	M27x2	36	27/30	102	62	34	G1/2	M22x1,5	98	120	48,5	18	305
63	**40/45**	M33x2	45	32/36	120	78	42	G3/4	M27x2	112	133	56,5	21	348
80	**50/56**	M42x2	56	41/46	145	95	42	G3/4	M27x2	120	155	69,5	24	395
100	**63/70**	M48x2	63	50/60	170	125	47	G1	M33x2	134	171	82	27	442
125	**80/90**	M64x3	85	65/75	206	150	47	G1	M33x2	153	205	100,5	31	520
140	**90/100**	M72x3	90	75/85	226	170	58	G1 1/4	M42x2	166	219	109,5	31	580
160	**100/110**	M80x3	95	85/95	265	190	58	G1 1/4	M42x2	185	235	129,5	35	617
180	**110/125**	M90x3	105	95/110	292	210	58	G1 1/4	M42x2	194	264	143,5	40	690
200	**125/140**	M100x3	112	110/120	306	235	58	G1 1/4	M42x2	220	278	150,5	40	756
220 6)	**140/160**	M125x4	125	120/140	355	270	65	G1 1/2	M48x2 3)	244	326	174	42	890
250	**160/180**	M125x4	125	140/160	395	305	65	G1 1/2	M48x2 3)	257	326	194	42	903
280 6)	**180/200**	M160x4	160	160/180	445	343	65	G1 1/2	M48x2 3)	290	375	220,5	48	1072
320	**200/220**	M160x4	160	180/200	490	394	65	G1 1/2	M48x2 3)	282	391	243	48	1080

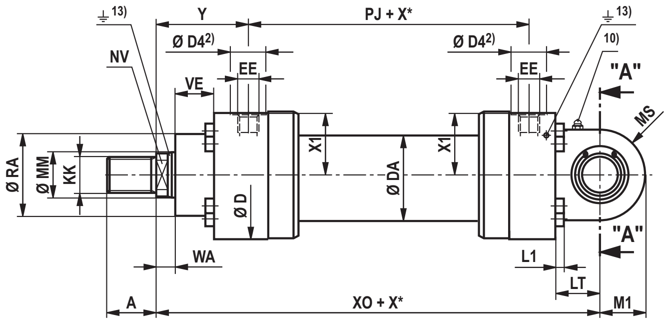
2

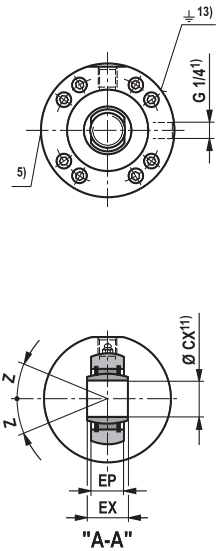
AL Ø	MM Ø	L	L1	MR	M1	CD H9	EW h12	RA 7)	VE 7)	RA 8)	VE 8)
40 6)	**25/28**	53	8	32	32	25	25	52	29	88	–
50	**32/36**	61	8	40	40	32	32	63	29	102	–
63	**40/45**	74	8	50	50	40	40	75	32	120	–
80	**50/56**	90	10	63	63	50	50	90	36	145	–
100	**63/70**	102	12	71	71	63	63	110	41	170	–
125	**80/90**	124	16	90	90	80	80	132	45	206	–
140	**90/100**	149	16	100	100	90	90	145	45	226	–
160	**100/110**	150	16	112	112	100	100	160	50	200	50
180	**110/125**	180	20	129	129	110	110	185	55	220	55
200	**125/140**	206	20	145	145	125	125	200	61	235	61
220 6)	**140/160**	253	20	179 12)	187 12)	160	160	235	71	270	71
250	**160/180**	253	24	179 12)	187 12)	160	160	250	71	300	71
280 6)	**180/200**	320	30	230 12)	240 12)	200	200	295	88	325	88
320	**200/220**	320	30	231 12)	241 12)	200	200	320	88	365	88

AL = Piston Ø
MM = Piston rod Ø
X* = Stroke length
1) Bleeding: When viewed on the piston rod, the orientation is always offset by 90° to the pipe connection (in a clockwise direction)
2) Ø D4 max. 0.5 mm deep
3) M50 x 2 available on request
4) For flange connections see separate table on pages 18 and 19
5) Throttle valve only with end position damping „E" (180° to the bleed point)
6) Piston Ø not standardised
7) Dimensions for cylinder with seal versions M, T and S
8) Dimensions for cylinder with seal versions A and B
10) Grease nipple; cone head form A to DIN 71412
11) Associated pin Ø f8
12) The specified dimensions are maximum values, tolerance classes 342 according to ISO 9013 Thermal cutting
13) For equipotential bonding, see page 25

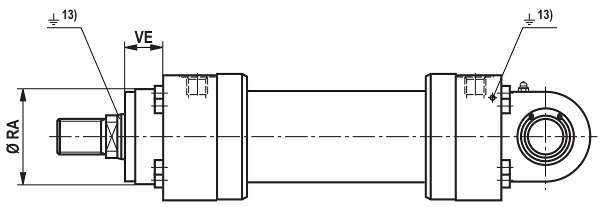
Self-aligning at base MP5

CDH2 MP5





CDH2 MP5: for seal versions „A”, „B” and AL-Ø 160-320 mm



Dimensions MP5 (dimensions in mm)

AL Ø	MM Ø	KK	A	NV	D	DA	D4 2)	EE 4)	EE 4)	Y	PJ	X1	WA	XO
40 6)	**25/28**	M20x1,5	28	19/22	88	52	34	G1/2	M22x1,5	83	120	41	18	282
50	**32/36**	M27x2	36	27/30	102	62	34	G1/2	M22x1,5	98	120	48,5	18	305
63	**40/45**	M33x2	45	32/36	120	78	42	G3/4	M27x2	112	133	56,5	21	348
80	**50/56**	M42x2	56	41/46	145	95	42	G3/4	M27x2	120	155	69,5	24	395
100	**63/70**	M48x2	63	50/60	170	125	47	G1	M33x2	134	171	82	27	442
125	**80/90**	M64x3	85	65/75	206	150	47	G1	M33x2	153	205	100,5	31	520
140	**90/100**	M72x3	90	75/85	226	170	58	G1 1/4	M42x2	166	219	109,5	31	580
160	**100/110**	M80x3	95	85/95	265	190	58	G1 1/4	M42x2	185	235	129,5	35	617
180	**110/125**	M90x3	105	95/110	292	210	58	G1 1/4	M42x2	194	264	143,5	40	690
200	**125/140**	M100x3	112	110/120	306	235	58	G1 1/4	M42x2	220	278	150,5	40	756
220 6)	**140/160**	M125x4	125	120/140	355	270	65	G1 1/2	M48x2 3)	244	326	174	42	890
250	**160/180**	M125x4	125	140/160	395	305	65	G1 1/2	M48x2 3)	257	326	194	42	903
280 6)	**180/200**	M160x4	160	160/180	445	343	65	G1 1/2	M48x2 3)	290	375	220,5	48	1072
320	**200/220**	M160x4	160	180/200	490	394	65	G1 1/2	M48x2 3)	282	391	243	48	1080

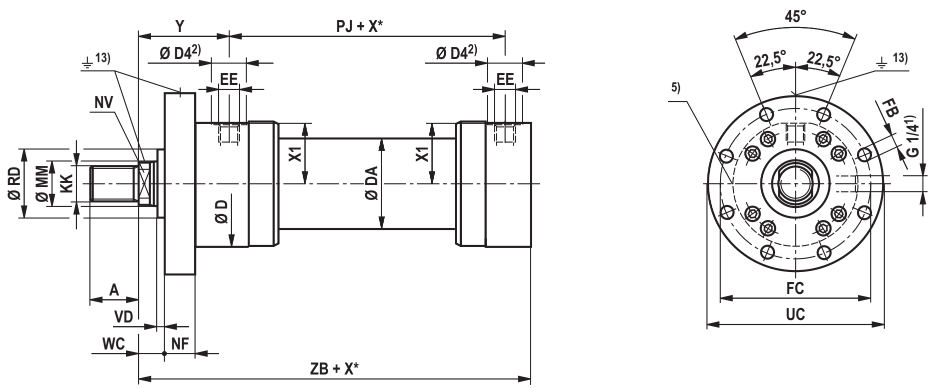
AL Ø	MM	LT	L1	MS	M1	CX 11) H7	EP	EX h12	RA 7)	VE 7)	RA 8)	VE 8)	Z
40 6)	**25/28**	53	8	32	32	25	22	25	52	29	88	–	2°
50	**32/36**	61	8	40	40	32	27	32	63	29	102	–	4°
63	**40/45**	74	8	50	50	40	32	40	75	32	120	–	4°
80	**50/56**	90	10	63	63	50	40	50	90	36	145	–	4°
100	**63/70**	102	12	71	71	63	52	63	110	41	170	–	4°
125	**80/90**	124	16	90	90	80	66	80	132	45	206	–	4°
140	**90/100**	149	16	100	100	90	72	90	145	45	226	–	4°
160	**100/110**	150	16	112	112	100	84	100	160	50	200	50	4°
180	**110/125**	180	20	129	129	110	88	110	185	55	220	55	4°
200	**125/140**	206	20	145	145	125	102	125	200	61	235	61	4°
220 6)	**140/160**	253	20	179 12)	187 12)	160	130	160	235	71	270	71	4°
250	**160/180**	253	24	179 12)	187 12)	160	130	160	250	71	300	71	4°
280 6)	**180/200**	320	30	230 12)	240 12)	200	138	200	295	88	325	88	4°
320	**200/220**	320	30	231 12)	241 12)	200	162	200	320	88	365	88	4°

AL = Piston Ø
MM = Piston rod Ø
X* = Stroke length

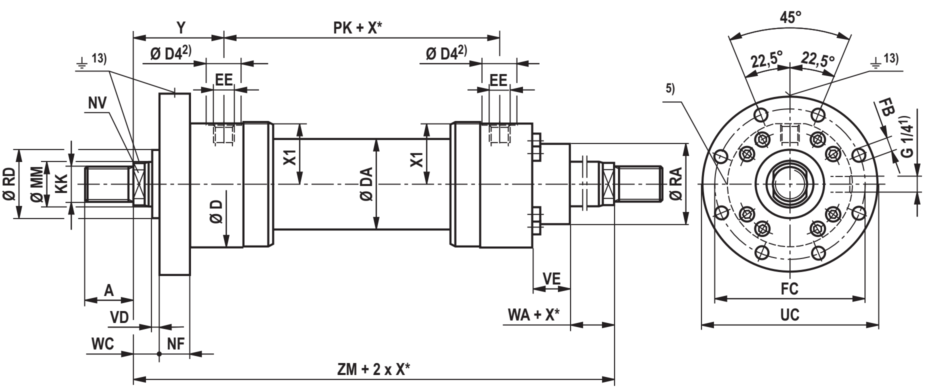
1) Bleeding: When viewed on the piston rod, the orientation is always offset by 90° to the pipe connection (in a clockwise direction)
2) Ø D4 max. 0.5 mm deep
3) M50 x 2 available on request
4) For flange connections see separate table on pages 18 and 19
5) Throttle valve only with end position damping „E“ (180° to the bleed point)
6) Piston Ø not standardised
7) Dimensions for cylinder with seal versions M, T and S
8) Dimensions for cylinder with seal versions A and B
10) Grease nipple; cone head form A to DIN 71412
11) Associated pin Ø m6
12) The specified dimensions are maximum values, tolerance classes 342 according to ISO 9013 Thermal cutting
13) For equipotential bonding, see page 25

Round flange at head MF3

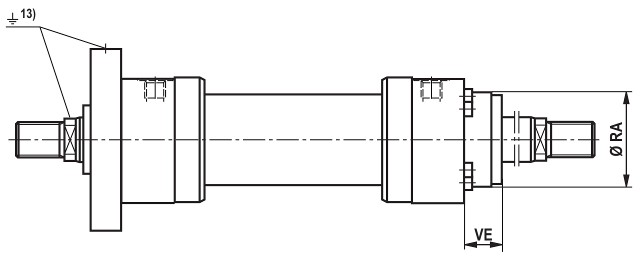
CDH2 MF3



CGH2 MF3 [10)]



CGH2 MF3 [10)]: for seal versions „A", „B" and AL-Ø 160 - 320 mm



Dimensions MF3 (dimensions in mm)

AL Ø	MM Ø	KK	A	NV	D	DA	D4 2)	EE 4)	EE 4)	Y	PJ	X1	WA
40 6)	**25/28**	M20x1,5	28	19/22	88	52	34	G1/2	M22x1,5	83	120	41	18
50	**32/36**	M27x2	36	27/30	102	62	34	G1/2	M22x1,5	98	120	48,5	18
63	**40/45**	M33x2	45	32/36	120	78	42	G3/4	M27x2	112	133	56,5	21
80	**50/56**	M42x2	56	41/46	145	95	42	G3/4	M27x2	120	155	69,5	24
100	**63/70**	M48x2	63	50/60	170	125	47	G1	M33x2	134	171	82	27
125	**80/90**	M64x3	85	65/75	206	150	47	G1	M33x2	153	205	100,5	31
140	**90/100**	M72x3	90	75/85	226	170	58	G1 1/4	M42x2	166	219	109,5	31
160	**100/110**	M80x3	95	85/95	265	190	58	G1 1/4	M42x2	185	235	129,5	35
180	**110/125**	M90x3	105	95/110	292	210	58	G1 1/4	M42x2	194	264	143,5	40
200	**125/140**	M100x3	112	110/120	306	235	58	G1 1/4	M42x2	220	278	150,5	40
220 6)	**140/160**	M125x4	125	120/140	355	270	65	G1 1/2	M48x2 3)	244	326	174	42
250	**160/180**	M125x4	125	140/160	395	305	65	G1 1/2	M48x2 3)	257	326	194	42
280 6)	**180/200**	M160x4	160	160/180	445	343	65	G1 1/2	M48x2 3)	290	375	220,5	48
320	**200/220**	M160x4	160	180/200	490	394	65	G1 1/2	M48x2 3)	282	391	243	48

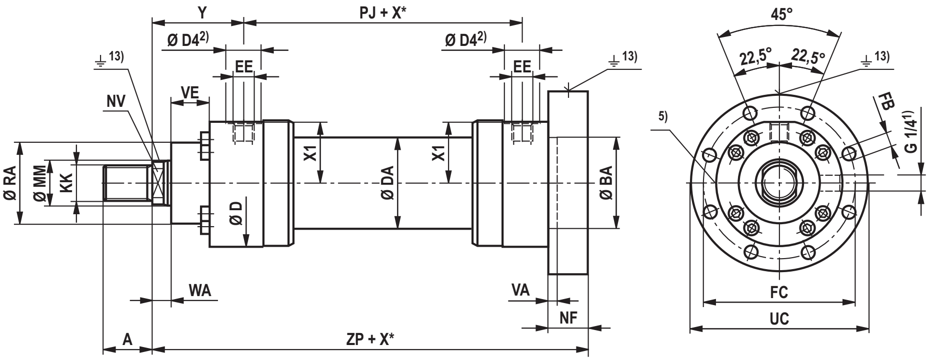
2

AL Ø	MM Ø	RD f8	WC	VD	NF js13	PK	ZB max.	ZM	FB H13	FC js13	UC Ø-1	RA 7)	VE 7)	RA 8)	VE 8)
40 6)	**25/28**	52	22	4	25	120	230	286	11	115	138	52	29	88	–
50	**32/36**	63	22	4	25	120	244	316	13,5	132	155	63	29	102	–
63	**40/45**	75	25	4	28	133	274	357	13,5	150	175	75	32	120	–
80	**50/56**	90	28	4	32	155	305	395	17,5	180	210	90	36	145	–
100	**63/70**	110	32	5	36	171	340	439	22	212	250	110	41	170	–
125	**80/90**	132	36	5	40	205	396	511	22	250	290	132	45	206	–
140	**90/100**	145	36	5	40	219	430	551	26	285	330	145	45	226	–
160	**100/110**	160	40	5	45	235	467	605	26	315	360	160	50	200	50
180	**110/125**	185	45	5	50	264	510	652	33	355	410	185	55	220	55
200	**125/140**	200	45	5	56	278	550	718	33	385	440	200	61	235	61
220 6)	**140/160**	235	50	8	63	326	637	814	39	435	500	235	71	270	71
250	**160/180**	250	50	8	63	326	650	840	39	475	540	250	71	300	71
280 6)	**180/200**	295	56	8	80	375	752	955	45	555	630	295	88	325	88
320	**200/220**	320	56	8	80	391	760	955	45	600	675	320	88	365	88

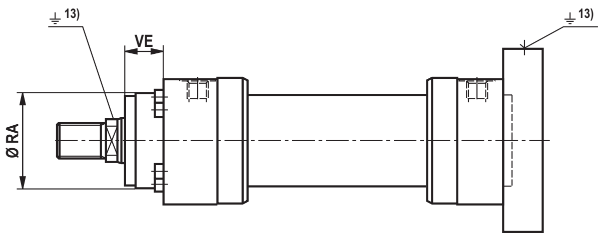
AL = Piston Ø
MM = Piston rod Ø
X* = Stroke length
1) Bleeding: When viewed on the piston rod, the orientation is always offset by 90° to the pipe connection (in a clockwise direction)
2) Ø D4 max. 0.5 mm deep
3) M50 x 2 available on request
4) For flange connections see separate table on pages 18 and 19
5) Throttle valve only with end position damping „E“ (180° to the bleed point)
6) Piston Ø not standardised
7) Dimensions for cylinder with seal versions M, T and S
8) Dimensions for cylinder with seal versions A and B
10) Grease nipple; cone head form A to DIN 71412
13) For equipotential bonding, see page 25

Round flange at base MF4

CDH2 MF4



CDH2 MF4: for seal versions „A", „B" and AL-Ø 160 - 320 mm



Dimensions MF4 (dimensions in mm)

AL Ø	MM Ø	KK	A	NV	D	DA	D4 2)	EE 4)	EE 4)	Y	PJ	X1	WA
40 6)	**25/28**	M20x1,5	28	19/22	88	52	34	G1/2	M22x1,5	83	120	41	18
50	**32/36**	M27x2	36	27/30	102	62	34	G1/2	M22x1,5	98	120	48,5	18
63	**40/45**	M33x2	45	32/36	120	78	42	G3/4	M27x2	112	133	56,5	21
80	**50/56**	M42x2	56	41/46	145	95	42	G3/4	M27x2	120	155	69,5	24
100	**63/70**	M48x2	63	50/60	170	125	47	G1	M33x2	134	171	82	27
125	**80/90**	M64x3	85	65/75	206	150	47	G1	M33x2	153	205	100,5	31
140	**90/100**	M72x3	90	75/85	226	170	58	G1 1/4	M42x2	166	219	109,5	31
160	**100/110**	M80x3	95	85/95	265	190	58	G1 1/4	M42x2	185	235	129,5	35
180	**110/125**	M90x3	105	95/110	292	210	58	G1 1/4	M42x2	194	264	143,5	40
200	**125/140**	M100x3	112	110/120	306	235	58	G1 1/4	M42x2	220	278	150,5	40
220 6)	**140/160**	M125x4	125	120/140	355	270	65	G1 1/2	M48x2 3)	244	326	174	42
250	**160/180**	M125x4	125	140/160	395	305	65	G1 1/2	M48x2 3)	257	326	194	42
280 6)	**180/200**	M160x4	160	160/180	445	343	65	G1 1/2	M48x2 3)	290	375	220,5	48
320	**200/220**	M160x4	160	180/200	490	394	65	G1 1/2	M48x2 3)	282	391	243	48

2

AL Ø	MM Ø	ZP	NF js13	VA	BA H8	FB H13	FC js13	UC Ø-1	RA 7)	VE 7)	RA 8)	VE 8)
40 6)	**25/28**	250	25	5	52	11	115	138	52	29	88	–
50	**32/36**	265	25	4	63	13,5	132	155	63	29	102	–
63	**40/45**	298	28	4	75	13,5	150	175	75	32	120	–
80	**50/56**	332	32	5	90	17,5	180	210	90	36	145	–
100	**63/70**	371	36	5	110	22	212	250	110	41	170	–
125	**80/90**	430	40	6	132	22	250	290	132	45	206	–
140	**90/100**	465	40	5	145	26	285	330	145	45	226	–
160	**100/110**	505	45	7	160	26	315	360	160	50	200	50
180	**110/125**	550	50	10	185	33	355	410	185	55	220	55
200	**125/140**	596	56	10	200	33	385	440	200	61	235	61
220 6)	**140/160**	690	63	10	235	39	435	500	235	71	270	71
250	**160/180**	703	63	10	250	39	475	540	250	71	300	71
280 6)	**180/200**	822	80	10	295	45	555	630	295	88	325	88
320	**200/220**	830	80	10	320	45	600	675	320	88	365	88

AL = Piston Ø
MM = Piston rod Ø
X* = Stroke length

1) Bleeding: When viewed on the piston rod, the orientation is always offset by 90° to the pipe connection (in a clockwise direction)

2) Ø D4 max. 0.5 mm deep

3) M50 x 2 available on request

4) For flange connections see separate table on pages 18 and 19

5) Throttle valve only with end position damping „E“ (180° to the bleed point)

6) Piston Ø not standardised

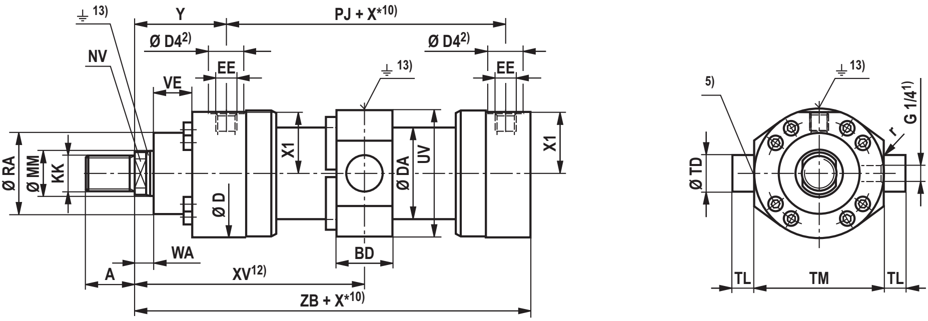
7) Dimensions for cylinder with seal versions M, T and S

8) Dimensions for cylinder with seal versions A and B

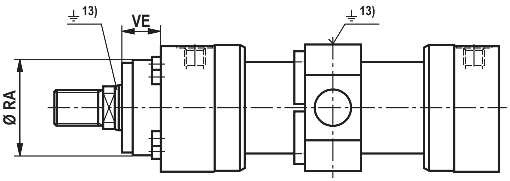
13) For equipotential bonding, see page 25

Trunnions MT4

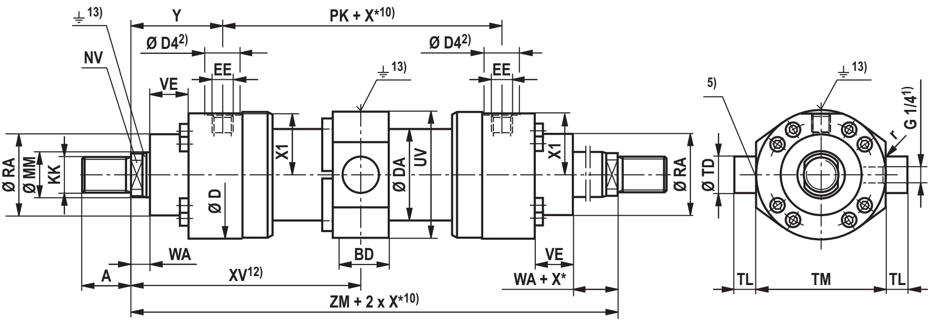
CDH2 MT4



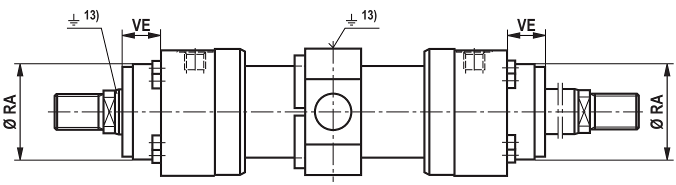
CDH2 MT4: for seal versions „A", „B" and AL-Ø 160-320 mm



CGH2 MT4 11)



CGH2 MT4 11): for seal versions „A", „B" and AL-Ø 160-320 mm



Dimensions MT4 (dimensions in mm)

AL Ø	MM Ø	KK	A	NV	D	DA	D4 2)	EE 4)	EE 4)	Y	PJ	X1	WA
40 6)	**25/28**	M20x1,5	28	19/22	88	52	34	G1/2	M22x1,5	83	120	41	18
50	**32/36**	M27x2	36	27/30	102	62	34	G1/2	M22x1,5	98	120	48,5	18
63	**40/45**	M33x2	45	32/36	120	78	42	G3/4	M27x2	112	133	56,5	21
80	**50/56**	M42x2	56	41/46	145	95	42	G3/4	M27x2	120	155	69,5	24
100	**63/70**	M48x2	63	50/60	170	125	47	G1	M33x2	134	171	82	27
125	**80/90**	M64x3	85	65/75	206	150	47	G1	M33x2	153	205	100,5	31
140	**90/100**	M72x3	90	75/85	226	170	58	G1 1/4	M42x2	166	219	109,5	31
160	**100/110**	M80x3	95	85/95	265	190	58	G1 1/4	M42x2	185	235	129,5	35
180	**110/125**	M90x3	105	95/110	292	210	58	G1 1/4	M42x2	194	264	143,5	40
200	**125/140**	M100x3	112	110/120	306	235	58	G1 1/4	M42x2	220	278	150,5	40
220 6)	**140/160**	M125x4	125	120/140	355	273	65	G1 1/2	M48x2 3)	244	326	174	42
250	**160/180**	M125x4	125	140/160	395	305	65	G1 1/2	M48x2 3)	257	326	194	42
280 6)	**180/200**	M160x4	160	160/180	445	343	65	G1 1/2	M48x2 3)	290	375	220,5	48
320	**200/220**	M160x4	160	180/200	490	394	65	G1 1/2	M48x2 3)	282	391	243	48

AL Ø	MM Ø	PK	ZB max.	ZM	X* min.	XV 14) mitt	XV 12) min.	XV 12) max.	BD	UV 15)	TD f8	TL js16	TM h12	r	RA 7)	VE 7)	RA 8)	VE 8)
40 6)	**25/28**	120	230	286	22	143+X*/2	154	140+X*	38	97	25	20	95	0,8	52	29	88	–
50	**32/36**	120	244	316	32	158+X*/2	174	151+X*	38	111	32	25	112	0,8	63	29	102	–
63	**40/45**	133	274	357	47	178,5+X*/2	202	167+X*	48	129	40	32	125	1	75	32	120	–
80	**50/56**	155	305	395	58	197,5+X*/2	226,5	180,5+X*	58	163	50	40	150	1	90	36	145	–
100	**63/70**	171	340	439	79	219,5+X*/2	259	195+X*	78	188	63	50	180	1,2	110	41	170	–
125	**80/90**	205	396	511	91	255,5+X*/2	301	225+X*	98	234	80	63	224	1,2	132	45	206	–
140	**90/100**	219	430	551	121	275,5+X*/2	336	230+X*	118	257	90	70	265	1,5	145	45	226	–
160	**100/110**	235	467	605	142	302,5+X*/2	373,5	251,5+X*	128	287	100	80	280	1,5	160	50	200	50
180	**110/125**	264	510	652	158	326+X*/2	405	267+X*	138	328	110	90	320	1,5	185	55	220	55
200	**125/140**	278	550	718	204	359+X*/2	461	277+X*	178	343	125	100	335	1,5	200	61	235	61
220 6)	**140/160**	326	637	814	200	407+X*/2	507	307+X*	180	393	160	125	385	1,5	235	71	270	71
250	**160/180**	326	650	840	210	420+X*/2	525	315+X*	180	433	160	125	425	1,5	250	71	300	71
280 6)	**180/200**	375	752	955	241	477,5+X*/2	598	357+X*	220	486	200	160	480	2	295	88	325	88
320	**200/220**	391	760	955	245	477,5+X*/2	600	355+X*	220	536	200	160	530	2	320	88	365	88

AL = Piston Ø
MM = Piston rod Ø
X* = Stroke length

1) Bleeding: When viewed on the piston rod, the orientation is always offset by 90° to the pipe connection (in a clockwise direction)

2) Ø D4 max. 0.5 mm deep

3) M50 x 2 available on request

4) For flange connections see separate table on pages 18 and 19

5) Throttle valve only with end position damping „E“ (180° to the bleed point)

6) Piston Ø not standardised

7) Dimensions for cylinder with seal versions M, T and S

8) Dimensions for cylinder with seal versions A and B

10) Take the minimum stroke length „X*min.“ into account

11) Double roded cylinders are not standardised

12) The trunnions can be located as required.
Dim. „XV“ must always be stated in clear text, in the case of an order, in mm.
Take „XVmin.“ and „XVmax.“ into account.

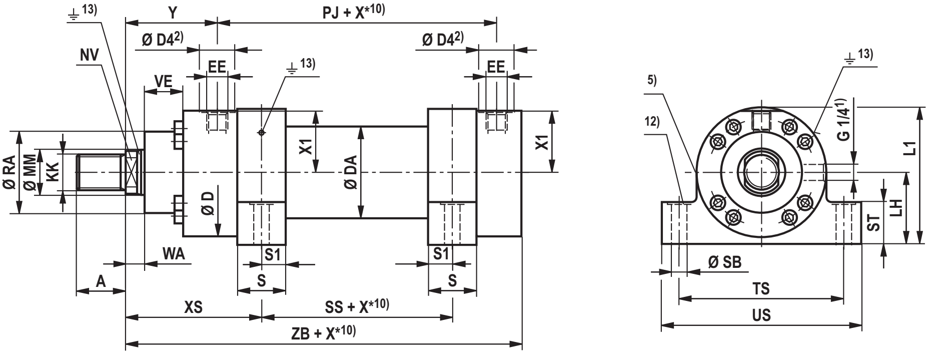
13) For equipotential bonding, see page 25

14) XVmid. recommendation:
The trunnions are located in the middle of the cylinder

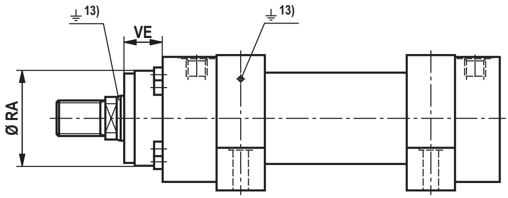
15) The specified dimensions are maximum values, tolerance classes 342 according to ISO 9013
Thermal cutting

Foot mounting MS2

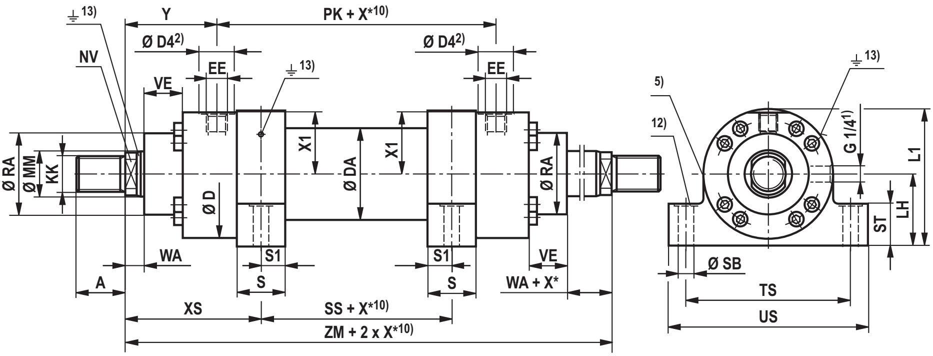
CDH2 MS2 2) 11)



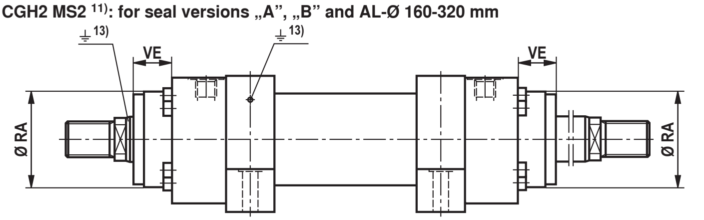
CDH2 MS2 11): for seal versions „A", „B" and AL-Ø 160-320 mm



CGH2 MS2 11)



CGH2 MS2 11): for seal versions „A", „B" and AL-Ø 160-320 mm



Dimensions MS2 (dimensions in mm)

AL Ø	MM Ø	KK	A	NV	D	DA	D4 2)	EE 4)	EE 4)	Y	PJ	X1	WA
40 6)	**25/28**	M20x1,5	28	19/22	88	52	34	G1/2	M22x1,5	83	120	41	18
50	**32/36**	M27x2	36	27/30	102	62	34	G1/2	M22x1,5	98	120	48,5	18
63	**40/45**	M33x2	45	32/36	120	78	42	G3/4	M27x2	112	133	56,5	21
80	**50/56**	M42x2	56	41/46	145	95	42	G3/4	M27x2	120	155	69,5	24
100	**63/70**	M48x2	63	50/60	170	125	47	G1	M33x2	134	171	82	27
125	**80/90**	M64x3	85	65/75	206	150	47	G1	M33x2	153	205	100,5	31
140	**90/100**	M72x3	90	75/85	226	170	58	G1 1/4	M42x2	166	219	109,5	31
160	**100/110**	M80x3	95	85/95	265	190	58	G1 1/4	M42x2	185	235	129,5	35
180	**110/125**	M90x3	105	95/110	292	210	58	G1 1/4	M42x2	194	264	143,5	40
200	**125/140**	M100x3	112	110/120	306	235	58	G1 1/4	M42x2	220	278	150,5	40
220 6)	**140/160**	M125x4	125	120/140	355	270	65	G1 1/2	M48x2 3)	244	326	174	42
250	**160/180**	M125x4	125	140/160	395	305	65	G1 1/2	M48x2 3)	257	326	194	42
280 6)	**180/200**	M160x4	160	160/180	445	343	65	G1 1/2	M48x2 3)	290	375	220,5	48
320	**200/220**	M160x4	160	180/200	490	394	65	G1 1/2	M48x2 3)	282	391	243	48

AL Ø	MM Ø	PK	XS	ZB max.	ZM	SS	X* 10) min.	S	S1	SB H13	ST	TS js13	US 14)	LH	L1	RA 7)	VE 7)	RA 8)	VE 8)
40 6)	**25/28**	120	118	230	286	50	1	30	15	11	32	110	140	45	89	52	29	88	–
50	**32/36**	120	135,5	244	316	45	1	35	17,5	11	37	130	161	55	106	63	29	102	–
63	**40/45**	133	154	274	357	49	1	40	20	13,5	42	150	183	65	125	75	32	120	–
80	**50/56**	155	171,5	305	395	52	2	50	25	17,5	47	180	220	75	147,5	90	36	145	–
100	**63/70**	171	189	340	439	61	3	60	30	22	57	210	260	90	175	110	41	170	–
125	**80/90**	205	218	396	511	75	1	70	35	26	67	255	313	105	208	132	45	206	–
140	**90/100**	219	240,5	430	551	70	19	85	42,5	30	72	290	359	115	228	145	45	226	–
160	**100/110**	235	270	467	605	65	44	105	52,5	33	77	330	402	135	267,5	160	50	200	50
180	**110/125**	264	291,5	510	652	69	50	115	57,5	40	92	360	445	150	296	185	55	220	55
200	**125/140**	278	322,5	550	718	73	56	125	62,5	40	97	385	471	160	313	200	61	235	61
220 6)	**140/160**	326	369,5	637	814	75	100	155	77,5	45	102	445	541	185	362,5	235	71	270	71
250	**160/180**	326	382,5	650	840	75	100	155	77,5	52	112	500	610	205	402,5	250	71	300	71
280 6)	**180/200**	375	415,5	752	955	124	51	155	77,5	52	142	550	661	235	457,5	295	88	325	88
320	**200/220**	391	435	760	955	85	125	190	95	62	142	610	732	255	500	320	88	365	88

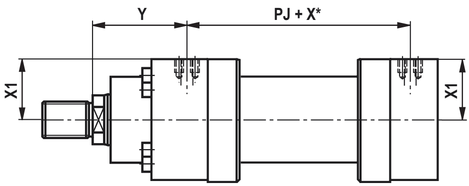
AL = Piston Ø
MM = Piston rod Ø
X* = Stroke length

1) Bleeding: When viewed on the piston rod, the orientation is always offset by 90° to the pipe connection (in a clockwise direction)
2) Ø D4 max. 0.5 mm deep
3) M50 x 2 available on request
4) For flange connections see separate table on pages 18 and 19
5) Throttle valve only with end position damping „E“ (180° to the bleed point)
6) Piston Ø not standardised
7) Dimensions for cylinder with seal versions M, T and S
8) Dimensions for cylinder with seal versions A and B
9) Tolerance: f8
10) Take the minimum stroke length „X*min.” into account
11) Not standardised
12) 2 mm deep counter bore for the ISO 4762 S.H.C.S. The screws must not be subjected to shear loads. The forces have to be distributed by keys
13) For equipotential bonding, see page 25
14) The specified dimensions are maximum values, tolerance classes 342 according to ISO 9013 Thermal cutting

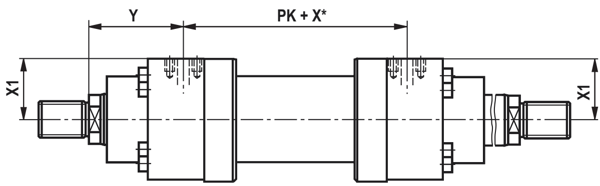
2

Flange connections

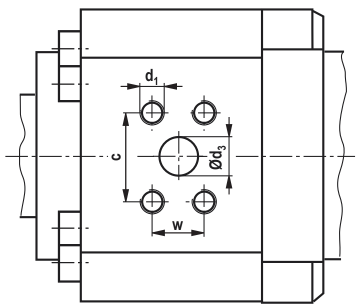
CDH2



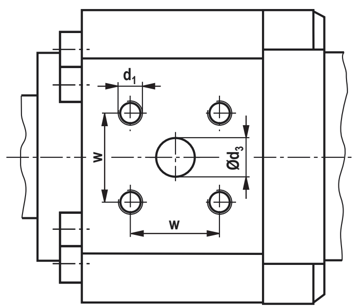
CGH2



Porting pattern for rectangular flanges to ISO 6162-1 Tab. 2 Type1 and ISO 6162-2 Tab. 2 Type1



Porting pattern for square flanges to ISO 6164 Tables 1 and 2



Flange connections (dimensions in mm)

AL	Version „F“ ISO 6162-1 Tab. 2 Type1 (200 - 350 bar) (≙ SAE 3000 PSI)											Version „K“ ISO 6164 Tab.1 (250 bar)								
Ø	Y	PJ PK	X1	d_3 Ø	d_3 4) Ø	c ±0,25	w ±0,25	d_1	t_1 1)	t_1 2)	p 3)	Y	PJ PK	X1	d_3 Ø	w ±0,25	d_1	t_1 1)	t_1 2)	p 3)
40	–	–	–	–	–	–	–	–	–	–	–	82	122	40,5	10	24,7	M6	12,5	10	250
50	–	–	–	–	–	–	–	–	–	–	–	97	122	48	10	24,7	M6	12,5	12,5	250
63	111	135	55	13	1/2“	38,1	17,5	M8	16	16	350	111	135	57	13	29,7	M8	16	16	250
80	123,5	148	68	13	1/2“	38,1	17,5	M8	16	16	350	123,5	148	69,5	13	29,7	M8	16	16	250
100	133	173	79	19	3/4“	47,6	22,3	M10	20	20	350	133	173	81,5	19	35,4	M8	16	16	250
125	153	205	98	25	1“	52,4	26,2	M10	20	20	350	157	197	100	19	35,4	M8	16	16	250
140	162	227	107	32	1 1/4“	58,7	30,2	M10	20	20	250	162	227	109	25	43,8	M10	20	20	250
160	181,5	242	127	32	1 1/4“	58,7	30,2	M10	20	20	250	181,5	242	128,5	25	43,8	M10	20	20	250
180	193	266	139	38	1 1/2“	69,9	35,7	M12	24	24	200	194	264	142	32	51,6	M12	24	24	250
200	219	280	146,5	38	1 1/2“	69,9	35,7	M12	24	24	200	220	278	148,5	32	51,6	M12	24	24	250

AL	Version „D“ ISO 6162-2 Tab. 2 Type1 (400 bar) (≙ SAE 6000 PSI)											Version „H“ ISO 6164 Tab.2 (400 bar)								
Ø	Y	PJ PK	X1	d_3 Ø	d_3 5) Ø	c ±0,25	w ±0,25	d_1	t_1 1)	t_1 2)	p 3)	Y	PJ PK	X1	d_3 Ø	w ±0,25	d_1	t_1 1)	t_1 2)	p 3)
40	–	–	–	–	–	–	–	–	–	–	–	82	122	40,5	10	24,7	M6	12,5	10	400
50	–	–	–	–	–	–	–	–	–	–	–	97	122	48	10	24,7	M6	12,5	12,5	400
63	–	–	–	–	–	–	–	–	–	–	–	111	135	57	13	29,7	M8	16	16	400
80	120	155	67	13	1/2“	40,5	18,2	M8	16	14	400	123,5	148	69,5	13	29,7	M8	16	16	400
100	134	171	80,5	13	1/2“	40,5	18,2	M8	16	16	400	133	173	81,5	19	35,4	M8	16	16	400
125	153	205	97	19	3/4“	50,8	23,8	M10	20	20	400	157	197	100	19	35,4	M8	16	16	400
140	162	227	107	25	1“	57,2	27,8	M12	24	24	400	162	227	109	25	43,8	M10	20	20	400
160	181,5	242	127	25	1“	57,2	27,8	M12	24	24	400	181,5	242	128,5	25	43,8	M10	20	20	400
180	194	264	139,5	32	1 1/4“	66,6	31,8	M14	26	26	400	194	264	142	32	51,6	M12	24	24	400
200	220	278	147	32	1 1/4“	66,6	31,8	M14	26	26	400	220	278	148,5	32	51,6	M12	24	24	400
220	244	326	168	38	1 1/2“	79,3	36,5	M16	30	30	400	244	326	171	38	60,1	M16	30	30	400
250	257	326	189	38	1 1/2“	79,3	36,5	M16	30	30	400	257	326	192	38	60,1	M16	30	30	400
280	290	375	215	38	1 1/2“	79,3	36,5	M16	30	30	400	290	375	218	38	60,1	M16	30	30	400
320	282	391	236	51	2“	96,8	44,5	M20	36	36	400	282	391	240	51	69,3	M16	30	30	400

For main dimensions see pages 6 to 17

AL = Piston Ø

X* = Stroke length

1) Thread depth for seal versions M, T and S

2) Thread depth for seal versions A and B

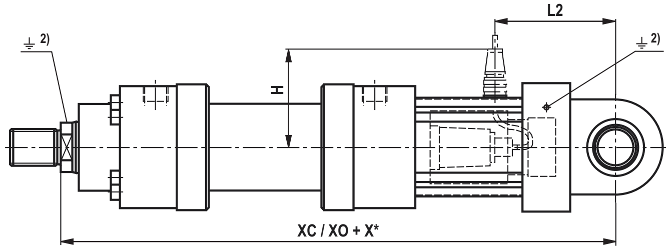
3) Max. operating pressure for associated flanges in bar

4) Flange porting pattern to ISO 6162-1 Tab. 2 Type1 relates to a flange porting pattern to SAE 3000 PSI

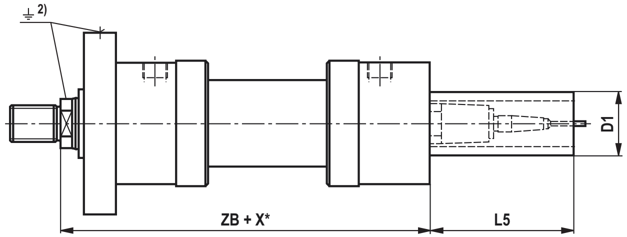
5) Flange porting pattern to ISO 6162-2 Tab. 2 Type1 relates to a flange porting pattern to SAE 6000 PSI

Position measuring system

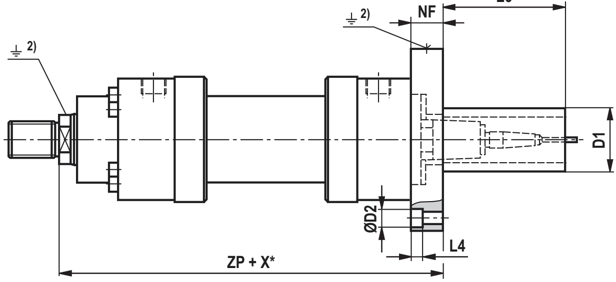
MP3, MP5



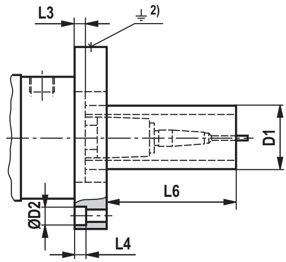
MF3



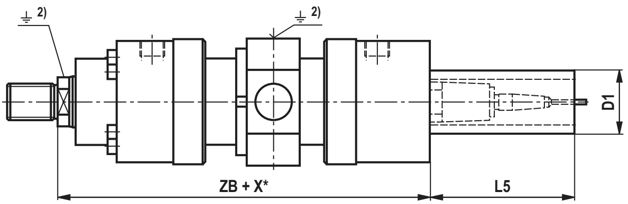
MF4: AL-Ø 40 - 80 mm



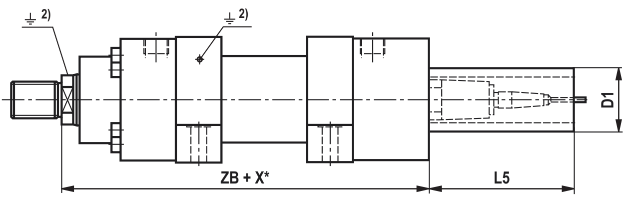
MF4: AL-Ø 100 - 320 mm



MT4



MS2



Position measuring system (dimensions in mm)

AL Ø	MM Ø	X^*_{max}	XC	XO	H	ZB	ZP	NF js13	L2	L3	L4	L5	L6	D1 max	D2 Ø
40	**–** **28**	1400	447	447	115	239	262	28	124	–	3	166	166	80	18
50	**32** **36**	1400	470	470	120	254	278	28	132	–	3	166	166	96	20
63	**40** **45**	2000	526	526	130	299	313	28	150	–	0	166	166	96	0
80	**50** **56**	2000	580	580	125	332,5	350	32	176,5	–	0	166	166	96	0
100	**63** **70**	3000	617	617	135	362	390	36	192	8	0	166	138	96	0
125	**80** **90**	3000	693	693	145	410	445	55	227	20	21,5	166	131	96	33
140	**90** **100**	3000	755	755	155	440	485	60	262	15	25,5	166	121	96	40
160	**100** **110**	3000	787	787	165	472,5	525	65	269,5	12,5	25,5	166	113,5	96	40
180	**110** **125**	3000	855	855	175	510	570	70	307	10	32	166	106	96	48
200	**125** **140**	3000	926	926	190	550	616	76	333	10	32	166	100	96	48
220	**140** **160**	3000	1100	1100	205	637	715	88	418	10	38	166	88	96	57
250	**160** **180**	3000	1115	1115	220	650	730	90	420	10	38	166	86	96	57
280	**180** **200**	3000	1295	1295	280	752	857	115	510	10	44	166	61	96	66
320	**200** **220**	3000	1300	1300	300	760	865	115	520	10	44	166	61	96	66

For main dimensions see pages 6 to 17

AL = Piston Ø

MM = Piston rod Ø

X* = Stroke length

X^*_{max} = Max. stroke length

[2)] Centering ring BA cannot be used

[2)] For equipotential bonding, see page 25

2

Position measuring system

The contactless, absolute position measuring system is rated up to 500 bar. Its function principle is based on the magnetostrictive effect. In connection with this, a torsion impulse is triggered off when two magnetic fields meet. This impulse is directed from the point of measurement via the wave guide inside the measuring scale to the sensor head. The transmission time is constant and virtually independent of temperature. It is proportional to the position of the magnet and can therefore be used as a reference for the actual position value and is converted into a direct analogue of digital output in the sensor head.

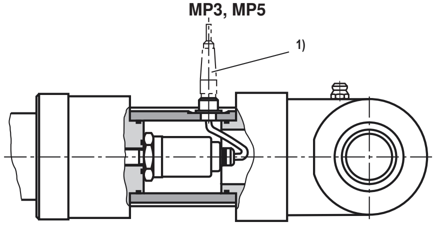
Technical data (for applications outside these parameters, please consult us!)

Operating pressure		bar	250
Analogue output		V	0 to 10
	Load resistance	kΩ	≥ 5
	Resolution		Infinite
Analogue output		mA	4 to 20
	Load resistance	Ω	0 to 500
	Resolution		Infinite
Linearity (absolute accuracy)	Analogue	% mm	≤ ±0,02 % (with reference to the measurement length) min. ±0,05
Repeatability		% mm	±0,001 (with reference to the measurement length) min. ±0,0025
Hysteresis		mm	≤ 0,004
Supply voltage		V DC	24 (± 10 % with an anlogue output)
	Current consumption	mA	100
	Residual ripple	% s-s	≤ 1
Protection	Tube and flange		IP 67
	Sensor electronics		IP 65
Operating temperature	Sensor electronics	°C	– 40 bis + 75
Temperature co-efficient	Voltage	ppm/°C	70
	Current	ppm/°C	90

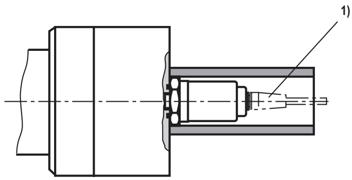
Position measuring system

Mounting style

MP3, MP5



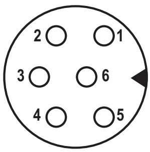
MF3, MF4, MT4, MS2



[1] For analogue output:
6-pin Amphenol -
Plug-in connector Material No. **R900072231**
(plug-in connector is **not** included within the scope of supply, it must be ordered separately)

Connection allocation

Position measuring system (analogue output)
Component plug (viewed on the pin side)



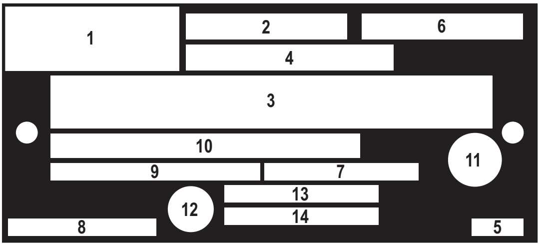
Pin	Cable	Signal / current	Signal / voltage
1	grey	4…20 mA	0…10 V
2	pink	DC Ground	DC Ground
3	yellow	not connect	not connect
4	green	DC Ground	DC Ground
5	brown	+24 V DC (+20% / –15%)	+24 V DC (+20% / –15%)
6	white	DC Ground (0 V)	DC Ground (0 V)

Name plate

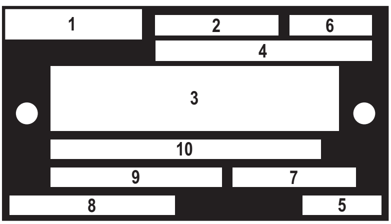
1 Trade mark	**9** Customer or manufacturing order
2 Material No.	**10** Customer material number or additional details
3 Material short text	**11** CE identification
4 Serial number	**12** EX protection
5 Area/factory number	**13** EX identification 1
6 Manufacturing date	**14** EX identification 2
7 Catalogue No.	**15** Test stamp [1)]
8 Origin code	**16** Assembly stamp [1)]

[1)] Items 15 and 16 must be applied to the component.

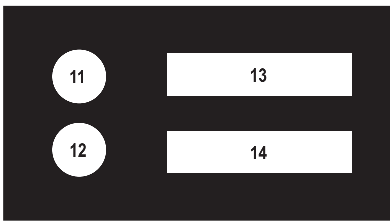
Name plate for piston Ø 63 mm to 320 mm



Name plate for piston Ø 40 mm and 50 mm

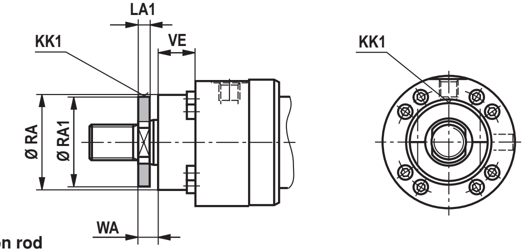


Separate bondable lable for ATEX components
Piston Ø 40 mm and 50 mm

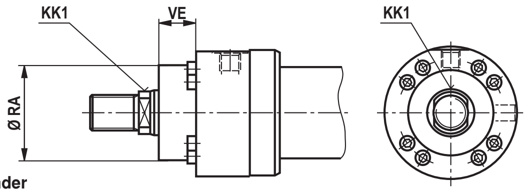


Equipotential bonding (dimensions in mm)

Mounting ring for equipotential bonding on the piston rod
Piston Ø 40-125 mm

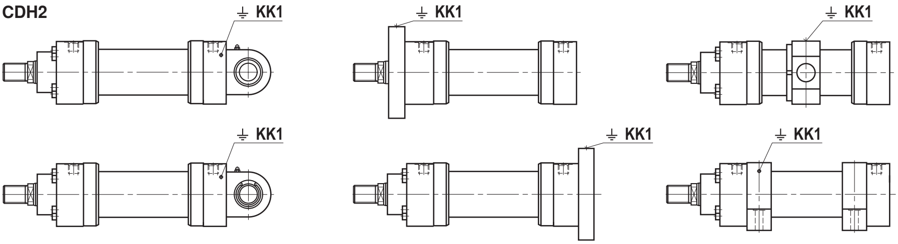


Equipotential bonding on the piston rod
Piston Ø 140-320 mm

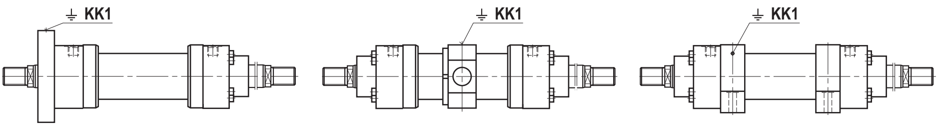


Equipotential bonding on the cylinder
Piston Ø 40-320 mm

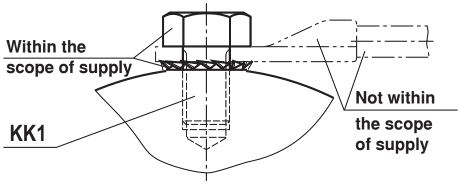
CDH2



CGH2



AL-Ø	MM-Ø	RA1	LA1	KK1
40	25	48	12	M6
	28	50		
50	32	56	12	M6
	36	60		
63	40	68	12	M6
	45	72		
80	50	80	13	M6
	56	85		
100	63	95	18	M6
	70	100		
125	80	110	18	M6
	90	120		
140 - 320	–	–	–	M8



AL = Piston Ø in mm
MM = Piston rod Ø in mm

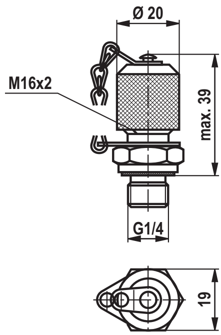
2

Screw coupling (dimensions in mm)

For pressure measurement or bleeding.
For installation in the bleed/measuring port. Coupling with check valve function, i.e. it can also be connected when pressure is present.

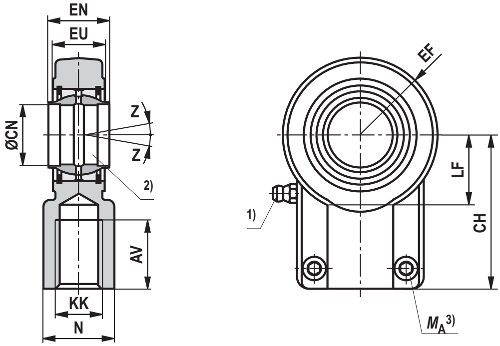
Scope of supply:

Coupling AB 20-11/K1 with NBR seal
Material No. **R900009090**
Coupling AB 20-11/K1 V with FKM seal
Material No. **R900001264**



Self-aligning clevis CGKD (dimensions in mm)

ISO 8132



Note:

The geometry and dimensions may vary depending on the make.

For combination with other mounting elements, the usability must be verified.

Series CDH2 AL Ø	MM Ø	Type	Material no.	m 4) kg	AV min.	N max.	CH js13	EF max.	CN H7	EN h12	EU max.
40	**25 / 28**	**CGKD 25**	R900323332	0,65	29	31	65	32	25	25	22
50	**32 / 36**	**CGKD 32**	R900322049	1,15	37	38	80	40	32	32	28
63	**40 / 45**	**CGKD 40**	R900322029	2,1	46	47	97	50	40	40	34
80	**50 / 56**	**CGKD 50**	R900322719	4	57	58	120	63	50	50	42
100	**63 / 70**	**CGKD 63**	R900322028	7,2	64	70	140	72,5	63	63	53,5
125	**80 / 90**	**CGKD 80**	R900322700	15	86	91	180	92	80	80	68
140	**90 / 100**	**CGKD 90** 7)	R900325702	19	91	100	195	101	90	90	72
160	**100 / 110**	**CGKD 100**	R900322030	25,5	96	110	210	114	100	100	85,5
180	**110 / 125**	**CGKD 110** 7)	R900308153	36,5	106	125	235	129	110	110	88
200	**125 / 140**	**CGKD 125**	R900322026	52,5	113	135	260	160	125	125	105
220	**140 / 160**	**CGKD 160**	R900300718	82,5	126	165	310	200	160	160	133
250	**160 / 180**	**CGKD 160**	R900300718	82,5	126	165	310	200	160	160	133
280	**180 / 200**	**CGKD 200**	R900324814	168	161	215	390	250	200	200	165
320	**200 / 220**	**CGKD 200**	R900324814	168	161	215	390	250	200	200	165

Series CDH2 AL Ø	MM Ø	Type	Material no.	KK	LF min.	Z	C_0 5) [kN]	F_{zul} 6) [kN]	Screw 10.9	M_A [Nm]
40	**25 / 28**	**CGKD 25**	R900323332	M20 x 1,5	25,5	4°	78	28,8	M8	30
50	**32 / 36**	**CGKD 32**	R900322049	M27 x 2	30	4°	114	42,1	M10	59
63	**40 / 45**	**CGKD 40**	R900322029	M33 x 2	39	4°	204	75,3	M10	59
80	**50 / 56**	**CGKD 50**	R900322719	M42 x 2	47	4°	310	114,4	M12	100
100	**63 / 70**	**CGKD 63**	R900322028	M48 x 2	58	4°	430	158,7	M16	250
125	**80 / 90**	**CGKD 80**	R900322700	M64 x 3	74	4°	695	256,5	M20	490
140	**90 / 100**	**CGKD 90** 7)	R900325702	M72 x 3	85	4°	750	276,8	M20	490
160	**100 / 110**	**CGKD 100**	R900322030	M80 x 3	94	4°	1060	391,1	M24	840
180	**110 / 125**	**CGKD 110** 7)	R900308153	M90 x 3	105	4°	1200	442,8	M24	840
200	**125 / 140**	**CGKD 125**	R900322026	M100 x 3	116	4°	1430	527,7	M24	840
220	**140 / 160**	**CGKD 160**	R900300718	M125 x 4	145	4°	2200	811,8	M24	840
250	**160 / 180**	**CGKD 160**	R900300718	M125 x 4	145	4°	2200	811,8	M24	840
280	**180 / 200**	**CGKD 200**	R900324814	M160 x 4	190	4°	3650	1346,9	M30	1700
320	**200 / 220**	**CGKD 200**	R900324814	M160 x 4	190	4°	3650	1346,9	M30	1700

AL = Piston Ø

MM = Piston rod Ø

1) Lubricating nipple, cone head form A according to DIN 71412

2) Associated pin Ø m6 (pins and pin securing rings are included within the scope of supply and not mounted at the point in time of the supply)

3) M_A Tightening torque
The swivel head must always be screwed against the piston rod shoulder. Then, the clamping screws must be tightened to the specified tightening torque

4) m Weight swivel head

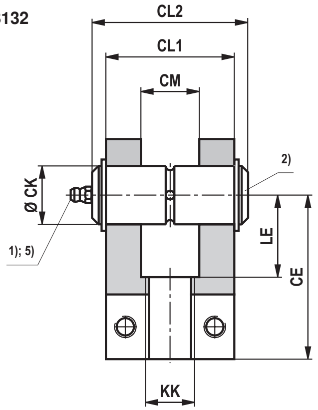
5) C_0 Static load rating of the swivel head

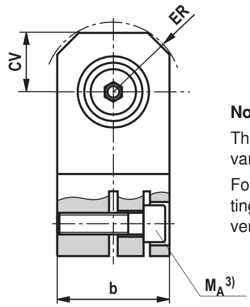
6) F_{zul} Maximum admissible load of the swivel heads with oscillatory or alternating loads

7) Not standardised

Fork clevis CCKB (dimensions in mm)

ISO 8132





Note:

The geometry and dimensions may vary depending on the make.

For combination with other mounting elements, the usability must be verified.

Series CDH2 AL Ø	MM Ø	Type	Material no.	Nominal force N	b max.	CE js13	CK H9	CL1 h16	CL2 max.	CM A13	ER max.
40	**25 / 28**	**CCKB 25**	R900542845	32.000	50	65	25	56	84	25	32
50	**32 / 36**	**CCKB 32**	R900542846	50.000	65	80	32	70	105	32	40
63	**40 / 45**	**CCKB 40**	R900542847	80.000	80	97	40	90	133	40	50
80	**50 / 56**	**CCKB 50**	R900542848	125.000	100	120	50	110	165	50	63
100	**63 / 70**	**CCKB 63**	R900542849	200.000	140	140	63	140	185	63	71
125	**80 / 90**	**CCKB 80**	R900542850	320.000	180	180	80	170	225	80	90
140	**90 / 100**	**CCKB 90**	8)	400.000	200	195	90	190	8)	90	100
160	**100 / 110**	**CCKB 100**	8)	500.000	220	210	100	210	8)	100	110

Series CDH2 AL Ø	MM Ø	Type	KK	LE min.	CV max.	Clamping screw ISO 4762-10.9	M_A 3) Nm	m 4) kg
40	**25 / 28**	**CCKB 25**	M20 x 1,5	34	32	M10 x 35	49	1,4
50	**32 / 36**	**CCKB 32**	M27x 2	41	40	M12 x 40	85	2,8
63	**40 / 45**	**CCKB 40**	M33 x 2	51	50	M16 x 50	210	5,2
80	**50 / 56**	**CCKB 50**	M42 x 2	63	63	M20 x 60	425	9,5
100	**63 / 70**	**CCKB 63**	M48 x 2	75	71	M24 x 80	730	21,5
125	**80 / 90**	**CCKB 80**	M64 x 3	94	90	M30 x 100	1450	38,2
140	**90 / 100**	**CCKB 90**	M72 x 3	108	100	M36 x 120	2480	8)
160	**100 / 110**	**CCKB 100**	M80 x 3	114	110	M36 x 130	2480	8)

AL = Piston Ø

MM = Piston rod Ø

1) Grease nipple, cone head form A according to DIN 71412

2) Associated pin Ø m6
(pins and pin securing rings are included within the scope of supply and not mounted at the point in time of the supply)

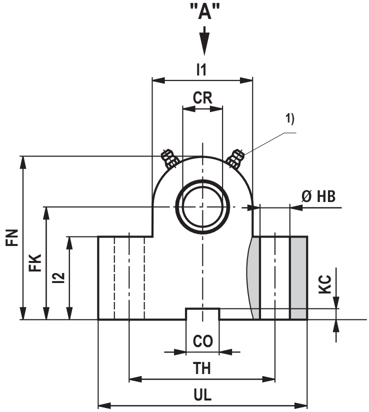
3) M_A Tightening torque
The fork clevis must always be screwed to the piston rod thread stop. Subsequently, the clamping screws have to be tightened to the specified torque.

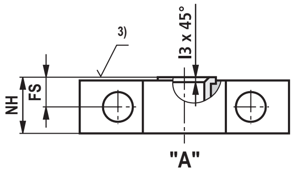
4) m Weight of the fork clevis

8) Upon request

Trunnion bracket CLTB (dimensions in mm)

ISO 8132





Note:
The geometry and dimensions may vary depending on the make.
For combination with other mounting elements, the usability must be verified.

2

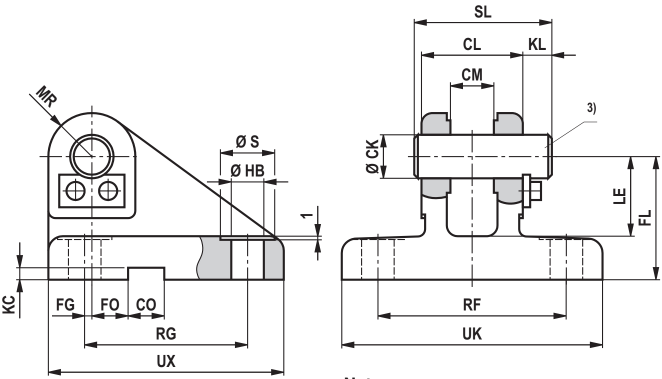
Series CDH2 AL Ø	Type	Material no.	Nominal force N	CR H7	CO N9	FK js12	FN max.	FS js14	HB H13	KC +0,3
40	**CLTB 25**	R900772610 4)	32.000	25	25	55	80	12	13,5	5,4
50	**CLTB 32**	R900772611 4)	50.000	32	25	65	100	15	17,5	5,4
63	**CLTB 40**	R900772612 4)	80.000	40	36	76	120	16	22	8,4
80	**CLTB 50**	R900772613 4)	125.000	50	36	95	140	20	26	8,4
100	**CLTB 63**	R900772614 4)	200.000	63	50	112	180	25	33	11,4
125	**CLTB 80**	R900772615 4)	320.000	80	50	140	220	31	39	11,4
140	**CLTB 90**	8); 4)	385.000	90	63	160	250	40	45	12,4
160	**CLTB 100**	R901205929 4)	500.000	100	63	180	280	45	52	12,4
180	**CLTB 110**	8); 4)	630.000	110	80	200	310	50	52	15,4
200	**CLTB 125**	8); 4)	785.000	125	80	220	345	56	45	15,4

Series CDH2 AL Ø	Type	l1	l2	l3	NH max.	TH js14	UL max.	*m* 2) kg
40	**CLTB 25**	56	45	1,5	26	80	110	2,1
50	**CLTB 32**	70	52	2	33	110	150	4,55
63	**CLTB 40**	88	60	2,5	41	125	170	7,3
80	**CLTB 50**	100	75	2,5	51	160	210	14,5
100	**CLTB 63**	130	85	3	61	200	265	23,1
125	**CLTB 80**	160	112	3,5	81	250	325	52,3
140	**CLTB 90**	8)	8)	3,5	91	265	345	8)
160	**CLTB 100**	215	145	3,5	102	295	385	100
180	**CLTB 110**	8)	8)	8)	112	320	410	8)
200	**CLTB 125**	8)	8)	8)	132	385	570	8)

AL = Piston Ø
1) Grease nipple, cone head form A according to DIN 71412
2) *m* Weight of the trunnion bracket (indication per pair)
3) Contact surface of the trunnion (inside face)
4) Mounting blocks are always supplied in pairs
8) Upon request

Clevis bracket CLCA (Maßangaben in mm)

ISO 8132, Form B



Note:

The geometry and dimensions may vary depending on the make.

For combination with other mounting elements, the usability must be verified.

Series CDH2 AL Ø	MM Ø	Type	Material-no.	Nominal force N	CK H9	CL h16	CM A12	CO N9	FG js14	FL js12	FO js14	HB H13	KC +0,3	KL	LE min.
40	**25 / 28**	**CLCA 25**	R900542864	32.000	25	56	25	25	10	55	10	13,5	5,4	10	37
50	**32 / 36**	**CLCA 32**	R900542865	50.000	32	70	32	25	14,5	65	6	17,5	5,4	13	43
63	**40 / 45**	**CLCA 40**	R900542866	80.000	40	90	40	36	17,5	76	6	22	8,4	16	52
80	**50 / 56**	**CLCA 50**	R900542867	125.000	50	110	50	36	25	95	0	26	8,4	19	65
100	**63 / 70**	**CLCA 63**	R900542868	200.000	63	140	63	50	33	112	0	33	11,4	20	75
125	**80 / 90**	**CLCA 80**	R900542869	320.000	80	170	80	50	45	140	0	39	11,4	26	95
140	**90 / 100**	**CLCA 90**	8)	400.000	90	190	90	63	47,5	160	0	45	12,4	28	108
160	**100 / 110**	**CLCA 100**	8)	500.000	100	210	100	63	52,5	180	0	52	12,4	30	120
180	**110 / 125**	**CLCA 110**	8)	635.000	110	240	110	80	62,5	200	0	52	15,4	31	138
200	**125 / 140**	**CLCA 125**	8)	800.000	125	270	125	80	75	230	0	52	15,4	32	170

Series CDH2 AL Ø	MM Ø	Type	MR max.	RF js14	RG js14	S	SL	UK max.	UX max.	*m* 4) kg
40	**25 / 28**	**CLCA 25**	25	90	85	20	69	120	115	3
50	**32 / 36**	**CLCA 32**	32	110	110	26	87	145	145	5
63	**40 / 45**	**CLCA 40**	40	140	125	33	110	185	170	9,6
80	**50 / 56**	**CLCA 50**	50	165	150	40	133	215	200	15,5
100	**63 / 70**	**CLCA 63**	63	210	170	48	164	270	230	27,5
125	**80 / 90**	**CLCA 80**	80	250	210	57	202	320	280	47
140	**90 / 100**	**CLCA 90**	90	280	235	66	224	360	320	8)
160	**100 / 110**	**CLCA 100**	100	315	250	76	246	405	345	8)
180	**110 / 125**	**CLCA 110**	110	335	305	76	277	425	400	8)
200	**125 / 140**	**CLCA 125**	125	365	350	76	310	455	450	8)

AL = Piston Ø

MM = Piston rod Ø

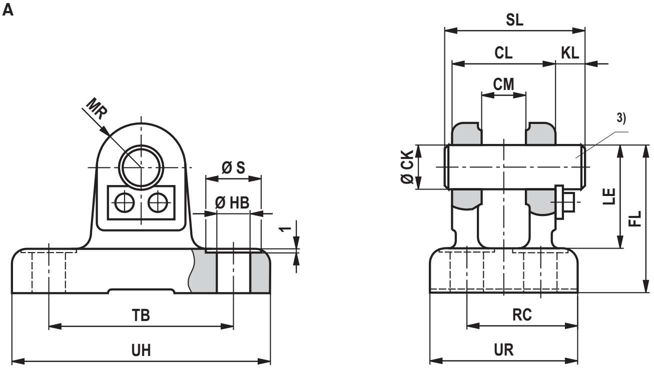
3) Associated pin Ø m6 (pins and pin securing rings are included within the scope of supply and not mounted at the point in time of the supply)

4) *m* Weight of the clevis bracket

8) Upon reques

Clevis bracket CLCD (dimensions in mm)

ISO 8132, Form A



Note:

The geometry and dimensions may vary depending on the make.

For combination with other mounting elements, the usability must be verified.

Series CDH2 AL Ø	MM Ø	Type	Material no.	Nominal force N	CK H9	CL h16	CM A13	FL js12	HB H13	KL	LE min.	MR max.	RC js14	S
40	**25 / 28**	**CLCD 25**	R900542882	32.000	25	56	25	55	13,5	10	37	25	40	20
50	**32 / 36**	**CLCD 32**	R900542883	50.000	32	70	32	65	17,5	13	43	32	50	26
63	**40 / 45**	**CLCD 40**	R900542884	80.000	40	90	40	76	22	16	52	40	65	33
80	**50 / 56**	**CLCD 50**	R900542885	125.000	50	110	50	95	26	19	65	50	80	40
100	**63 / 70**	**CLCD 63**	R900542886	200.000	63	140	63	112	33	20	75	63	100	48
125	**80 / 90**	**CLCD 80**	R900542887	320.000	80	170	80	140	39	26	95	80	125	57
140	**90 / 100**	**CLCD 90**	8)	400.000	90	190	90	160	45	28	108	90	140	66
160	**100 / 110**	**CLCD 100**	8)	500.000	100	210	100	180	45	30	120	100	160	66
180	**110 / 125**	**CLCD 110**	8)	635.000	110	240	110	200	52	31	138	110	180	76
200	**125 / 140**	**CLCD 125**	8)	800.000	125	270	125	230	52	32	170	125	200	76

Series CDH2 AL Ø	MM Ø	Type	SL	TB js14	UR max.	UH max.	*m* 4) kg
40	**25 / 28**	**CLCD 25**	69	85	70	113	1,9
50	**32 / 36**	**CLCD 32**	87	110	85	143	3
63	**40 / 45**	**CLCD 40**	110	130	108	170	5,5
80	**50 / 56**	**CLCD 50**	133	170	130	220	10,6
100	**63 / 70**	**CLCD 63**	164	210	160	270	17
125	**80 / 90**	**CLCD 80**	202	250	210	320	32
140	**90 / 100**	**CLCD 90**	224	290	230	370	8)
160	**100 / 110**	**CLCD 100**	246	315	260	400	8)
180	**110 / 125**	**CLCD 110**	277	350	290	445	8)
200	**125 / 140**	**CLCD 125**	310	385	320	470	8)

AL = Piston Ø

MM = Piston rod Ø

3) Associated pin Ø m6 (pins and pin securing rings are included within the scope of supply and not mounted at the point in time of the supply)

4) *m* Weight of the clevis bracket

8) Upon reques

Buckling

The permissible stroke length with a flexibly guided load and a
3.5 safety factor against buckling can be obtained from the appropriate table. With a deviating cylinder installation, the permissible stroke length has to be interpolated. Permissible stroke lengths for non-guided loads are available on request.

The calculation for buckling are carried out as follows:

1. Calculation according to Euler

$$F = \frac{\pi^2 \cdot E \cdot I}{v \cdot L_K^2} \quad \text{wenn } \lambda > \lambda g$$

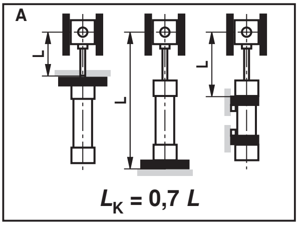
2. Calculation according to Tetmajer

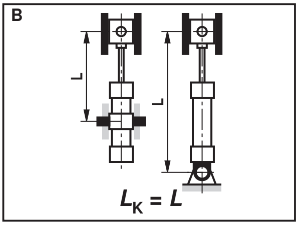
$$F = \frac{d^2 \cdot \pi \,(335 - 0{,}62 \cdot \lambda)}{4 \cdot v} \quad \text{wenn } \lambda \leq \lambda g$$

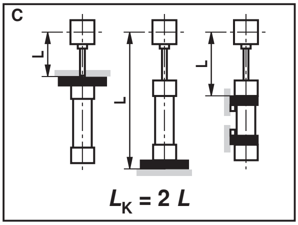
The influence of the mounting style on the buckling length:

Explanation:

E = Modulus of elasticity in N/mm^2
= 2.1×10^5 for steel
I = Moment of inertia in mm^4 for a circular cross-section area $= \frac{d^4 \cdot \pi}{64} = 0{,}0491 \cdot d^4$
v = 3.5 (safety factor)
L_K = Free buckling length in mm (dependent on the mounting style, see sketches A, B, C)
d = Piston rod Ø in mm
λ = Slenderness ratio
$= \frac{4 \cdot L_K}{d}$ $\quad \lambda g = \pi \sqrt{\frac{E}{0.8 \cdot R_e}}$
R_e = Yield strength of the piston rod material

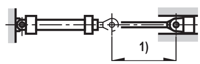
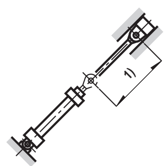
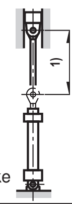






Permissible stroke lengths (dimensions in mm)

Mounting styles MP3, MP5

AL Ø	MM Ø	Permissible stroke lengths at 100 bar 0°	100 bar 45°	100 bar 90°	160 bar 0°	160 bar 45°	160 bar 90°	250 bar 0°	250 bar 45°	250 bar 90°	Max. available stroke lengths	Installation
40	25	195	200	215	130	135	140	40	45	55	2000	0° 
	28	385	400	445	295	300	320	215	220	225		
50	32	380	390	430	280	285	300	195	200	205		
	36	505	525	595	395	405	430	290	295	305		
63	40	480	500	550	365	370	385	255	260	265		
	45	640	660	750	505	515	550	380	385	395		
80	50	590	615	690	455	465	495	330	335	345		
	56	765	800	930	615	630	685	470	475	495		
100	63	750	780	910	595	610	660	445	455	470	3000	45° 
	70	940	985	1195	775	800	885	605	615	650		
125	80	970	1015	1200	780	805	880	595	605	635		
	90	1235	1300	1610	1030	1070	1200	825	840	895		
140	90	1075	1130	1360	875	905	1000	675	685	725		
	100	1335	1405	1770	1120	1165	1325	900	920	985		
160	100	1175	1230	1480	955	985	1085	735	750	785		
	110	1430	1500	1875	1195	1240	1400	955	975	1040		
180	110	1250	1310	1570	1010	1045	1150	775	790	830		
	125	1620	1710	2160	1365	1420	1620	1100	1125	1205		
200	125	1435	1510	1860	1180	1220	1365	915	935	990		
	140	1795	1900	2450	1525	1590	1840	1240	1270	1370		
220	140	1620	1710	2180	1360	1415	1630	1090	1120	1200	6000	90° 
	160	2075	2200	3000	1810	1890	2280	1510	1560	1730		
250	160	1805	1910	2490	1520	1590	1850	1220	1250	1360		
	180	2250	2395	3300	1960	2060	2500	1630	1690	1880		
280	180	2075	2200	2900	1775	1880	2170	1450	1490	1620		
	200	2510	2670	3700	2200	2310	2820	1850	1920	2140		
320	200	2135	2270	3030	1820	1900	2260	1470	1510	1660		1) Perm. stroke length
	220	2550	2720	3820	2230	2340	2880	1860	1930	2170		

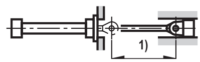
Permissible stroke lengths (dimensions in mm)

Mounting style: MF3

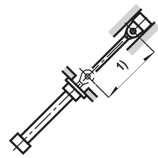
AL Ø	MM Ø	100 bar 0°	100 bar 45°	100 bar 90°	160 bar 0°	160 bar 45°	160 bar 90°	250 bar 0°	250 bar 45°	250 bar 90°	Max. available stroke lengths
40	25	895	915	980	730	735	760	440	450	510	2000
	28	1400	1415	1630	1180	1205	1275	970	980	1010	
50	32	1440	1490	1670	1210	1230	1300	985	995	1025	
	36	1760	1830	2000	1510	1545	1675	1255	1270	1320	
63	40	1735	1800	2000	1475	1510	1620	1215	1230	1270	
	45	2000	2000	2000	1830	1880	2080	1540	1560	1640	
80	50	2000	2000	2000	1810	1850	1995	1495	1515	1570	
	56	2000	2000	2000	2000	2000	2000	1870	1900	2000	
100	63	2580	2690	3000	2235	2300	2550	1875	1910	2010	3000
	70	3000	3000	3000	2690	2780	3000	2300	2350	2520	
125	80	3000	3000	3000	2840	2930	3000	2400	2450	2590	
	90	3000	3000	3000	3000	3000	3000	3000	3000	3000	
140	90	3000	3000	3000	3000	3000	3000	2700	2760	2950	
	100	3000	3000	3000	3000	3000	3000	3000	3000	3000	
160	100	3000	3000	3000	3000	3000	3000	2920	2980	3000	
	110	3000	3000	3000	3000	3000	3000	3000	3000	3000	
180	110	3000	3000	3000	3000	3000	3000	3000	3000	3000	
	125	3000	3000	3000	3000	3000	3000	3000	3000	3000	
200	125	3000	3000	3000	3000	3000	3000	3000	3000	3000	
	140	3000	3000	3000	3000	3000	3000	3000	3000	3000	
220	140	5400	5680	6000	4800	4980	5780	4120	4220	4560	6000
	160	6000	6000	6000	5820	6000	6000	5150	5330	6000	
250	160	5850	6000	6000	5270	5500	6000	4600	4740	5250	
	180	6000	6000	6000	6000	6000	6000	5650	5850	6000	
280	180	6000	6000	6000	6000	6000	6000	5270	5420	5970	
	200	6000	6000	6000	6000	6000	6000	6000	6000	6000	
320	200	6000	6000	6000	6000	6000	6000	5950	6000	6000	
	220	6000	6000	6000	6000	6000	6000	6000	6000	6000	

Installation

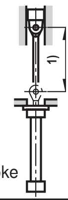
0°



45°



90°



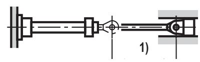
1) Perm. stroke length

Mounting style: MF4

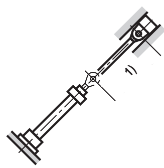
AL Ø	MM Ø	100 bar 0°	100 bar 45°	100 bar 90°	160 bar 0°	160 bar 45°	160 bar 90°	250 bar 0°	250 bar 45°	250 bar 90°	Max. available stroke lengths
40	25	325	340	370	245	250	260	105	110	140	2000
	28	565	590	695	465	475	520	365	370	385	
50	32	600	625	715	485	495	530	370	375	390	
	36	755	790	950	630	650	715	505	515	540	
63	40	730	765	905	600	615	675	470	480	500	
	45	920	965	1190	780	805	905	630	645	685	
80	50	910	950	1130	750	775	845	595	605	630	
	56	1125	1185	1470	960	990	1120	785	800	850	
100	63	1120	1175	1460	945	980	1105	770	785	835	3000
	70	1350	1430	1860	1175	1220	1420	980	1000	1090	
125	80	1430	1510	1910	1225	1270	1450	1000	1025	1100	
	90	1750	1855	2490	1540	1610	1910	1300	1340	1470	
140	90	1585	1675	2170	1370	1425	1650	1135	1165	1260	
	100	1895	2010	2750	1675	1755	2110	1425	1470	1630	
160	100	1725	1820	2340	1490	1545	1780	1230	1260	1360	
	110	2030	2150	2900	1785	1870	2230	1510	1560	1720	
180	110	1855	1960	2510	1595	1660	1910	1315	1350	1450	
	125	2300	2440	3350	2040	2130	2580	1735	1790	1990	
200	125	2105	2230	2950	1830	1910	2250	1530	1570	1715	
	140	2535	2700	3000	2260	2370	2920	1940	2010	2255	
220	140	2250	2400	3350	1990	2090	2550	1685	1740	1950	6000
	160	2800	2990	4500	2530	2680	3480	2220	2310	2700	
250	160	2600	2770	3900	2310	2430	3000	1975	2040	2300	
	180	3130	3350	5050	2840	3000	3910	2500	2600	3040	
280	180	2850	3050	4400	2550	2680	3370	2190	2270	2600	
	200	3370	3610	5550	3070	3250	4300	2700	2820	3330	
320	200	3070	3270	4750	2750	2890	3650	2150	2460	2810	
	220	3560	3820	5850	3250	3430	4550	2860	2980	3530	

Installation

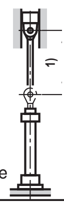
0°



45°



90°

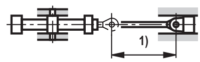
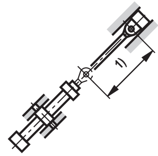
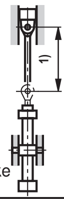


1) Perm. stroke length

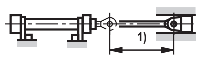
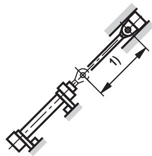
2

Permissible stroke lengths (dimensions in mm)

Mounting style: MT4 (trunnion located in the middle of the cylinder)

AL Ø	MM Ø	Permissible stroke lengths at 100 bar			160 bar			250 bar			Max. available stroke lengths	Installation
		0°	45°	90°	0°	45°	90°	0°	45°	90°		
40	25	340	345	365	250	255	260	130	135	145	2000	0° 
	28	590	605	665	470	480	500	365	370	375		
50	32	600	615	670	470	480	495	355	360	365		
	36	770	795	890	625	635	670	485	490	505		
63	40	740	765	845	590	600	630	450	455	465		
	45	940	975	1115	770	790	845	610	620	640		
80	50	920	950	1055	735	750	790	570	575	590		
	56	1155	1195	1375	950	975	1045	755	765	790		
100	63	1145	1190	1365	940	960	1030	740	750	775	3000	
	70	1400	1460	1740	1180	1210	1330	955	970	1015		
125	80	1470	1530	1780	1220	1250	1350	970	985	1020		45° 
	90	1820	1910	2320	1550	1600	1780	1275	1300	1370		
140	90	1640	1710	2020	1370	1410	1540	1100	1120	1170		
	100	1980	2080	2570	1700	1755	1970	1400	1430	1515		
160	100	1780	1850	2180	1485	1520	1660	1190	1210	1260		
	110	2110	2210	2710	1800	1860	2080	1480	1510	1595		
180	110	1910	1990	2340	1590	1635	1780	1275	1295	1350		
	125	2405	2530	3000	2065	2130	2400	1710	1740	1850		
200	125	2180	2280	2740	1840	1890	2090	1490	1510	1590		
	140	2660	2800	3000	2300	2380	2720	1915	1960	2100		
220	140	2490	2510	3150	2050	2120	2400	1685	1720	1835	6000	90° 
	160	3000	3170	4230	2640	2750	3260	2240	2310	2530		
250	160	2730	2870	3640	2350	2440	2790	1950	1990	2140		
	180	3320	3520	4720	2940	3060	3650	2500	2570	2830		
280	180	3040	3210	4140	2640	2750	3170	2210	2260	2440		
	200	3620	3840	5210	3210	3360	4040	2750	2830	3140		
320	200	3250	3430	4455	2820	2930	3410	2360	2420	2620		1) Perm. stroke length
	220	3800	4030	5500	3370	3530	4250	2880	2970	3290		

Mounting style: MS2

AL Ø	MM Ø	Permissible stroke lengths at 100 bar			160 bar			250 bar			Max. available stroke lengths	Installation
		0°	45°	90°	0°	45°	90°	0°	45°	90°		
40	25	825	840	885	645	650	665	370	375	410	2000	0° 
	28	1305	1350	1535	1085	1110	1180	875	885	910		
50	32	1330	1375	1560	1095	1120	1190	875	885	910		
	36	1645	1715	2030	1395	1430	1560	1140	1160	1210		
63	40	1610	1670	1950	1345	1380	1490	1085	1100	1145		
	45	1980	2000	2000	1700	1750	1950	1410	1435	1510		
80	50	1980	2000	2000	1665	1710	1850	1350	1370	1425		
	56	2000	2000	2000	2000	2000	2000	1730	1760	1860		
100	63	2420	2535	3000	2080	2140	2390	1720	1750	1850	3000	
	70	2880	3000	3000	2530	2630	3000	2140	2190	2360		
125	80	3000	3000	3000	2660	2750	3000	2220	2270	2410		45° 
	90	3000	3000	3000	3000	3000	3000	2810	2890	3000		
140	90	3000	3000	3000	2970	3000	3000	2490	2550	2740		
	100	3000	3000	3000	3000	3000	3000	3000	3000	3000		
160	100	3000	3000	3000	3000	3000	3000	2690	2750	2950		
	110	3000	3000	3000	3000	3000	3000	3000	3000	3000		
180	110	3000	3000	3000	3000	3000	3000	2890	2960	3000		
	125	3000	3000	3000	3000	3000	3000	3000	3000	3000		
200	125	3000	3000	3000	3000	3000	3000	3000	3000	3000		
	140	3000	3000	3000	3000	3000	3000	3000	3000	3000		
220	140	5090	5370	6000	4490	4670	5470	3820	3910	4260	6000	90° 
	160	6000	6000	6000	5510	5800	6000	4850	5020	5750		
250	160	5520	5860	6000	4940	5170	6000	4270	4410	4920		
	180	6000	6000	6000	6000	6000	6000	5320	5520	6000		
280	180	6000	6000	6000	5700	5960	6000	4930	5070	5630		
	200	6000	6000	6000	6000	6000	6000	6000	6000	6000		
320	200	6000	6000	6000	5890	6000	6000	4750	5310	6000		1) Perm. stroke length
	220	6000	6000	6000	6000	6000	6000	6000	6000	6000		

End position cushioning

End position cushioning:
The objective is to reduce the speed of a moving mass, whose centre of gravity lies on the cylinder axis, to a level, at which neither the cylinder nor the machine, into which the cylinder is installed, can be damaged. For speeds over 20 mm/s we recommend the use of end position cushioning so that the energy can be absorbed without the use of any additional equipment. Checks must always be carried out whether, also at lower speeds, with high masses end position cushioning is required.

Cushioning capacity:
When braking masses via the end position cushioning, the design constricted cushioning capacity must not be exceeded. Cylinders with end position cushioning can only utilise their full cushioning capacity when the entire stroke length is used.

With the adjustable end position cushioning „E“ an additional throttle valve is aded to the „D“ version. The end position cushioning „E“ makes it possible to optimise the cycle times. The maximum cushioning capacity can only be achieved when the throttle valve is fully closed.

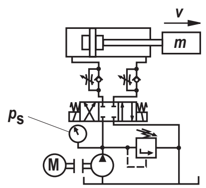
The calculation depends on the factors of weight, velocity, system pressure and installation position. Therefore, the variable D_m is to be calculated from weight and speed, the variable D_p from system pressure and installation position.

These variables are then used to verify the permissible cushioning performance in the „cushioning capacity“ diagram. The interception point of the variables D_m and D_p must always be below the cushioning capacity curve of the selected cylinder. The values in the diagram refer to an average oil temperature of + 45 to +65 °C and with a closed throttle valve.

For special applications with very short stroke times, high speeds or masses, special cylinders with special end position cushioning can be offered on request.

When fixed or adjustable end stops are used, then special measures have to be taken.

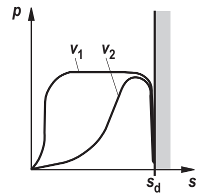
2



Formulas:

$$D_m = \frac{m}{10^K} \; ; \; K = kv\,(0{,}5 - v)$$

m = Moved mass in kg
v = Stroke velocity in m/s
kv = See table on page 36



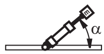
Extending:

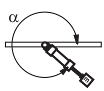
$$D_p = p_S - \frac{m \cdot 9{,}81 \cdot \sin\alpha}{A_1 \cdot 10}$$

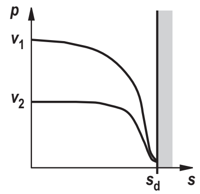
Retracing:

$$D_p = p_S + \frac{m \cdot 9{,}81 \cdot \sin\alpha}{A_3 \cdot 10}$$

p_S = System pressure in bar
A_1 = Piston area in cm² (see page 3)
A_3 = Annulus area in cm² (see page 3)
α = Angle in degrees with reference to the horizontal plain







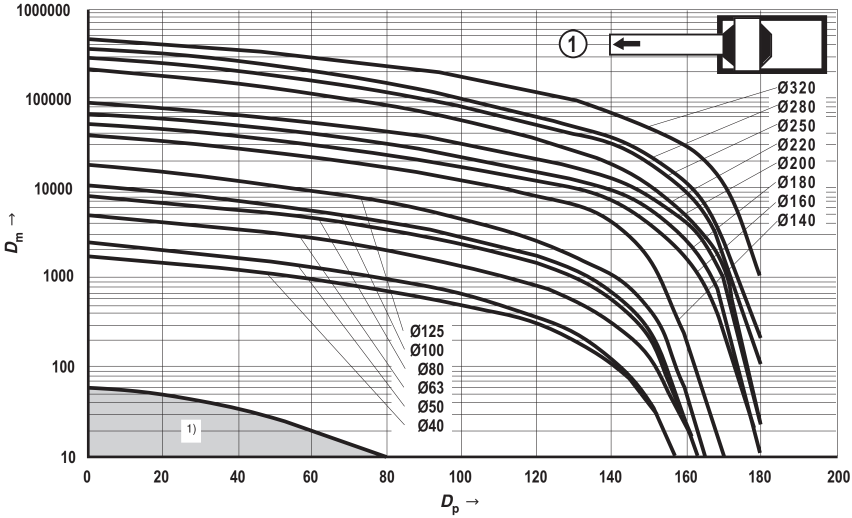
Damping length in mm

AL Ø mm	40	50	63	80	100	125	140	160	180	200	220	250	280	320
Head side	21	20	23	25	25	25	33	33	37	37	76	81	86	90
Base side	21	20	23	25	25	25	33	33	37	37	76	81	86	90

End position cushioning

AL Ø mm	40	50	63	80	100	125	140	160	180	200	220	250	280	320
kv ①	2,85	2,97	2,56	2,82	3,51	3,02	2,53	2,65	2,91	2,76	2,85	2,95	3,11	3,13
kv ②	3,1	3,25	2,85	2,85	3,52	2,91	2,53	2,93	2,95	2,95	2,93	3,1	3,12	3,07
kv ③	2,95	3,1	2,73	3,1	3,51	2,95	2,51	2,91	2,95	2,91	2,93	2,93	3,15	3,25

Cushioning capacity: Extending

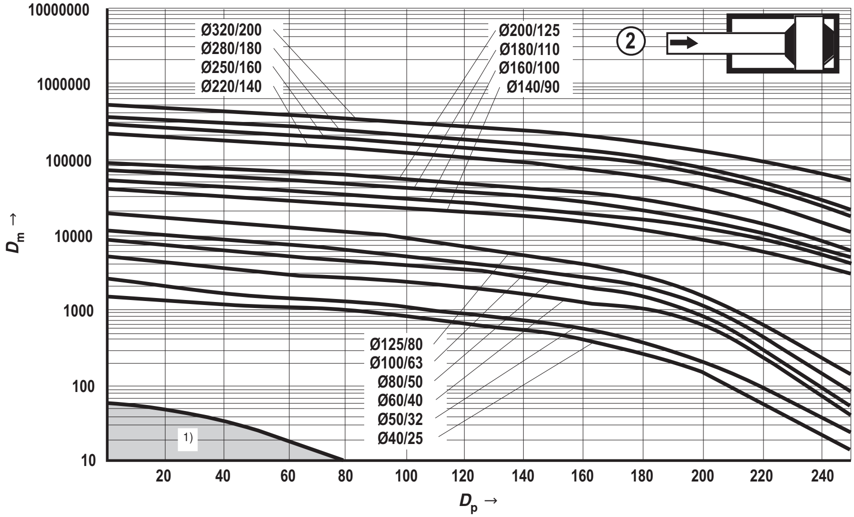


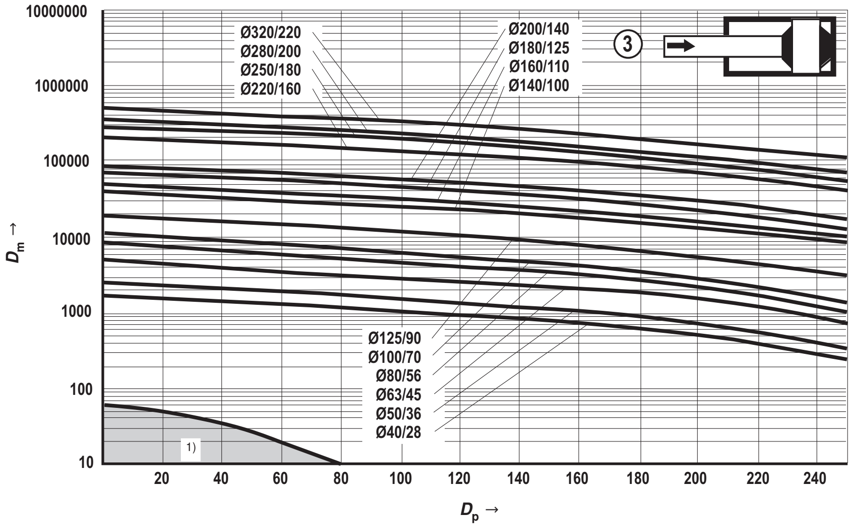
AL = Piston Ø

1) If, for standard applications, the calculated interception point from D_m and D_p is within the indicated area, then we recommend that a cylinder is used without end position cushioning.

End position cushioning

Cushioning capacity: Retracing

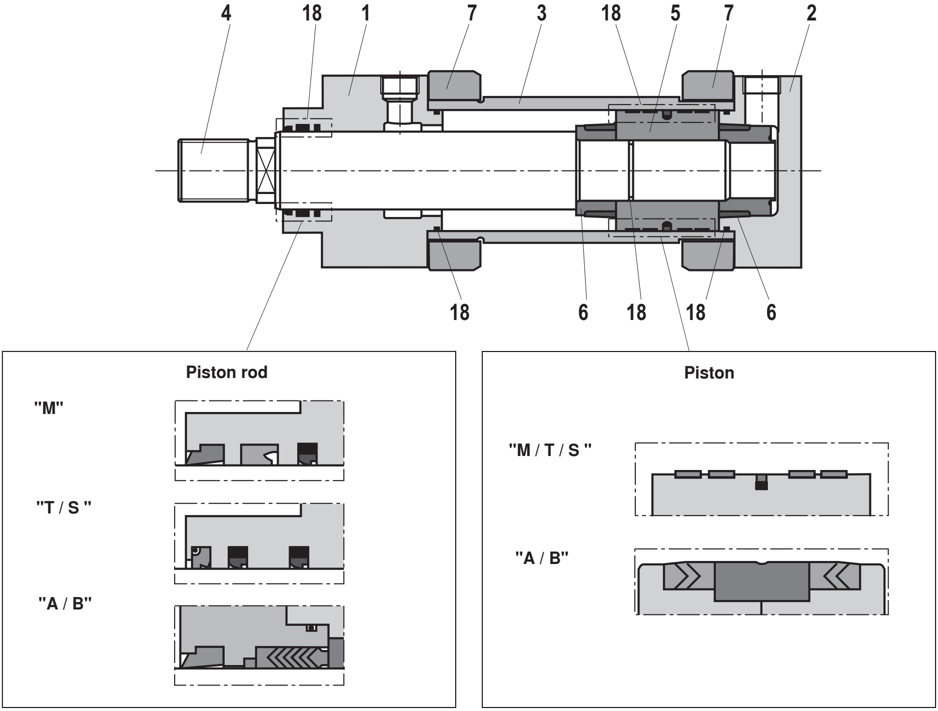


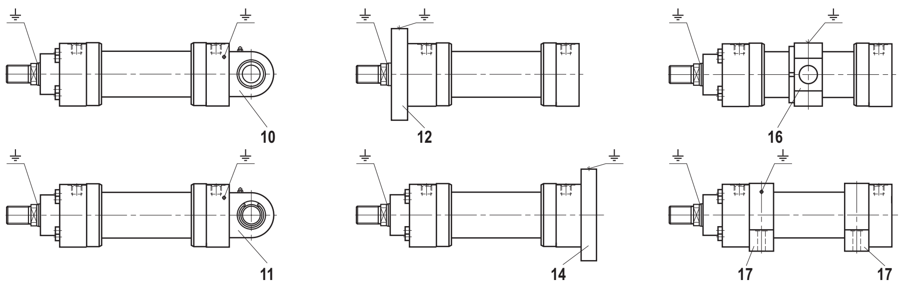


[1] If, for standard applications, the calculated interception point from D_m and D_p is within the indicated area, then we recommend that a cylinder is used without end position cushioning.

Spare parts

CDH2...X.





1 Head
2 Base
3 Barrel
4 Piston rod
5 Piston
6 Cushioning bush
7 Flange

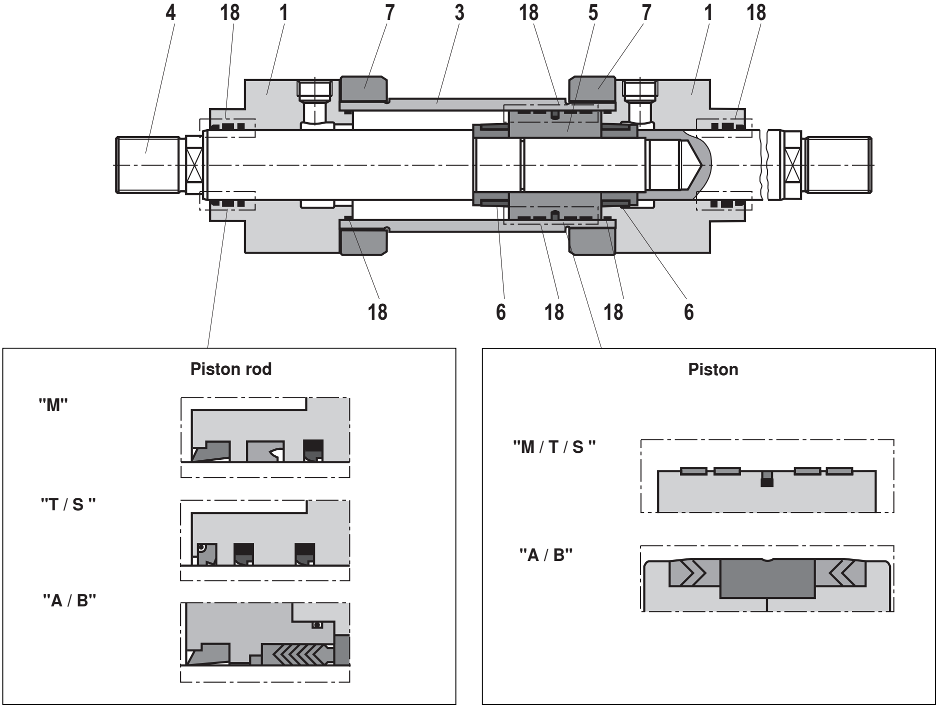
10 Base MP3
11 Base MP5
12 Round flange MF3
14 Round flange MF4
16 Trunnion MT4
17 Foot MS2

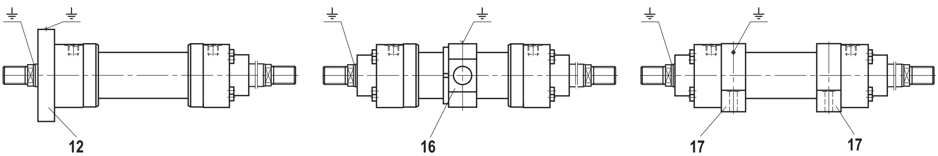
18 Seal kit:
Wiper
Rod seal
Piston seal
O-ring
Guide bush

⏚ Equipotential bonding (must be connected)

Spare parts

CGH2...X.



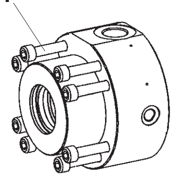


- **1** Head
- **3** Barrel
- **4** Piston rod
- **5** Piston
- **6** Cushioning bush
- **7** Flange
- **12** Round flange MF3
- **16** Trunnion MT4
- **17** Foot MS2
- **18** Seal kit:
  - Wiper
  - Rod seal
  - Piston seal
  - O-ring
  - Guide bush
- ⏚ Equipotential bonding (must be connected)

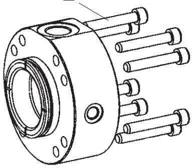
Tightening torques

Screws: Head and base (Pos. 1 and 2)

1



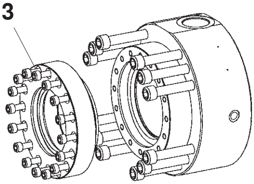
2



Series	Piston Ø	Screw	Quantity	Grade	Tightening torque
CDH2 / CGH2	**40**	M8	4	10.9	23 Nm
CDH2 / CGH2	**50**	M8	8	10.9	20 Nm
CDH2 / CGH2	**63**	M8	8	10.9	30 Nm
CDH2 / CGH2	**80**	M10	8	10.9	55 Nm
CDH2 / CGH2	**100**	M12	8	10.9	100 Nm
CDH2 / CGH2	**125**	M16	8	10.9	200 Nm
CDH2 / CGH2	**140**	M16	12	10.9	170 Nm
CDH2 / CGH2	**160**	M16	12	10.9	220 Nm
CDH2 / CGH2	**180**	M20	12	10.9	350 Nm
CDH2 / CGH2	**200**	M20	12	10.9	410 Nm
CDH2 / CGH2	**220**	M20	16	10.9	460 Nm
CDH2 / CGH2	**250**	M24	16	10.9	700 Nm
CDH2 / CGH2	**280**	M30	12	10.9	1700 Nm
CDH2 / CGH2	**320**	M30	16	10.9	1500 Nm

Screws: Seal cover (Pos. 3)

3



Only for seal versions „A“ and „B“

<table>
<tr><th>Series</th><th>Piston Ø</th><th>Piston rod Ø</th><th>Screw</th><th>Quantity</th><th>Grade</th><th>Tightening torque</th></tr>
<tr><td rowspan="2">CDH2 / CGH2</td><td rowspan="2">160</td><td>100</td><td rowspan="2">M10</td><td rowspan="2">16</td><td rowspan="2">10.9</td><td rowspan="2">60 Nm</td></tr>
<tr><td>110</td></tr>
<tr><td rowspan="2">CDH2 / CGH2</td><td rowspan="2">180</td><td>110</td><td rowspan="2">M12</td><td rowspan="2">16</td><td rowspan="2">10.9</td><td rowspan="2">80 Nm</td></tr>
<tr><td>125</td></tr>
<tr><td rowspan="2">CDH2 / CGH2</td><td rowspan="2">200</td><td>125</td><td rowspan="2">M12</td><td rowspan="2">16</td><td rowspan="2">10.9</td><td rowspan="2">90 Nm</td></tr>
<tr><td>140</td></tr>
<tr><td rowspan="2">CDH2 / CGH2</td><td rowspan="2">220</td><td>140</td><td rowspan="2">M12</td><td>16</td><td rowspan="2">10.9</td><td rowspan="2">90 Nm</td></tr>
<tr><td>160</td><td>24</td></tr>
<tr><td rowspan="2">CDH2 / CGH2</td><td rowspan="2">250</td><td>160</td><td rowspan="2">M12</td><td rowspan="2">24</td><td rowspan="2">10.9</td><td rowspan="2">90 Nm</td></tr>
<tr><td>180</td></tr>
<tr><td rowspan="2">CDH2 / CGH2</td><td rowspan="2">280</td><td>180</td><td rowspan="2">M12</td><td rowspan="2">24</td><td rowspan="2">10.9</td><td rowspan="2">90 Nm</td></tr>
<tr><td>200</td></tr>
<tr><td rowspan="2">CDH2 / CGH2</td><td rowspan="2">320</td><td>200</td><td>M12</td><td>24</td><td rowspan="2">10.9</td><td>90 Nm</td></tr>
<tr><td>220</td><td>M16</td><td>16</td><td>230 Nm</td></tr>
</table>

Seal kits [1)]

CDH2...X – Standard

AL Ø	MM Ø	Material No. for seal version M	T	A	S	B
40	25	R901010141	R901010143	R901010145	R901010146	R901010147
	28	R900851087	R900858841	R900859445	R900861001	R900859770
50	32	R900860274	R900860275	R900860929	R900861003	R900860939
	36	R900849392	R900860277	R900851515	R900861004	R900860940
63	40	R900859509	R900860279	R900851637	R900861006	R900860941
	45	R900847956	R900847855	R900851638	R900861007	R900859678
80	50	R900857129	R900860281	R900856092	R900861009	R900860943
	56	R900850905	R900856180	R900854718	R900861010	R900851205
100	63	R900860283	R900860284	R900856093	R900861012	R900860945
	70	R900853382	R900860285	R900856094	R900861013	R900860946
125	80	R900860287	R900860288	R900860931	R900861015	R900860950
	90	R900857949	R900856102	R900856095	R900861016	R900855464
140	90	R900858281	R900860289	R900860932	R900861017	R900860951
	100	R900853965	R900860290	R900856096	R900849080	R900860952
160	100	R900855683	R900860291	R900860468	R900861018	R900860953
	110	R900851146	R900857536	R900860933	R900861019	R900860954
180	110	R900856497	R900852561	R900860934	R900861020	R900860955
	125	R900848603	R900860292	R900860935	R900861021	R900860956
200	125	R900860294	R900860295	R900860936	R900861022	R900860957
	140	R900856431	R900860293	R900860937	R900861023	R900860958
220	140	R900888100	R900888108	R900888116	R900888132	R900888140
	160	R900888101	R900888109	R900888117	R900888133	R900888141
250	160	R900888102	R900888110	R900888118	R900888134	R900888142
	180	R900888103	R900888111	R900888119	R900888135	R900888143
280	180	R900888104	R900888112	R900888120	R900888136	R900888144
	200	R900888105	R900888113	R900888121	R900888137	R900888145
320	200	R900888106	R900888114	R900888122	R900888138	R900888146
	220	R900888107	R900888115	R900888123	R900888139	R900888147

AL = Piston Ø in mm
MM = Piston rod Ø in mm
[1)] Seal kits for position measuring system, separate Material No.

2

Seal kits

CGH2...X – Standard

AL	MM	Material No. for seal version				
Ø	Ø	M	T	A	S	B
40	25	R901010159	R901010161	R901010162	R901010169	R901010170
	28	R900867252	R900868889	R900866747	R900868943	R900867133
50	32	R900867254	R900868891	R900866749	R900868945	R900857135
	36	R900864930	R900868892	R900866750	R900868946	R900867136
63	40	R900867261	R900868894	R900866752	R900868948	R900867138
	45	R900867262	R900868895	R900866753	R900868949	R900867139
80	50	R900867264	R900868897	R900866755	R900868951	R900867141
	56	R900867265	R900868898	R900866756	R900868952	R900867142
100	63	R900867267	R900868900	R900866758	R900868954	R900867144
	70	R900867268	R900868901	R900866759	R900868955	R900867146
125	80	R900860730	R900868903	R900866761	R900868956	R900867148
	90	R900867270	R900868904	R900866762	R900868957	R900867149
140	90	R900867271	R900868905	R900866763	R900868958	R900867150
	100	R900867272	R900868906	R900866764	R900868959	R900867151
160	100	R900867273	R900868907	R900866765	R900868960	R900867152
	110	R900867274	R900868908	R900866766	R900868961	R900867153
180	110	R900867275	R900868909	R900866767	R900868962	R900867154
	125	R900867276	R900868910	R900866768	R900868963	R900867155
200	125	R900867277	R900868911	R900866769	R900868964	R900867156
	140	R900867278	R900868912	R900866770	R900868965	R900867157
220	140	R900888020	R900888028	R900888036	R900888052	R900888060
	160	R900888021	R900888029	R900888037	R900888053	R900888061
250	160	R900888022	R900888030	R900888038	R900888054	R900888062
	180	R900888023	R900888031	R900888039	R900888055	R900888063
280	180	R900888024	R900888032	R900888040	R900888056	R900888064
	200	R900888025	R900888033	R900888041	R900888057	R900888065
320	200	R900888026	R900888034	R900888042	R900888058	R900888066
	220	R900888027	R900888035	R900888043	R900888059	R900888067

AL = Piston Ø in mm
MM = Piston rod Ø in mm

Seal kits

CDH2...X – Standard + Option F

AL Ø	MM Ø	Material No. for seal versions M+F	T+F	S+F
40	25	R901010148	R901010149	R901010150
	28	R900861025	R900861050	R900861100
50	32	R900861027	R900861052	R900861102
	36	R900861028	R900861053	R900861103
63	40	R900861030	R900861055	R900861105
	45	R900861031	R900861056	R900861106
80	50	R900861033	R900861058	R900861108
	56	R900861034	R900861059	R900861109
100	63	R900861036	R900861061	R900861114
	70	R900861037	R900861062	R900861115
125	80	R900861039	R900861064	R900861120
	90	R900861040	R900861065	R900861122
140	90	R900861041	R900861066	R900861124
	100	R900861042	R900861067	R900861126
160	100	R900861043	R900861068	R900861128
	110	R900861044	R900861069	R900861130
180	110	R900861045	R900861070	R900861133
	125	R900861046	R900861071	R900861135
200	125	R900861047	R900861072	R900861142
	140	R900861048	R900861073	R900861143

2

CGH2...X – Standard + Option F

AL Ø	MM Ø	Material No. for seal versions M+F	T+F	S+F
40	25	R901010151	R901010154	R901010156
	28	R900868999	R900869026	R900869093
50	32	R900869001	R900869028	R900869095
	36	R900869002	R900869029	R900869096
63	40	R900869004	R900869031	R900869098
	45	R900869005	R900869032	R900869099
80	50	R900869007	R900869034	R900869101
	56	R900869008	R900869035	R900869102
100	63	R900869012	R900869037	R900869104
	70	R900869013	R900869038	R900869105
125	80	R900869015	R900869040	R900869107
	90	R900869016	R900869041	R900869108
140	90	R900869017	R900869042	R900869109
	100	R900869018	R900869043	R900869110
160	100	R900869019	R900869044	R900869111
	110	R900869020	R900869045	R900869112
180	110	R900869021	R900869046	R900869113
	125	R900869022	R900869047	R900869114
200	125	R900869023	R900869048	R900869115
	140	R900869024	R900869049	R900869116

AL = Piston Ø in mm
MM = Piston rod Ø in mm

Seal kits

Only for position measuring system

AL	Material No. for seal versions				
Ø	M / M+F	T / T+F	A	S / S+F	B
40	R900885935		–	R900885937	–
50	R900894958		–	R900894979	–
63	R900894959		–	R900894980	–
80	R900894960		–	R900894981	–
100	R900894961		–	R900894982	–
125	R900894962		–	R900894983	–
140	R900894963		–	R900894985	–
160	R900894964		–	R900894986	–
180	R900894973		–	R900894987	–
200	R900894974		–	R900894988	–
220	R900894975		–	R900894989	–
250	R900894976		–	R900894991	–
280	R900894977		–	R900894993	–
320	R900894978		–	R900894994	–

AL = Piston Ø in mm

EG – Declaration of conformaty

We declare that the product conforms to the directive 94/9/EG explosion protection.

Product description Hydraulic cylinder mill type

Cylinder series CDH2.....X../....
CGH2.....X../....

Applied harmonised standards EN 1127-1, EN 13 463-1, EN 13 463-5

Manufacturer: BOSCH REXROTH AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main
Deutschland

Lohr am Main, May 2012

Franz Wirzberger
Leader development
Hydraulic cylinder

Bernd Balzer
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www.boschrexroth.fr

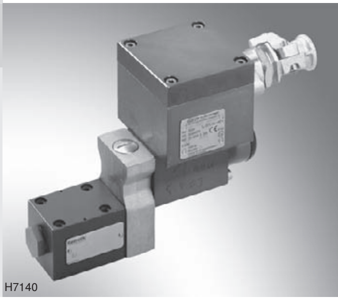
On/off valves

3

3/2 and 4/2 directional seat valves with solenoid actuation

RE 22047-XD-B2/08.12
Replaces: 01.10

Type M-.SE 6 ...XD...



H7140

Size 6
Component series 6X
Maximum operating pressure 420 bar
Maximum flow 12 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **I M2; II 2G**
- Type of protection of the valve solenoid:
  Ex d I Mb / Ex d IIC T4 Gb
  according to EN 60079-0:2009 / EN 60079-1:2007

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 22047-XD-B0**
Part II	Data sheet 22047-XD-B2	
Part III	Product-specific instructions 22047-XD-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Direct operated directional seat valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to DIN 24340-A6
- Subplates available in FE/ZN version (see pages 12/13)
- Blocked connection tight in a leak-free form
- Safe switching also with longer standstill periods under pressure
- Air-gap DC solenoids
- Electrical connection with individual connection and cable gland
- With manual override

Ordering code and scope of delivery

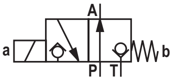
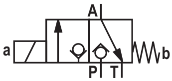
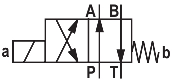
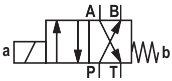
M	–	SE	6		6X	/	420	L	G24	N	XD	Z2	/		V

Mineral oil = **M**

3 main ports = **3**
4 main ports = **4**

Seat valve

Size 6 = **6**

Main ports	3	4	
Control spool symbols			
	•	–	= **U**
	•	–	= **C**
	–	•	= **D**
	–	•	= **Y**

• = Available

Component series 60 to 69 (60 to 69: Unchanged installation and connection dimensions) = **6X**

Operating pressure up to 420 bar = **420**

High-power solenoid, (air-gap) = **L**

G24 = Direct voltage 24 V

N = With manual override (standard)

XD = Explosion protection "Pressure-resistant enclosure"
For details see information on the explosion protection, page 8

Electrical connection

Z2 = Solenoid with terminal box and cable gland,
For details see chapter Electrical connection

no code = Without check valve insert without throttle insert
P = With check valve insert
B12 = Throttle Ø 1.2 mm
B15 = Throttle Ø 1.5 mm
B18 = Throttle Ø 1.8 mm
B20 = Throttle Ø 2.0 mm
B22 = Throttle Ø 2.2 mm

V = FKM seals
(other seals upon request)
Important: Observe compatibility of seals with hydraulic fluid used!

Included in the scope of delivery:

- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

Function, section, control spool symbols: 3/2 directional seat valve

General:

The directional valve type M-.SE.. is a directional seat valve with solenoid actuation. It controls the start, stop and direction of a flow. It basically comprises a housing (1), the solenoid (2), the hardened valve system (3) and the balls (4.1 and 4.2) as closing element.

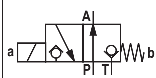
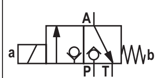
Basic principle:

In the initial position, the ball (4.1) is pressed onto the seat by the spring (7), in spool position, the ball (4.2) is pressed onto the seat by the solenoid (2). The force of solenoid (2) acts via the lever (17) and the ball (5) on the actuating plunger (6) that is sealed on two sides. The chamber between the two sealing elements is connected to port P.
Thus, the valve system (3) is pressure-compensated in relation to the actuating forces (solenoid or return spring). Thus, the valves can be used up to 420 bar.

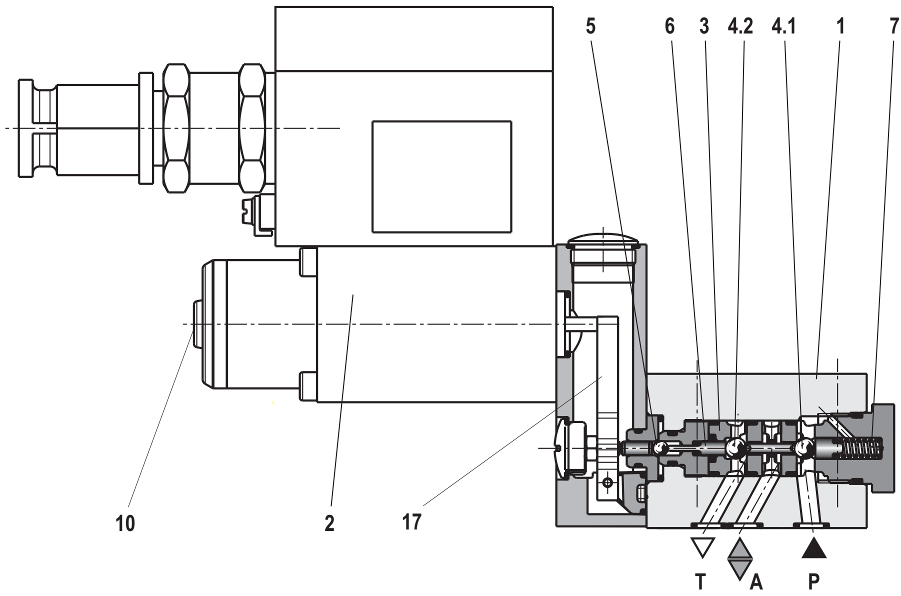
Important

- The 3/2 directional seat valves have a "negative spool overlap". Therefore, port T must always be connected. That means that during the switching process – from the starting of the opening of one valve seat to the closing of the other valve seat – ports P–A–T are connected with each other. This process takes, however, place within such a short time that it is irrelevant in nearly all applications.
- The manual override (10) allows for the switching of the valve without solenoid energization.
- It has to be made sure that the specified maximum flow is not exceeded! A throttle insert must be used for limiting the flow, if necessary (see page 6).
- In order to switch the valve safely or maintain it in its spool position, the pressure situation must be as follows: P≥ A ≥ T (for design reasons).
- The ports P, A and T (3/2 directional seat valve) are clearly determined according to the tasks. They must not be exchanged or closed. The flow is only permitted in the direction of arrow.

The seat arrangement offers the following options:

Control spool symbol	U	C
		
Initial position	P and A connected, T blocked in a leak-free form	P blocked in a leak-free form, A and T connected
Spool position	P blocked in a leak-free form, A and T connected	P and A connected, T blocked in a leak-free form

Example: Type M-3SE 6 C6X/420L.NXDZ2/V



Function, section, control spool symbols: 4/2 directional seat valve

With a sandwich plate, the **Plus-1 plate**, under the 3/2 directional seat valve, the function of a 4/2 directional seat valve is achieved.

Function of the Plus-1 plate:

Initial position:

The main valve is not operated. The spring (7) holds the ball (4.1) on the seat (11). Port P is blocked and A connected to T. Apart from that, one control line is connected from A to the large area of the control spool (12), which is thus unloaded to the tank. The pressure applied via P now pushes the ball (13) onto the seat (14). Now, P is connected to B, and A to T.

Transition position:

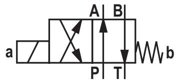
When the main valve is operated, the control spool (8) is shifted against the spring (7) and the ball (4.2) is pressed onto the seat (15). During this, port T is blocked, P, A, and B are briefly connected to each other.

Spool position:

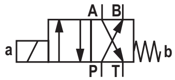
P is connected to A. As the pump pressure acts via A on the large area of the control spool (12), the ball (13) is pressed onto the seat (16). Thus, B is connected to T, and P to A. The ball (13) in the Plus-1 plate has a "positive spool overlap".

The use of the Plus-1 plate and the seat arrangement offer the following options:

Control spool symbol **D:**

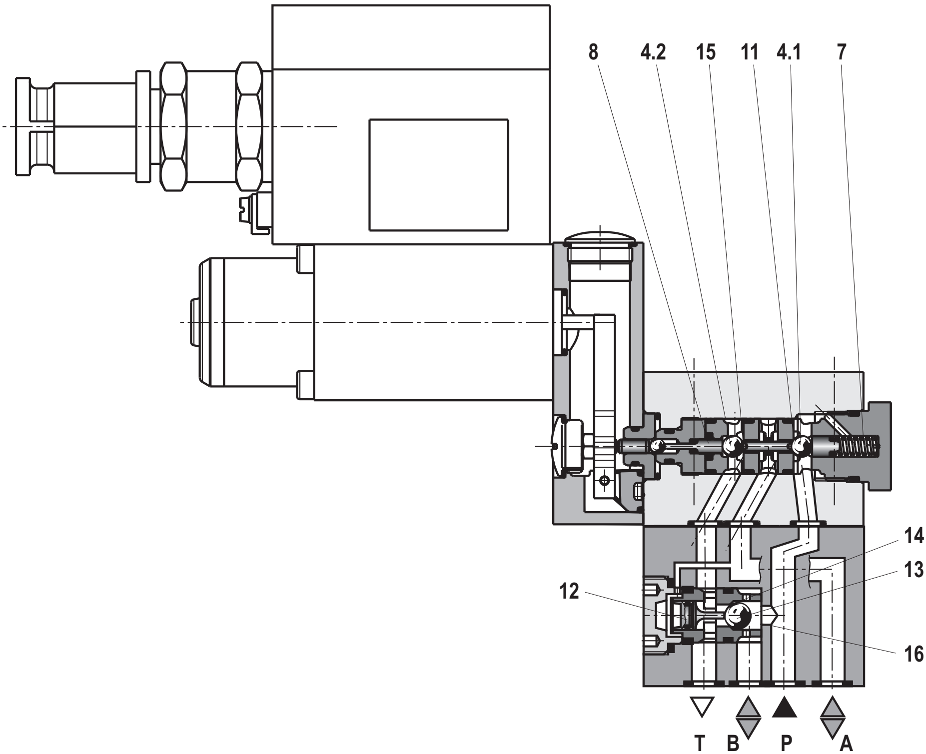


Control spool symbol **Y:**



To prevent pressure intensification in conjunction with differential cylinders, the annulus area of the cylinder must be connected to A.

Example: Type M-4SE 6 Y6X/420L.NXDZ2/V



Function, section: Throttle insert, check valve insert

Throttle insert

The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

Examples:

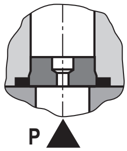
- Accumulator operation,
- Use as pilot control valve with internal pilot fluid tapping.

3/2 directional seat valve (see page 4)

The throttle insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)

The throttle insert is inserted in port P of the Plus-1 plate.



Check valve insert

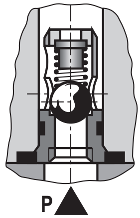
The check valve insert allows free flow from P → A and closes A → P in a leak-free form.

3/2 directional seat valve (see page 4)

The check valve insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)

The check valve insert is inserted in port P of the Plus-1 plate.



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20 … +80
Storage temperature range		°C	+15 … +30
Admissible vibration load			
Valve axis direction			20 … 2000 Hz amplitude 0.032 g^2/Hz (8 g RMS)
90 ° direction to the valve axis			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	3/2 directional seat valve	kg	6.2
	4/2 directional seat valve	kg	7.0
Surface protection			Galvanically coated

hydraulic

Maximum surface temperature		°C	See information on the explosion protection on page 8
Maximum operating pressure	Port P, A, B	bar	420
	Port T	bar	40
Maximum flow		l/min	12
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also data sheet 90221); HETG (rape seed oil); HEPG (polyglycols); HEES (synthetic esters), other hydraulic fluids on request, ignition temperature > 180 °C
Hydraulic fluid temperature range		°C	–15 ... +80
Viscosity range		mm^2/s	2.8 … 500
Maximum permitted degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)			Class 20/18/15 [1]

electric

Voltage type		Direct voltage
Available voltages	V	24
Voltage tolerance (nominal voltage)	%	±10
Admissible residual ripple	%	< 5
Duty cycle / operating mode according to VDE 0580		S1 (continuous operation)
Switching time according to ISO 6403		See page 8
Switching frequency	1/h	up to 15000
Nominal power at ambient temperature 20 °C	W	13
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C	W	15.8
Protection class according to EN 60529 [2]		IP 65

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

[2] With correctly installed electrical connection

Technical data

Information on the explosion protection

Area of application as per directive 94/9/EC		I M2, II 2G
Type of protection Valve		c (EN 13463-5:2011)
Maximum surface temperature [1)] Temperature class	°C	130 T4
Type of protection Solenoid according to EN 60079-0:2009 / EN 60079-1:2007		Ex d I Mb Ex d IIC T4 Gb
Type examination certificate Solenoid		BVS 03 ATEX E 300 X
"IEC Certificate of Conformity" Solenoid		IECEx BVS 11.0091 X
Special conditions for safe use		In case of bank assembly, only one solenoid of all valves may be energized at a time.
Ambient temperature range	°C	–20 … +80

[1)] Surface temperature > 50 °C, provide contact protection

Switching times *t* in ms (Installation position: Solenoid horizontal)

Pressure *p* in bar	Flow q_V in l/min	DC solenoid – Control spool symbols **U, C, D, Y** – t_{on} without tank pressure				t_{off}			
		U	**C**	**D**	**Y**	**U**	**C**	**D**	**Y**
70	12	35	55	40	60	20	10	25	15
140	12	35	55	40	60	25	10	30	15
280	12	35	60	40	65	30	10	35	15
320	12	35	65	40	70	30	12	35	17
420	12	35	65	40	70	35	12	40	17

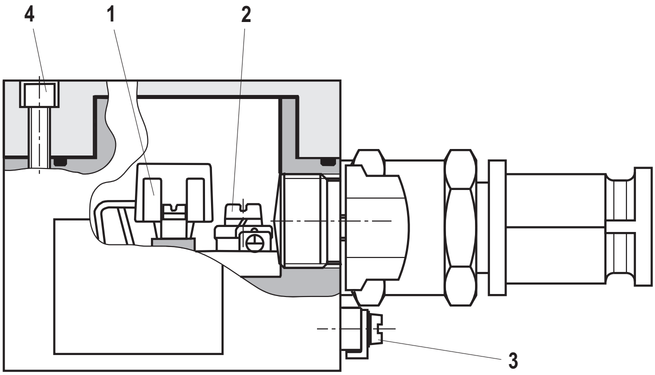
Electrical connection

The type-examination tested valve solenoid of the valve is equipped with one terminal box and a type-tested cable entry.

The connection is polarity-independent.

Important

When establishing the electrical connection, the protective earthing conductor (PE ⏚) has to be connected properly.



Properties of the connection terminals and mounting elements

Item	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire max. 2.5 mm^2 Finely stranded max. 2.5 mm^2
2	Connection for protective earthing conductor	Single-wire 0.75 … 2.5 mm^2 Finely stranded 0.75 … 1.5 mm^2
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm^2 Finely stranded min. 4 mm^2
4	Screws for cover	–

Cable gland

Line diameter	mm	9…12
Sealing		Outer sheath sealing

Connection line

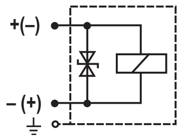
Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–20 … > +110

3

Electrical connection

Circuit diagram

Direct voltage, polarity-independent



Over-current fuse and switch-off voltage peak

Important

A fuse appropriate for the solenoid's rated current (max. 3 x I_{rated} according to DIN 41571 and/or IEC 60127) or a protective motor switch with short-circuit and thermal instantaneous tripping must be connected to each valve solenoid as short-circuit protection. The cut-off capacity of this fuse must match or exceed the short-circuit current of the supply source.

This fuse or protective motor switch may only be fitted outside the explosive area or must be of an explosion-proof design.

When inductivities are switched off, voltage peaks result which may cause failures in the connected control electronics. For this reason, the valve solenoids comprise a suppression circuit which dampens this voltage peak to the voltage value shown in the table.

Voltage data in the valve type code	Nominal voltage Valve solenoid	Rated current Valve solenoid	Recommended pre-fuse characteristics medium time-lag according to DIN 41571	Maximum voltage value upon switch-off	Suppression circuit
G24	24 V DC	0.542 A DC	630 mA	–90 V	Suppressor diode bi-directional

General information

Seat valves can be used according to the control spool symbols and the related operating pressures and flows (see performance limits page 11).

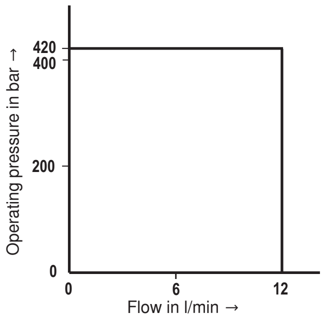
In order to guarantee safe functioning, the following points must imperatively be observed:

- Seat valves have negative spool overlap, i.e. leakage oil occurs during the switching process. This process takes, however, place within such a short time that it is irrelevant in nearly all applications.
- The specified maximum flow must not be exceeded (if necessary, use a throttle insert for the flow limitation)!

Plus-1 plate:

- When the Plus-1 plate (4/2 directional function) is used, the following lower operating values are to be observed: $\boldsymbol{p}_{min}$ = 8 bar, $\boldsymbol{q}_V$ > 3 l/min.
- The ports P, A, B and T are clearly determined according to the tasks. They must not be exchanged or closed arbitrarily!
- Port T must always be connected.
- Pressure level and pressure distribution are to be observed!
- The flow is only permitted in the direction of arrow!

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)



Important:

The specified switching power limits are valid for operation with two directions of flow (e.g. from P → A and simultaneous return flow from B → T).

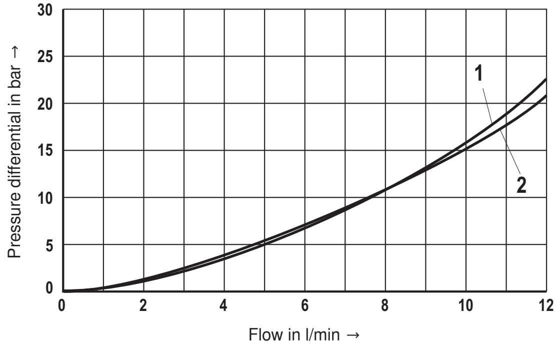
Due to the flow forces acting within the valves, the admissible switching power limit may be considerably lower with only one direction of flow (e.g. from P → A while port B is blocked)!

(In such cases, please consult us.)

The switching power limit was established while the solenoids were at operating temperature, at 10 % undervoltage and without tank pre-loading.

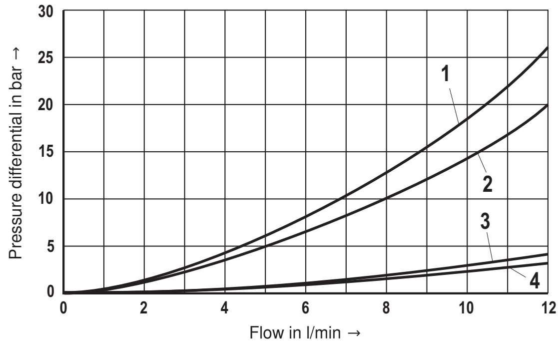
Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C and p = 100 bar)

without Plus-1 plate (M-3SE..)



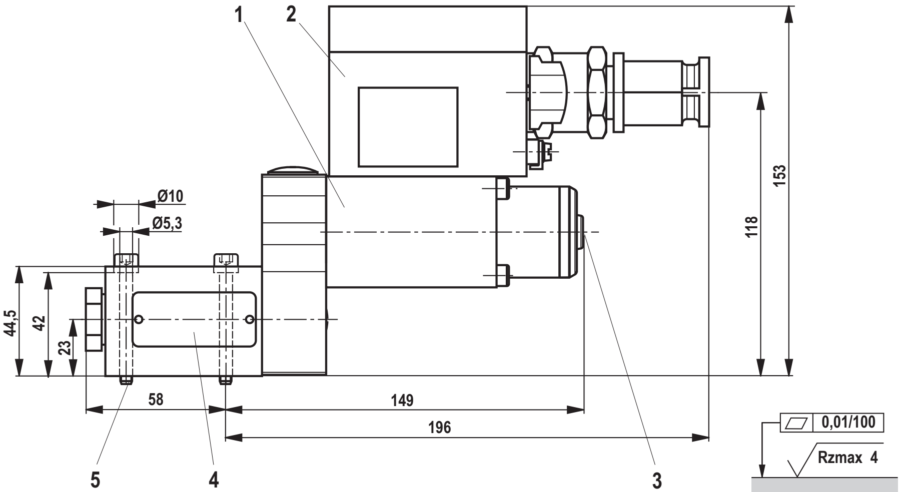
1	A–T
2	P–A

with Plus-1 plate (M-4SE..)

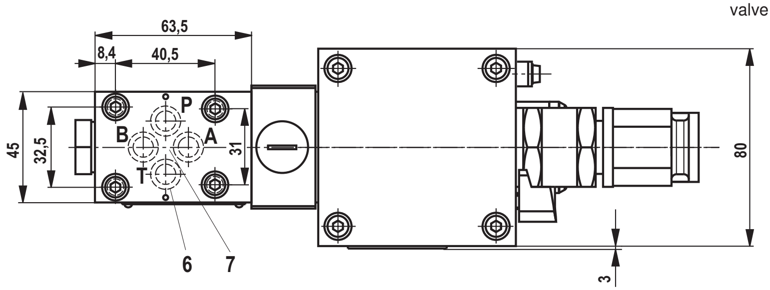


1	A–T
2	P–A
3	P–B
4	B–T

Device dimensions Type M-3SE 6.6X/420LG..NXDZ2/V (dimensions in mm)



Required surface quality of the valve contact surface



1 Valve solenoid
2 Terminal box
3 Manual override
4 Name plate
5 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)
6 Identical seal rings for ports P, A, B, T
7 Porting pattern according to DIN 24340-A6

Subplates (**without** locating hole)

G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

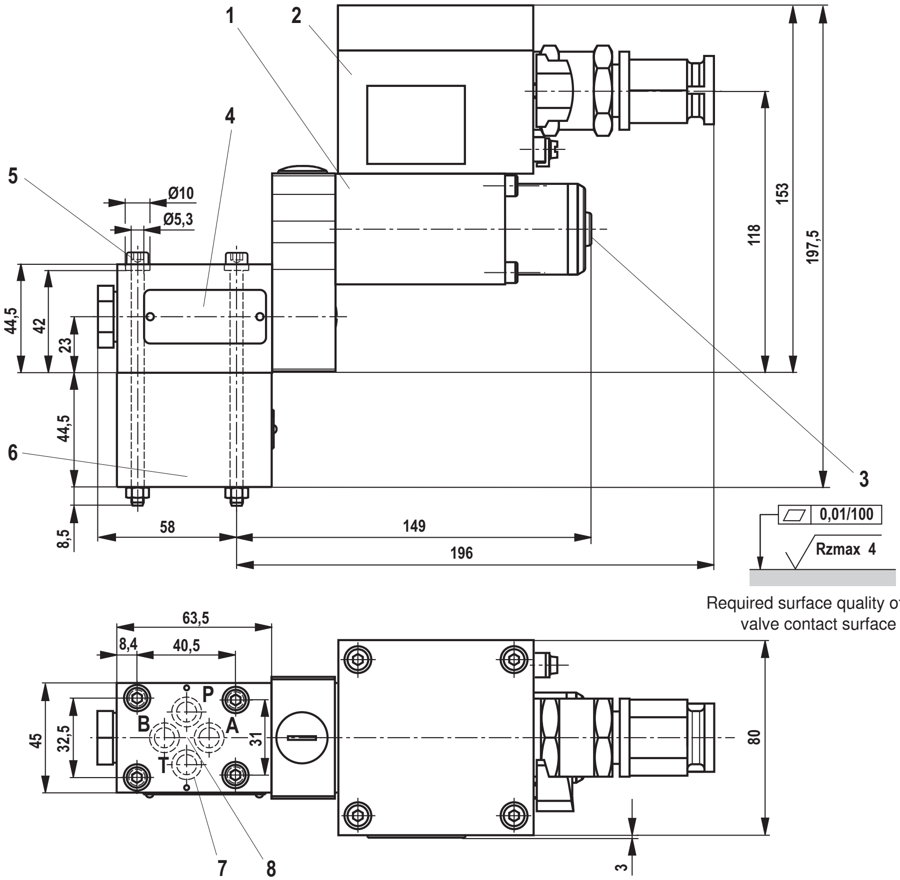
with dimensions as in the data sheet 45052 (must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Device dimensions Type M-4SE 6.6X/420LG..NXDZ2/V (dimensions in mm)



Required surface quality of the valve contact surface

3

- **1** Valve solenoid
- **2** Terminal box
- **3** Manual override
- **4** Name plate
- **5** Valve mounting screws
  For reasons of stability, exclusively use the following valve mounting screws:
  4 hexagon socket head cap screws
  ISO 4762-M5x95-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the scope of delivery)
- **6** Plus-1 plate
- **7** Identical seal rings for ports P, A, B, T
- **8** Porting pattern according to DIN 24340-A6

Subplates (**without** locating hole)

G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

with dimensions as in the data sheet 45052 (must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

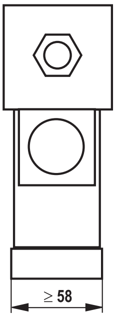
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

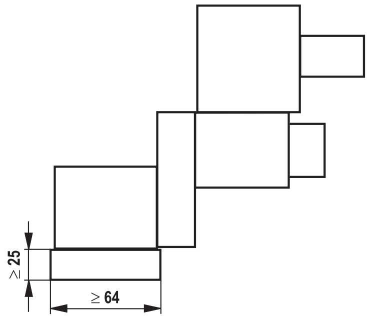
Installation conditions (dimensions in mm)

	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	See schematic diagram below	

Schematic diagram

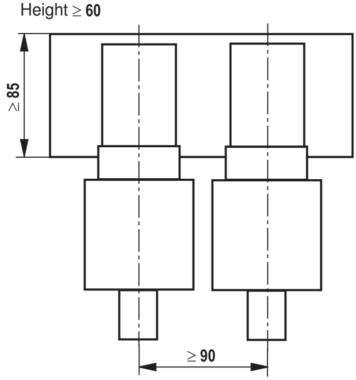
Individual assembly





Bank assembly

Height ≥ 60



Important:

In case of bank assembly, only one solenoid of all valves may be energized at a time.

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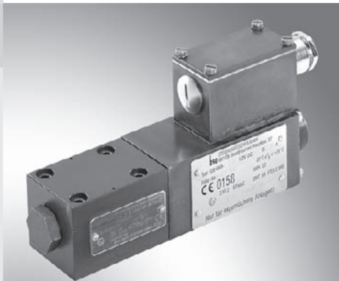
3/2 and 4/2 directional seat valves with solenoid actuation

RE 22047-XH-B2/09.12
Replaces: 05.12

Type E-.SE 6 ...X...
Type W-.SE 6 ...X...

Size 6
Component series 6X
Maximum operating pressure 420 bar
Maximum flow 4 l/min



H7095

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

– Area of application in accordance with the Explosion Protection Directive 94/9/EC: **I M2; II 2G**
– Types of protection of the valve solenoids: Ex ib I Mb / Ex ib IIC T6 Gb according to EN 60079-0:2009 / EN 60079-11:2007

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 22047-XH-B0**
Part II	Data sheet 22047-XH-B2	
Part III	Product-specific instructions 22047-XH-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Direct operated directional seat valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to DIN 24340-A6
- Subplates available in FE/ZN version (see pages 11 to 14)
- Blocked connection tight in a leak-free form
- Safe switching also with longer standstill periods under pressure
- Wet-pin DC solenoids in hydraulic fluid
- Electrical connection with:
  - Individual connection with cable gland
  - Connector

  depending on the valve type
- With manual override

Ordering code and scope of delivery

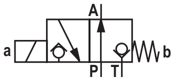
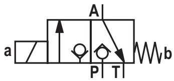
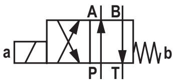
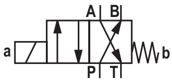
–	SE	6		6X/420	B		N		/	V

Oil-in-water emulsion = E
Water = W

3 main ports = 3
4 main ports = 4

Seat valve

Size 6 = 6

Main ports	3	4	
Control spool symbols			
	•	–	= U
	•	–	= C
	–	•	= D
	–	•	= Y

• = available

Component series 60 to 69 = 6X
(60 to 69: Unchanged installation and connection dimensions)

Operating pressure up to 420 bar = 420

High-power solenoid (switching in hydraulic fluid) = B

Direct voltage 12 V
G12-12 = Nominal power supply 120 mA (only with type **E**–.SE 6..)
G12-19 = Nominal power supply 190 mA (only with type **W**–.SE 6..)

N = With manual override (standard)

XH = Explosion protection "Intrinsically safe" for component group II (all, except for mining)
XM = Explosion protection "Intrinsically safe" for component group I (mining)
Details see information on the explosion protection page 8

Electrical connection
Z2 = Solenoid with terminal box and cable gland (only with type **E**–.SE 6..)
K20ZL = Solenoid with connector facing the valve housing (only with type **W**–.SE 6..)
For details see chapter Electrical connection

no code = Without check valve insert, Without throttle insert
P = With check valve insert
B12 = Throttle Ø 1.2 mm
B15 = Throttle Ø 1.5 mm
B18 = Throttle Ø 1.8 mm
B20 = Throttle Ø 2.0 mm
B22 = Throttle Ø 2.2 mm

V = FKM seals
(other seals upon request)
Important: Observe compatibility of seals with hydraulic fluid used!

Included in the scope of delivery:
- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

Function, section, control spool symbols: 3/2 directional seat valve

General:

The directional valve type .-SE.. is a directional seat valve with solenoid actuation. It controls the start, stop and direction of flow.
It basically comprises a housing (1), the solenoid (2), the hardened valve system (3) and the balls (4.1 and 4.2) as closing element.

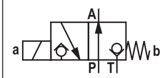
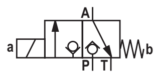
Basic principle:

In the initial position, the ball (4.1) is pressed onto the seat by the spring (7), in spool position, the ball (4.2) is pressed onto the seat by the solenoid (2). The force of solenoid (2) acts via the ball (5) on the actuating plunger (6) that is sealed on two sides. The chamber between the two sealing elements is connected to port P. Thus, the valve system (3) is pressure-compensated in relation to the actuating forces (solenoid or return spring). Thus, the valves can be used up to 420 bar.

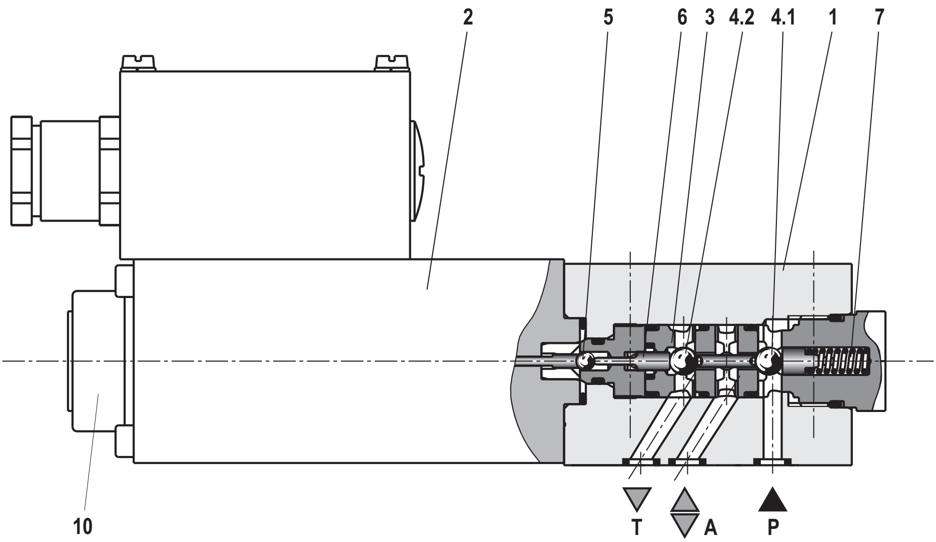
Important

- The 3/2 directional seat valves have a "negative spool overlap". Therefore, port T must always be connected. That means that during the switching process – from the starting of the opening of one valve seat to the closing of the other valve seat – ports P–A–T are connected with each other. This process takes, however, place within such a short time that it is irrelevant in nearly all applications.
- The manual override (10) allows for the switching of the valve without solenoid energization.
- It has to be made sure that the specified maximum flow is not exceeded! A throttle insert must be used for limiting the flow, if necessary (see page 6).
- In order to switch the valve safely or maintain it in its spool position, the pressure situation must be as follows: P ≥ A ≥ T (for design reasons).
- The ports P, A and T (3/2 directional seat valve) are clearly determined according to the tasks. They must not be exchanged or closed. The flow is only permitted in the direction of arrow.

The seat arrangement offers the following options:

Control spool symbol	U 	C 
Initial position	P and A connected, T blocked in a leak-free form	P blocked in a leak-free form, A and T connected
Spool position	P blocked in a leak-free form, A and T connected	P and A connected, T blocked in a leak-free form

Example: Type E-3SE 6 C6X/420BG12-12NX.Z2/V



Function, section, control spool symbols: 4/2 directional seat valve

With a sandwich plate, the **Plus-1 plate**, under the 3/2 directional seat valve, the function of a 4/2 directional seat valve is achieved.

Function of the Plus-1 plate:

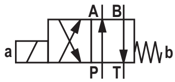
Initial position:
The main valve is not operated. The spring (7) holds the ball (4.1) on the seat (11). Port P is blocked and A connected to T. Apart from that, one pilot line is connected from A to the large area of the control spool (12), which is thus unloaded to the tank. The pressure applied via P now pushes the ball (13) onto the seat (14). Now, P is connected to B, and A to T.

Transition position:
When the main valve is operated, the control spool (8) is shifted against the spring (7) and the ball (4.2) is pressed onto the seat (15). During this, port T is closed, P, A, and B are briefly connected to each other.

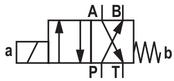
Spool position:
P is connected to A. As the pump pressure acts via A on the large area of the control spool (12), the ball (13) is pressed onto the seat (16). Thus, B is connected to T, and P to A. The ball (13) in the Plus-1 plate has a "positive spool overlap".

The use of the Plus-1 plate and the seat arrangement offer the following options:

Control spool symbol **D:**



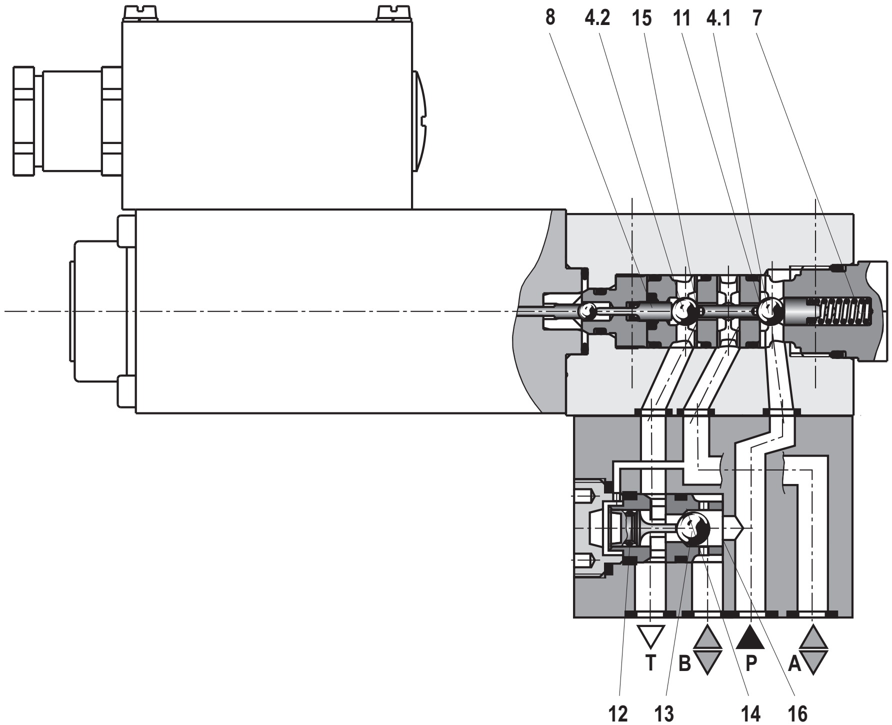
Control spool symbol **Y:**



To prevent pressure intensification in conjunction with single-rod cylinders, the annulus area of the cylinder must be connected to A.

3

Example: Type E-4SE 6 Y6X/420BG12-12NX.Z2/V



Function, section: Throttle insert, check valve insert

Throttle insert

The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

Examples:

– Accumulator operation,

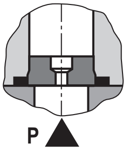
– Use as pilot control valve with internal pilot fluid tapping.

3/2 directional seat valve (see page 4)

The throttle insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)

The throttle insert is inserted in port P of the Plus-1 plate.



Check valve insert

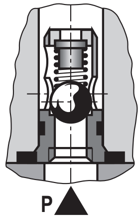
The check valve insert allows free flow from P → A and closes A → P in a leak-free form.

3/2 directional seat valve (see page 4)

The check valve insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)

The check valve insert is inserted in port P of the Plus-1 plate.



Technical data

general

Installation position				Any
Ambient temperature range			°C	–20 … +50
Storage temperature range			°C	+15… +30
Admissible vibration load				20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	3/2 directional seat valve		kg	2.6
	4/2 directional seat valve		kg	3.4
Surface protection	Valve body	Valve type	E	Galvanically coated
		Valve type	W	Stainless steel
	Solenoid			Galvanically coated

hydraulic

Maximum surface temperature		°C	See information on the explosion protection on page 8
Maximum operating pressure	Port P, A, B	bar	420
	Port T	bar	40
Maximum flow		l/min	4
Hydraulic fluid	Valve type	E	HFA, HFB, HFD
	Valve type	W	Water
Hydraulic fluid temperature range		°C	+5 … +50
Viscosity range		mm^2/s	1 … 380
Maximum permitted degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)			Class 20/18/15 [1)] For water-containing liquids, a comparable cleanliness is to be ensured.

electric

Nominal voltage	V	12	
Voltage type		Direct voltage (DC)	
Admissible residual ripple	%	< 5	
Voltage tolerance	%	±10	
Duty cycle / operating mode according to VDE 0580		100 % / S1 (DB)	
Information on the rated current in the ordering code		**G12-12**	**G12-19**
Rated current	mA	120	190
Coil resistance with solenoid temperature 20 °C	Ω	89	59
Minimum current for achieving the hydraulic switching power	mA	88	143
Switching times according to ISO 6403	ms	See table page 9	
Switch-off voltage peak Solenoid	V	Max. –3	
Protection class according to EN 60529 [2)]		IP 65	

1) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see www.boschrexroth.com/filter.

2) With correctly installed electrical connection

3

Technical data

Information on the explosion protection

Ordering code		G12-12		G12-19
Ordering code		XM	XH	XM
Area of application as per directive 94/9/EC		I M2	II 2G	I M2
Type of protection valve solenoid according to EN 60079-0:2009 / EN 60079-11:2007		Ex ib I Mb	Ex ib IIC T6 Gb	Ex ib I Mb
Maximum surface temperature [1]	°C	80		80
Temperature class		–	T6	–
Type examination certificate Solenoid		BVS 08 ATEX E 023		
"IEC Certificate of Conformity" Solenoid		IECEx BVS 07.0008		
Type of protection Valve		c (EN 13463-5:2011)		
Special operating conditions for a safe application		–		

Safety-related maximum values of the solenoids depending on the component group and the type of the electrical connection

Component group		**I (mining)**		**II (all, except for mining)**
Ordering code for explosion protection		**XM**		**XH**
Ordering code for solenoid		**G12-12**	**G12-19**	**G12-12**
Electrical connection Z2				
Maximum voltage U_i	V DC	15	Version not available	27
Maximum current I_i	A	2		2
Effective inner inductivity L_i	nH	Neglectable		Neglectable
Effective inner capacity C_i	pF	Neglectable		Neglectable
Ambient temperature range	°C	–20…+50		–20…+50
Electrical connection K20ZL				
Maximum voltage U_i	V DC	Version not available	15	Version not available
Maximum current I_i	A		2	
Effective inner inductivity L_i	nH		Neglectable	
Effective inner capacity C_i	pF		Neglectable	
Ambient temperature range	°C		–20…+50	

[1] Surface temperature > 50 °C, provide contact protection

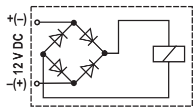
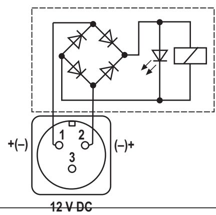
Switching times t in ms (installation position: Solenoid horizontal)

Type **.-**3SE 6 **C** 6X/… and type **.-**3SE 6 **U** 6X/…

Pressure p in bar	Flow q_V in l/min	with solenoid **G12-12**								with solenoid **G12-19**							
		t_{on} without tank pressure				t_{off}				t_{on} without tank pressure				t_{off}			
		C	U	Y	D	C	U	Y	D	C	U	Y	D	C	U	Y	D
70	4	220	265	230	275	95	85	105	95	140	160	150	170	110	100	120	110
140	4	260	265	270	275	100	90	110	100	150	165	160	175	120	110	130	120
280	4	320	260	330	270	115	110	125	120	170	170	180	180	125	135	135	145
320	4	350	260	360	270	120	115	130	125	175	170	185	180	130	140	140	150
420	4	360	260	370	270	120	130	130	140	185	170	195	180	135	145	145	155

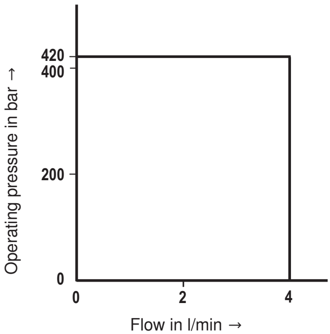
Electrical connection

The type-examination tested valve solenoid of the valve is equipped with an electrical connection according to the following table. The electrical connection of the solenoid is polarity-independent.

Ordering code for the electrical connection	Type of connection Description	Circuit diagram	Ordering code for the solenoid, availability
Z2	– Electrical connection via 2-pole terminal in terminal box – with cable gland – without operating display		**G12-12** (120 mA)
	Cable gland		
	Threaded connection	M20x1.5	
	Line diameter mm	6.5...9.5 [1]	
	Sealing	Outer sheath sealing	
	Connection terminal Solenoid		
	For line cross-section mm^2	0.75 … 1.5	
K20ZL	– Electrical connection via connector, 3-pole with pin contacts, type 845-11-1125-001, FCI/Souriau – Connector facing the valve housing – Operating display via light emitting diode (LED), red – Suitable mating connector, type 845-11-8522-001, FCI/Souriau, must be ordered separately		**G12-19** (190 mA)

[1] Larger diameters upon request

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)



Important:

The specified switching power limits are valid for operation with two directions of flow (e.g. from P → A and simultaneous return flow from B → T).

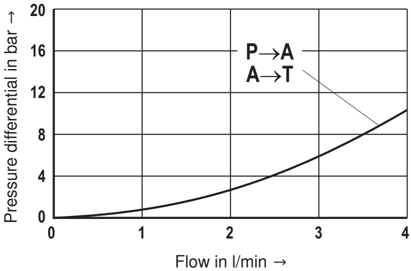
Due to the flow forces acting within the valves, the admissible switching power limit may be considerably lower with only one direction of flow (e.g. from P → A while port B is blocked)!

(In such cases, please consult us.)

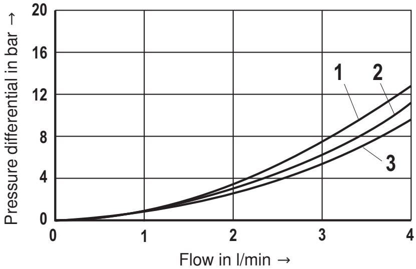
The switching power limit was established while the solenoids were at operating temperature, at 10 % undervoltage and without tank pre-loading.

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C and p = 100 bar)

Type .-3SE 6…

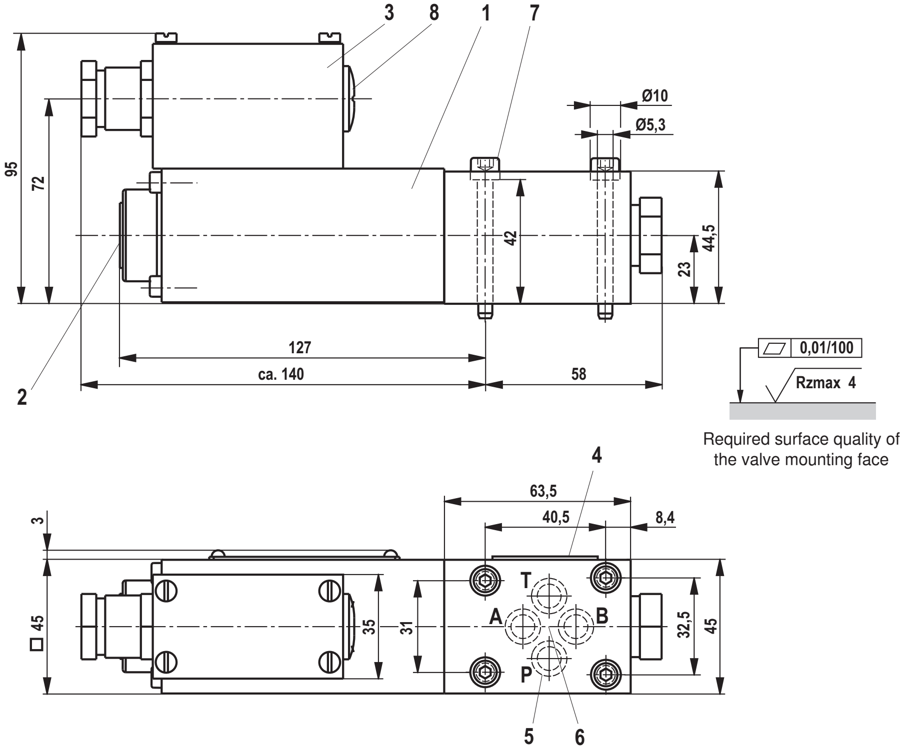


Type .-4SE 6…



1 = A → T
2 = P → A
3 = B → T, P → B

Unit dimensions type E-3SE 6 …BG12-12X.Z2/... (dimensions in mm)



Required surface quality of the valve mounting face

1 Valve solenoid
2 Manual override
3 Terminal box
4 Name plate
5 Identical seal rings for ports P, A, B, T
6 Porting pattern according to DIN 24340-A6
7 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)
8 Plug screw

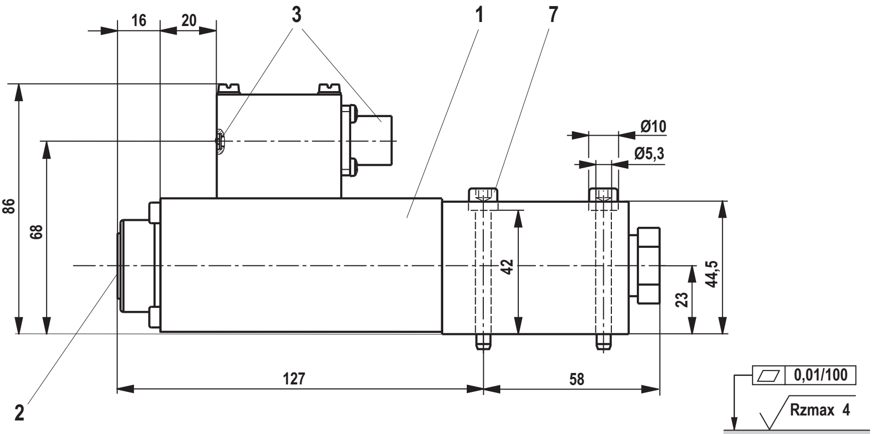
Subplates (**without** locating hole)
G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)
with dimensions as in the data sheet 45052
(must be ordered separately)

Important:

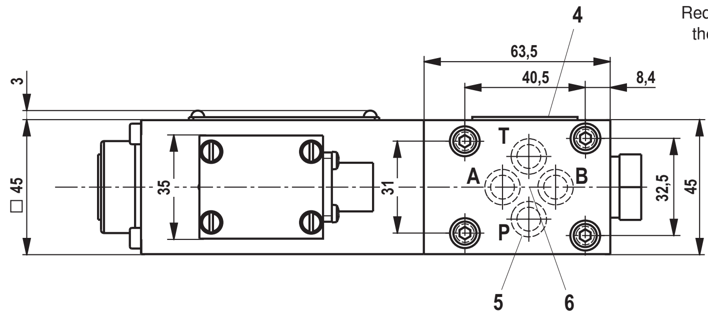
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Unit dimensions type W-3SE 6 …BG12-19X.K20ZL/...(dimensions in mm)



Required surface quality of the valve mounting face



- **1** Valve solenoid
- **2** Manual override
- **3** Operating display and connector
- **4** Name plate
- **5** Identical seal rings for ports P, A, B, T
- **6** Porting pattern according to DIN 24340-A6
- **7** Valve mounting screws
  For reasons of stability, exclusively use the following valve mounting screws:
  4 hexagon socket head cap screws
  ISO 4762-M5x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the scope of delivery)

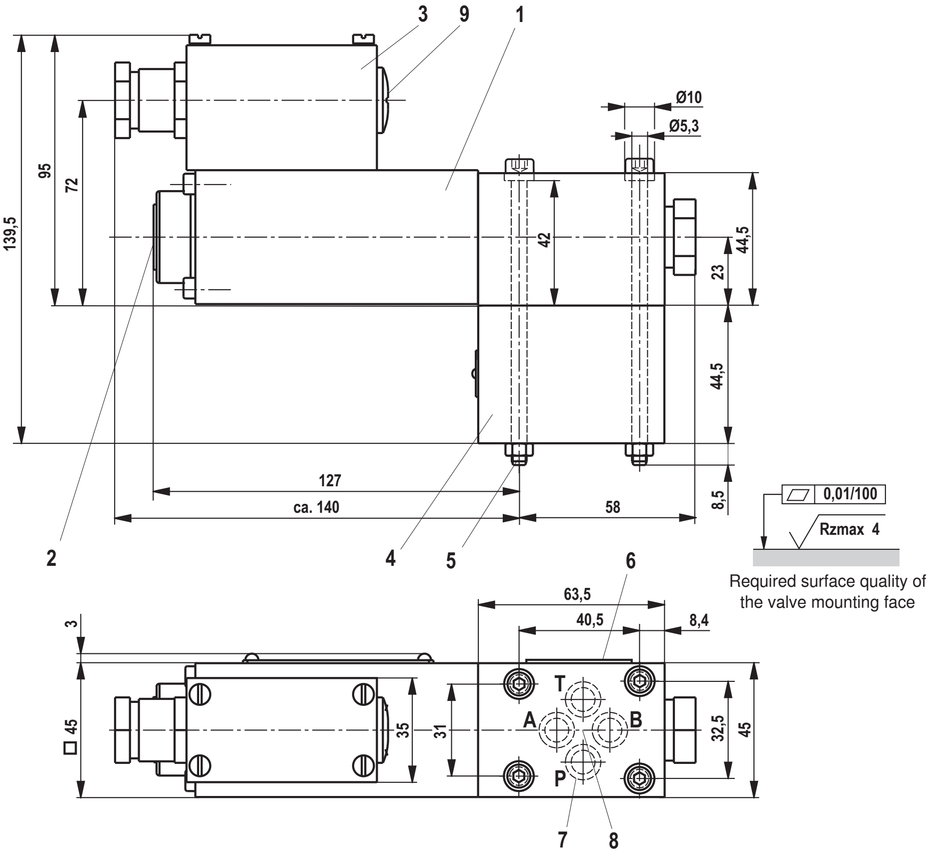
Subplates (**without** locating hole)
with dimensions as in the data sheet 45052 (upon request)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Unit dimensions type E-4SE 6 …BG12-12X.Z2/... (dimensions in mm)

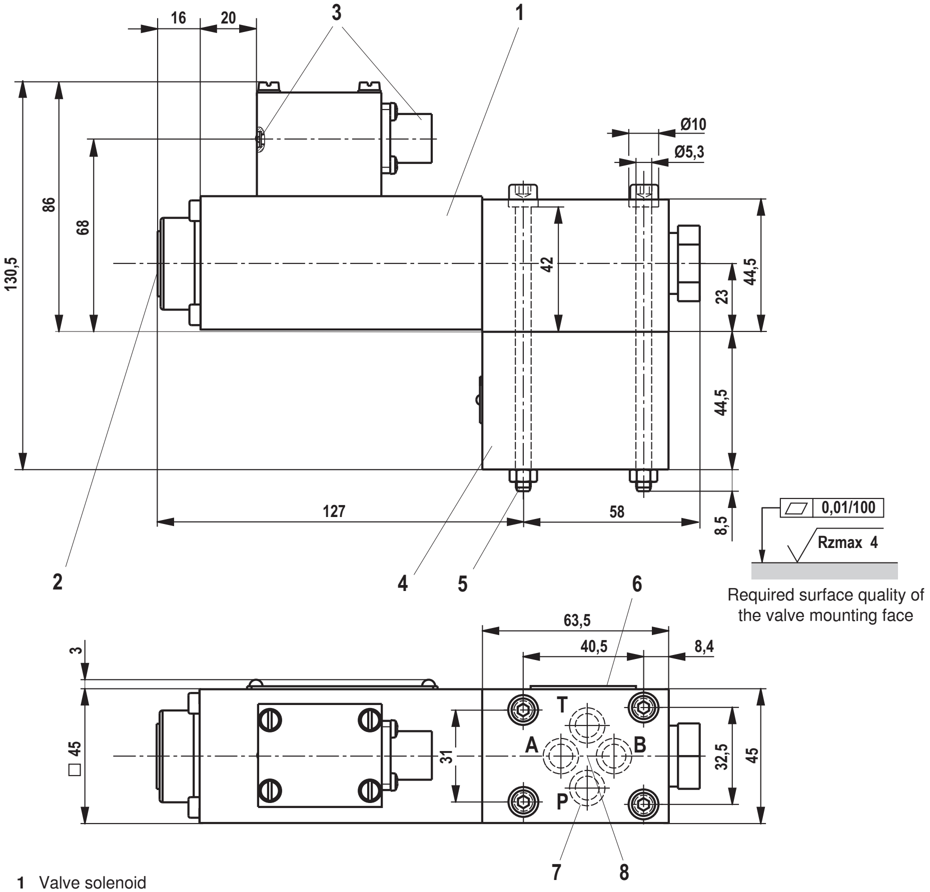


1 Valve solenoid
2 Manual override
3 Terminal box
4 Plus-1 plate
5 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x95-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)
6 Name plate
7 Identical seal rings for ports P, A, B, T
8 Porting pattern according to DIN 24340-A6
9 Plug screw

Subplates (**without** locating hole)
G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)
with dimensions as in the data sheet 45052
(must be ordered separately)

Important:
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Unit dimensions type W-4SE 6 …BG12-19X.K20ZL/... (dimensions in mm)



1 Valve solenoid
2 Manual override
3 Operating display and connector
4 Plus-1 plate
5 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x95-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)
6 Name plate
7 Identical seal rings for ports P, A, B, T
8 Porting pattern according to DIN 24340-A6

Subplates (**without** locating hole)
with dimensions as in the data sheet 45052 (upon request)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

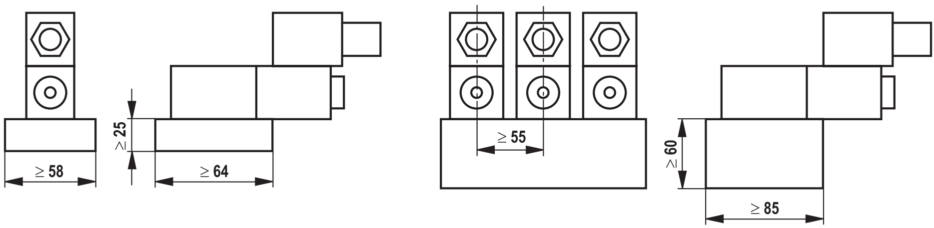
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Installation conditions (dimensions in mm)

	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Heat conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram

Individual assembly Bank assembly



Notes

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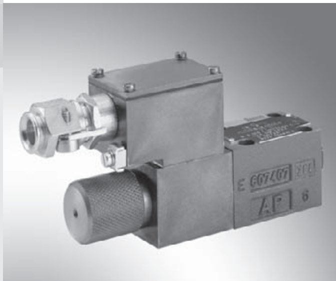
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

3/2 and 4/2 directional seat valves with solenoid actuation

RE 22049-XE-B2/09.13
Replaces: 01.10

Type M-.SED 6...XE...



H6998

Actual product may differ

Size 6
Component series 1X
Maximum operating pressure 350 bar
Maximum flow 25 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
- Type of protection of the valve solenoid: Ex e mb IIC T4 Gb according to EN 60079-7: 2007 / EN 60079-18: 2009

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	
Part II	Data sheet 22049-XE-B2	**Operating instructions 22049-XE-B0**
Part III	Product-specific instructions 22049-XE-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Contents **Page**

Features

- Direct operated directional seat valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to DIN 24340-A6
- Subplates available in FE/ZN version (see pages 12 to 15)
- Blocked port is tight
- Safe switching also with longer standstill periods under pressure
- Wet-pin DC and AC solenoids
- Solenoid coil can be rotated by 90°
- Electrical connection as individual connection with cable gland
- With concealed manual override, optional

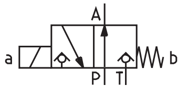
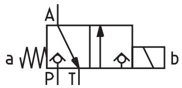
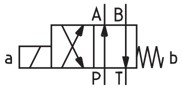
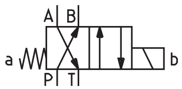
Ordering code and scope of delivery

M –		SED	6		1X /	350	C			XE	Z2 /	

3 main ports **= 3**
4 main ports **= 4**

Seat valve, electric, direct operated

Size 6 **= 6**

Main ports	3	4	
Control spool symbols			
	•	–	**= UK**
	•	–	**= CK**
	–	•	**= D**
	–	•	**= Y**

• = Available

Component series 10 to 19 **= 1X**
(10 to 19: Unchanged installation and connection dimensions)

Operating pressure up to 350 bar **= 350**

Solenoid, wet-pin **= C**

Direct voltage 24 V **= G24**
AC voltage 230 V, 50/60 Hz **= W230R**
For further ordering codes for other voltages, see page 9.

N9 = With concealed manual override
no code = Without manual override

XE = Explosion protection "increased safety", for details, see information on the explosion protection on page 7

Electrical connection
Z2 = Solenoid with terminal box and cable gland, for details see chapter Electrical connection

no code = Without check valve insert, without throttle insert
P = With check valve insert
B12 = Throttle Ø 1.2 mm
B15 = Throttle Ø 1.5 mm
B18 = Throttle Ø 1.8 mm
B20 = Throttle Ø 2.0 mm
B22 = Throttle Ø 2.2 mm

no code = NBR seals
V = FKM seals
Important:
Observe compatibility of seals with hydraulic fluid used!

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in Part III

3

Function, section, control spool symbols: 3/2 directional seat valve

General:

The directional valve type M-.SED is a direct operated directional seat valve with solenoid actuation. It controls the start, stop and direction of flow and basically comprises a housing (1), the solenoid (2), the valve seats (7) and (11) and the control spool (4).

The manual override (6) allows for the switching of the valve without solenoid energization.

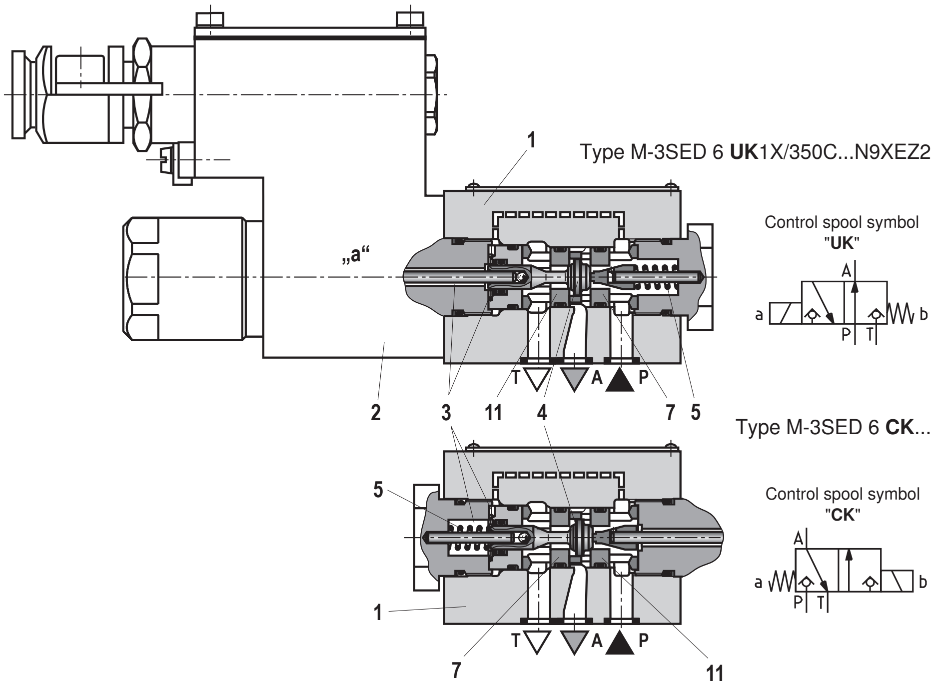
Basic principle:

The initial position of the valve (normally open "UK" or normally closed "CK") is determined by the arrangement of the spring (5). The chamber (3) behind the control spool (4) is connected to port P and sealed against port T. Thus, the valve is pressure-compensated in relation to the actuating forces (solenoid and spring).

By means of the control spool (4), the ports P, A and T can be loaded with the maximum operating pressure (350 bar) and the flow can be directed in both directions (see control spool symbols).

In the initial position, the control spool (4) is pressed onto the seat (11) by the spring (5), in spool position, it is pressed onto the seat (7) by the solenoid (2). The flow is blocked in a leak-free manner.

Seat valves can be used according to the control spool symbols and the related operating pressures and flows (see Performance limits page 10).



Function, section, control spool symbols: 4/2 directional seat valve

With a sandwich plate, the **Plus-1 plate**, under the 3/2 directional seat valve, the function of a 4/2 directional seat valve is achieved.

Function of the Plus-1 plate:

Initial position:

The main valve is not operated. The spring (5) holds the control spool (4) on the seat (11). Port P is blocked and A connected to T. Apart from that, one control line is connected from A to the large area of the control spool (8), which is thus unloaded to the tank. The pressure applied via P now pushes the ball (9) onto the seat (10). Now, P is connected to B, and A to T.

Transition position:

When the main valve is operated, the control spool (4) is shifted against the spring (5) and pressed onto the seat (7). During this, port T is blocked, P, A, and B are briefly connected to each other.

Spool position:

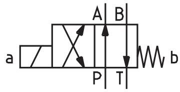
P is connected to A. As the pump pressure acts via A on the large area of the control spool (8), the ball (9) is pressed onto the seat (12). Thus, B is connected to T, and P to A. The ball (9) in the Plus-1 plate has a "positive spool overlap".

Important:

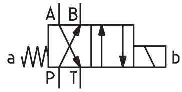
To prevent pressure intensification in conjunction with differential cylinders, the annulus area of the cylinder must be connected to A.

The use of the Plus-1 plate and the seat arrangement offer the following options:

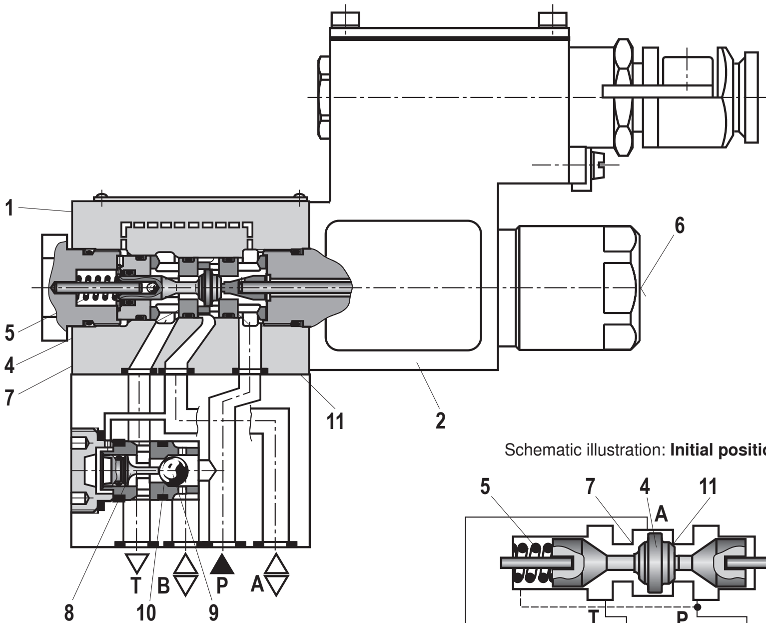
Control spool symbol "**D**"



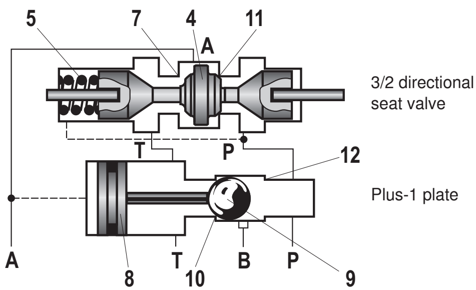
Control spool symbol "**Y**"



Type M-4SED 6 **Y**1X/350C...N9XEZ2



Schematic illustration: **Initial position**



Function, section: Throttle insert, check valve insert

Throttle insert

The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

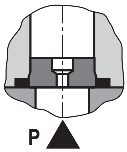
Examples:

– Accumulator operation,

– Use as pilot control valve with internal pilot fluid tapping.

3/2 directional seat valve (see page 4)
The throttle insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The throttle insert is inserted in port P of the Plus-1 plate.

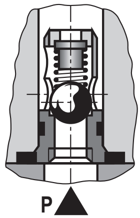


Check valve insert

The check valve insert allows free flow from P → A and closes A → P in a leak-free way.

3/2 directional seat valve (see page 4)
The check valve insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The check valve insert is inserted in port P of the Plus-1 plate.



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20 … +70 [1]
Storage temperature range		°C	–20 … +50
Admissible vibration load			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	3/2 directional seat valve	kg	3.1
	4/2 directional seat valve	kg	3.9
Surface protection			Galvanized coating

hydraulic

Maximum operating pressure	bar	See table on page 10
Maximum flow	l/min	25
Hydraulic fluid		Mineral oil (HL, HLP) according to DIN 51524 [2]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also RE 90221); HETG (rape seed oil) [2]; HEPG (polyglycols) [3]; HEES (synthetic esters) [3]; Other hydraulic fluids upon request Ignition temperature > 180 °C
Hydraulic fluid temperature range	°C	–20 ... +80 (for NBR seals)
		–15 ... +80 (for FKM seals)
Viscosity range	mm^2/s	2.8 … 500
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)		Class 20/18/15 [4]

[1] Observe the "Special conditions for safe use" on page 7.

[2] Suitable for NBR **and** FKM seals

[3] Suitable **only** for FKM seals

[4] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

Technical data

electric

Voltage type		Direct voltage	Alternating voltage 50/60 Hz
Available voltages	V	24, 48, 96, 110	110, 230
Voltage tolerance (nominal voltage)	%	–5 / +10	
Admissible residual ripple	%	< 5	–
Duty cycle/operating mode according to VDE 0580		100 % / S1 (continuous operation)	
Switching time according to ISO 6403		See table below	
Switching frequency	1/h	up to 15000	up to 7200
Nominal power at ambient temperature 20 °C	W	17	
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C	W	20.6	
Protection class according to EN 60529		IP 66 [1]	

[1] If the electrical connection is correctly installed

Information on the explosion protection

Area of application as per directive 94/9/EC		II 2G
Type of protection Valve		c (EN 13463-5:2011)
Maximum surface temperature [1] Temperature class	°C	135 T4
Type of protection Valve solenoid according to EN 60079-7:2007 / EN 60079-18:2009		Ex e mb IIC T4 Gb
Type examination certificate Solenoid		KEMA 02ATEX2240 X
"IECEx Certificate of Conformity" Solenoid		IECEx DEK 12.0068X
Ambient temperature range	°C	–20 … +70 [2]
Special conditions for safe use		– Maximum ambient temperature: In case of bank assembly, as long as only one solenoid is energized at a time, and in case of individual assembly: +70 °C In case of bank assembly when more than one solenoid is energized at a time: +60 °C – The maximum temperature of the valve casing surface is 120 °C. This has to be considered when selecting the connection cable and contact of the connection cable with the casing surface is to be prevented.

[1] Surface temperature > 50 °C, provide contact protection

[2] Observe the "Special conditions for safe use"

Switching times *t* in ms (Installation position: Solenoid horizontal)

		DC solenoid						**AC solenoid**							
		Control spool symbols UK, CK, D and Y						Control spool symbols UK, CK, D and Y							
		t_{on} without tank pressure				t_{off}		t_{on} without tank pressure				t_{off}			
Pressure p in bar	**Flow q_V in l/min**	**UK**	**CK**	**D**	**Y**	**UK CK**	**D Y**	**UK**	**CK**	**D**	**Y**	**UK**	**CK**	**D**	**Y**
70	25	50	45	55	50	10	10	50	65	55	70	50	45	55	50
140	25	65	45	70	50	10	15	55	65	60	70	50	50	55	55
210	25	75	55	80	60	10	15	65	65	70	70	50	55	55	60
280	25	90	55	95	60	15	20	80	65	85	70	50	65	55	70
315	25	95	55	100	60	15	20	95	65	100	70	50	65	55	70
350	25	100	55	105	60	20	25	110	65	115	70	50	65	55	70

3

Electrical connection

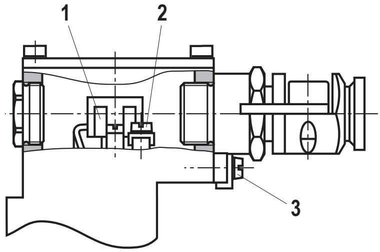
The type-examination tested valve solenoid of the valve is equipped with a terminal box and a type-tested cable gland.

The connection is polarity-independent.

Solenoids to be connected to AC voltage are equipped with an integrated rectifier.

Important

When establishing the electrical connection, the protective earthing conductor (PE ⏚) has to be connected properly.



Properties of the connection terminals

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 … 2.5 mm^2 Finely stranded 0.75 … 1.5 mm^2
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm^2 Finely stranded max. 1.5 mm^2
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm^2 Finely stranded 4 mm^2

Cable gland

Type approval		II 2G Ex e IIC Gb
Threaded connection		M20 x 1.5
Protection class according to EN 60529		IP66 [1)]
Line diameter	mm	9 … 11
Sealing		Outer sheath sealing

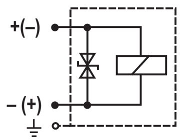
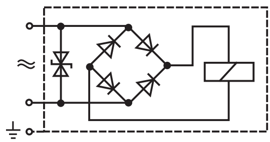
Connection line

Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–30 … > +110

1) If installed properly

Electrical connection

Circuit diagrams

Direct voltage, polarity-independent	Alternating voltage
	

Over-current fuse and switch-off voltage peaks

Important:

Corresponding to the rated current, a fuse according to DIN 41571 and EN / IEC 60127 has to be connected ahead of every valve solenoid (max. 3 x I_{rated}).

The shut-off threshold of the fuse has to match the prospective short-circuit current of the supply source.

The prospective short-circuit current of the supply source may amount to a maximum of 1500 A.

This fuse may only be installed outside the explosive area or must be of an explosion-proof design.

When inductivities are switched off, voltage peaks are the result which may cause faults in the connected control electronics. For this reason, the valve solenoids comprise an interference protection circuit which dampens this voltage peak to the voltage value shown in the table.

3

Voltage data in the valve type code	Nominal voltage valve solenoid	Rated current valve solenoid	Rated current external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Rated voltage of external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Maximum voltage value upon switch-off	Interference protection circuit
G24	24 V DC	0.708 A DC	800 mA	250 V	–90 V	Suppressor diode bi-directional
G48	48 V DC	0.354 A DC	400 mA	250 V	–200 V	
G96	96 V DC	0.177 A DC	200 mA	250 V	–370 V	
G110	110 V DC	0.155 A DC	200 mA	250 V	–390 V	
W110R	110 V AC	0.163 A AC	200 mA	250 V	–3 V	Bridge rectifier and suppressor diode
W230R	230 V AC	0.078 A AC	80 mA	250 V	–3 V	

General information

Seat valves can be used according to the control spool symbols and the related operating pressures and flows (see performance limits below).

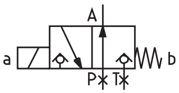
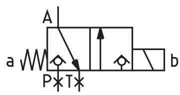
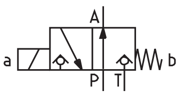
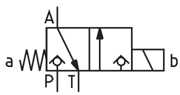
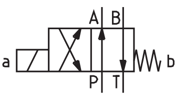
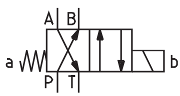
In order to guarantee safe functioning, the following points must imperatively be observed:

- Seat valves have negative spool overlap, i.e. leakage oil occurs during the switching process. However, this process takes place within such a short time that it is irrelevant in nearly all applications.
- The specified maximum flow must not be exceeded (if necessary, use a throttle insert for the flow limitation).

Plus-1 plate:

- When the Plus-1 plate (4/2 directional function) is used, the following lower operating values have to be observed: $\boldsymbol{p}_{min}$ = 8 bar, $\boldsymbol{q}_V$ > 3 l/min.
- The ports P, A, B and T are clearly determined according to the tasks. They must not be exchanged or closed.
- Port T must always be connected.
- Pressure level and pressure distribution are to be observed.
- The flow is only admissible in the direction of the arrow.

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

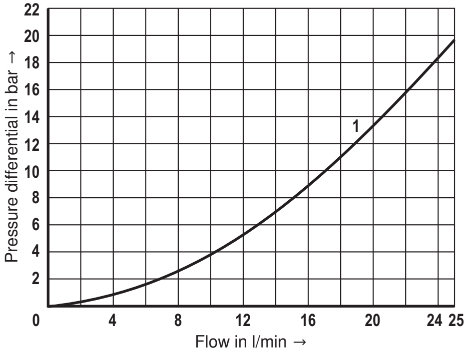
	Control spool symbol	Comment	Operating pressure in bar				Flow in l/min
			P	A	B	T	
2-way circuit	"UK" 	With 2/2-way circuits, port P **or** T must be closed by the customer!	350	350		350	25
	"CK" 		350	350		350	25
3-way circuit	"UK" 		350	350		350	25
	"CK" 		350	350		350	25
4-way circuit (flow only possible in the direction of arrow)	"D" 	3/2 directional valve (symbol "UK") in connection with Plus-1 plate: $p_P \geq p_A \geq p_B \geq p_T$	350	350	350	P/A/B –40	25
	"Y" 	3/2 directional valve (symbol "CK") in connection with Plus-1 plate: $p_P \geq p_A \geq p_B \geq p_T$	350	350	350	P/A/B –40	25

Important

The switching power limits were established while the solenoids were at operating temperature, at 10% undervoltage and without tank preloading.

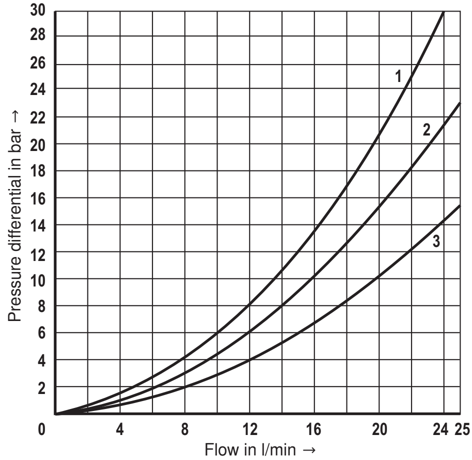
Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δp - q_V characteristic curves
3/2 directional seat valve



1 M-3SED 6 **UK(CK)**…, P → A and A → T

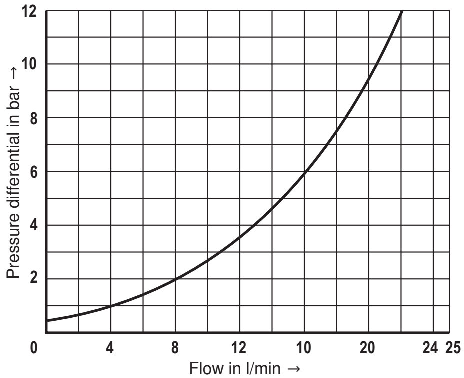
Δp - q_V characteristic curves
4/2 directional seat valve



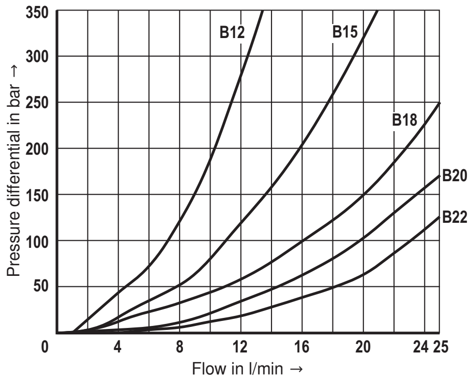
1 M-4SED 6 **D(Y)**…, A → T
2 M-4SED 6 **D(Y)**…, P → A
3 M-4SED 6 **D(Y)**…, B → T, P → B

3

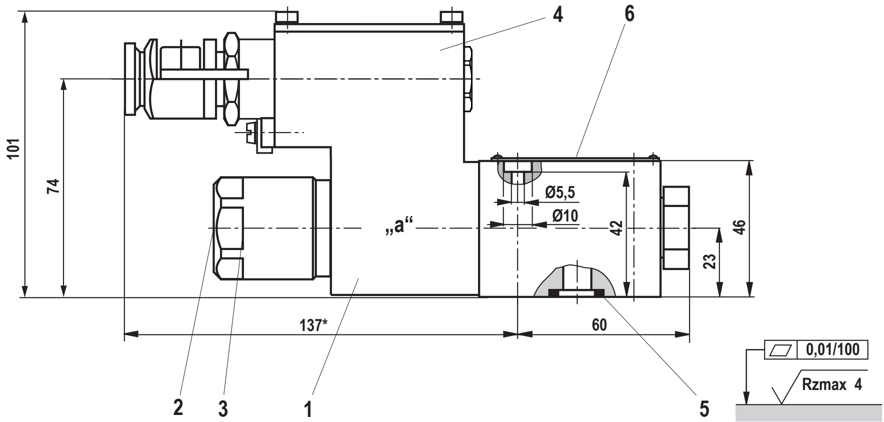
Δp - q_V characteristic curves
Check valve insert



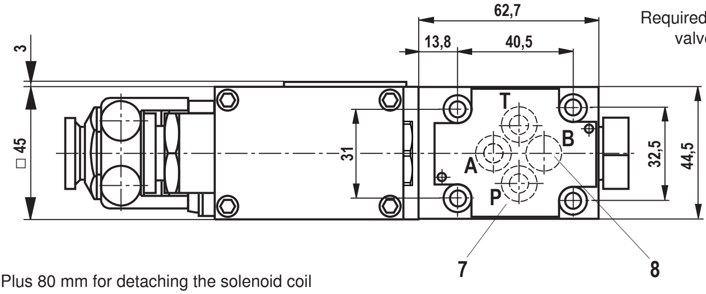
Δp - q_V characteristic curves
Throttle insert



Dimensions: 3/2 directional seat valve – design "UK" (dimensions in mm)



Required surface quality of the valve contact surface



* Plus 80 mm for detaching the solenoid coil

1. **1** Solenoid coil
2. **2** Concealed manual override "N9"
3. **3** Mounting nut with hexagon SW32
4. **4** Terminal box
5. **5** Identical seal rings for ports A, B, T seal ring for port P
6. **6** Name plate
7. **7** Porting pattern according to DIN 24340-A6
8. **8** Port B is designed as blind counterbore

Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(must be ordered separately)

Subplates

G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

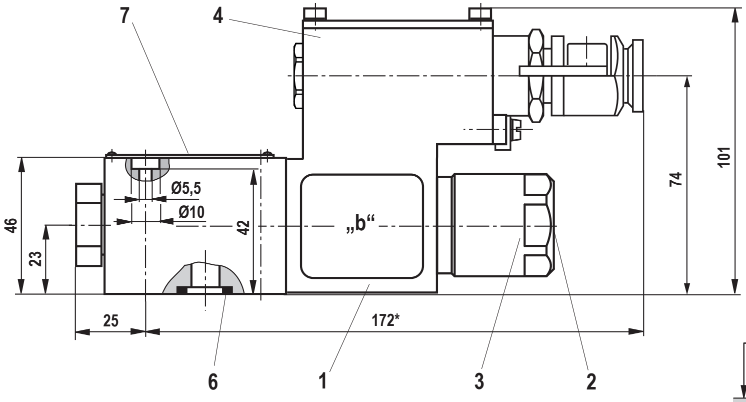
with dimensions as in the data sheet 45052
(must be ordered separately)

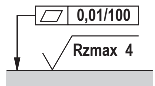
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

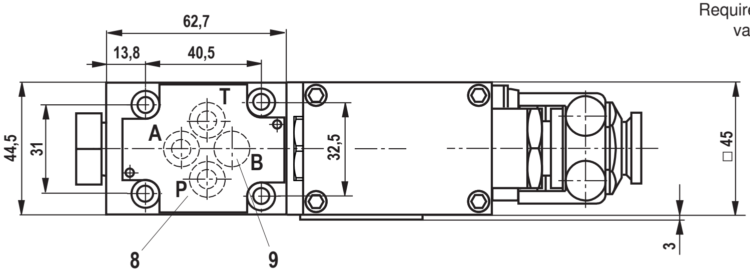
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Dimensions: 3/2 directional seat valve – design "CK" (dimensions in mm)





Required surface quality of the valve contact surface



* Plus 80 mm for detaching the solenoid coil

1 Solenoid coil
2 Concealed manual override "N9"
3 Mounting nut with hexagon SW32
4 Terminal box
5 Space required to remove the solenoid coil
6 Identical seal rings for ports A, B, T
seal ring for port P
7 Name plate
8 Porting pattern according to DIN 24340-A6
9 Port B is designed as blind counterbore

Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(must be ordered separately)

Subplates

G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

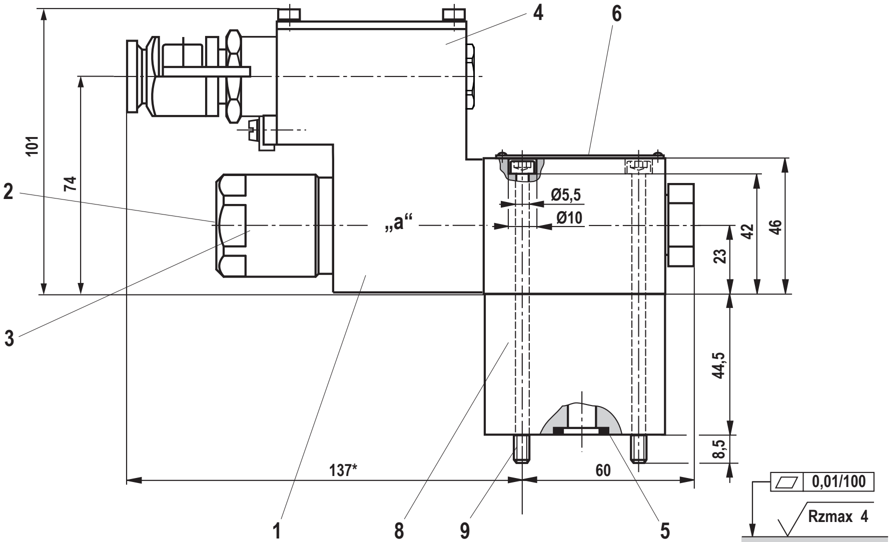
with dimensions as in the data sheet 45052
(must be ordered separately)

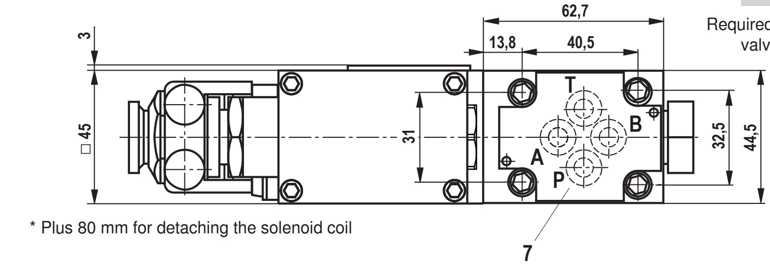
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Dimensions: 4/2 directional seat valve – design "D" (dimensions in mm)





Required surface quality of the valve contact surface

* Plus 80 mm for detaching the solenoid coil

1 Solenoid coil
2 Concealed manual override "N9"
3 Mounting nut with hexagon SW32
4 Terminal box
5 Identical seal rings for ports A, B, T
seal ring for port P
6 Name plate
7 Porting pattern according to DIN 24340-A6
8 Plus-1 plate
9 **Valve mounting screws**
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x95-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)

Subplates

G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

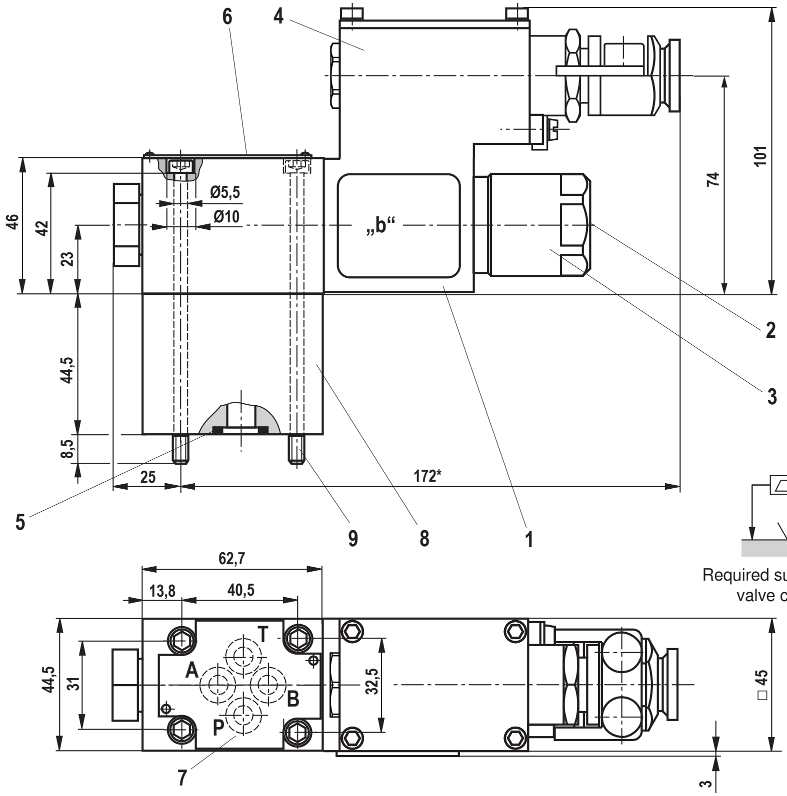
with dimensions as in the data sheet 45052 (must be ordered separately)

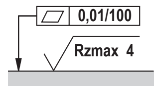
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Dimensions: 4/2 directional seat valve – design "Y" (dimensions in mm)





Required surface quality of the valve contact surface

* Plus 80 mm for detaching the solenoid coil

1 Solenoid coil
2 Concealed manual override "N9"
3 Mounting nut with hexagon SW32
4 Terminal box
5 Identical seal rings for ports A, B, T
seal ring for port P
6 Name plate
7 Porting pattern according to DIN 24340-A6
8 Plus-1 plate
9 **Valve mounting screws**
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x95-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)

Subplates

G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

with dimensions as in the data sheet 45052
(must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

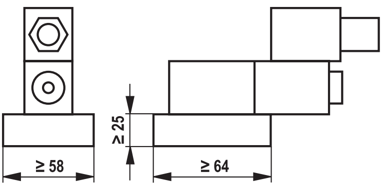
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Installation conditions (dimensions in mm)

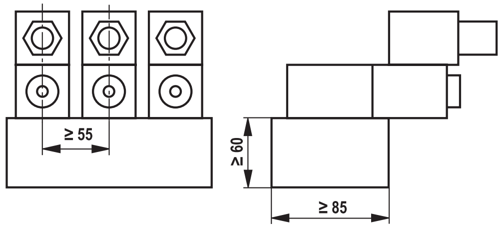
	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram

Individual assembly



Bank assembly



Important:

Observe the "Special conditions for safe use" on page 7.

Bosch Rexroth AG
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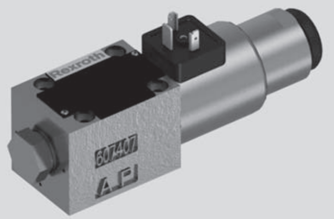
3/2 and 4/2 directional seat valves with solenoid actuation

RE 22049-XN-B2/08.12
Replaces: 07.10

Type M-.SED 6...XN...



Size 6
Component series 1X
Maximum operating pressure 350 bar
Maximum flow 25 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

– Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 3G; II 3D**
– Type of protection of the valve solenoid:
  Ex nA IIC T3 Gc according to EN 60079-15:2010 and
  Ex tc IIIC T140°C Dc IP65 according to EN 60079-31:2009

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 22049-XN-B0**
Part II	Data sheet 22049-XN-B2	
Part III	Product-specific instructions 22049-XN-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Contents	Page

Features

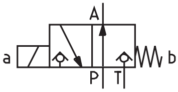
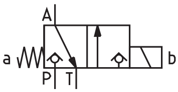
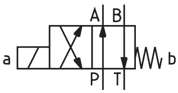
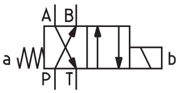
- Direct operated directional seat valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to DIN 24340-A6
- Subplates available in FE/ZN version (see pages 12 to 15)
- Blocked connection tight in a leak-free form
- Safe switching also with longer standstill periods under pressure
- Wet-pin DC solenoids
- Solenoid coil rotatable by 90 °
- Electrical connection as individual connection with connector according to EN 175301-803, design A
- With manual override, optional

Ordering code and scope of delivery

M–	SED	6		1X / 350	C	G24		XN	K4 /	

3 main ports **= 3**
4 main ports **= 4**

Size **= 6**

Main ports	3	4	
Control spool symbols			
	•	–	**= UK**
	•	–	**= CK**
	–	•	**= D**
	–	•	**= Y**
	• = Available		

Component series 10 to 19 (10 to 19: Unchanged installation and connection dimensions) **= 1X**

Operating pressure up to 350 bar **= 350**

Solenoid, wet-pin **= C**

G24 = Direct voltage 24 V

N9 = With manual override
no code = Without manual override

XN = Explosion protection "Non-sparking", Details see information on the explosion protection page 7

Electrical connection
K4 = Solenoid without mating connector
For details see chapter Electrical connection

no code = Without check valve insert, without throttle insert
P = With check valve insert
B12 = Throttle Ø 1.2 mm
B15 = Throttle Ø 1.5 mm
B18 = Throttle Ø 1.8 mm
B20 = Throttle Ø 2.0 mm
B22 = Throttle Ø 2.2 mm

Seal material
no code = NBR seals
V = FKM seals
Important: Observe compatibility of seals with hydraulic fluid used.

3

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in part III

Function, section, control spool symbols: 3/2 directional seat valve

General:

The directional valve type M-.SED is a direct operated directional seat valve with solenoid actuation. It controls the start, stop and direction of flow and basically comprises a housing (1), the solenoid (2), the valve seats (7) and (11) and the control spool (4).

The manual override (6) allows for the switching of the valve without solenoid energization.

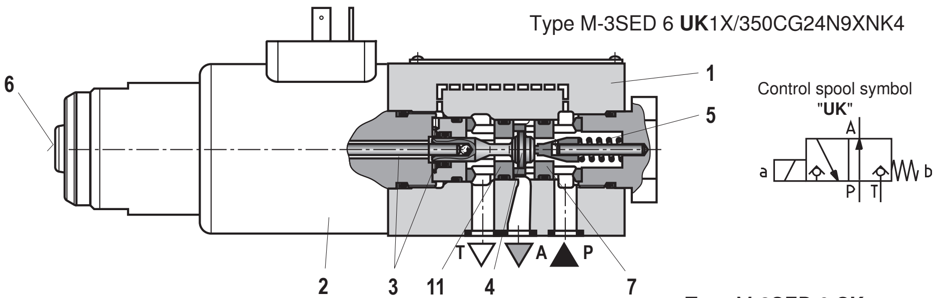
Basic principle:

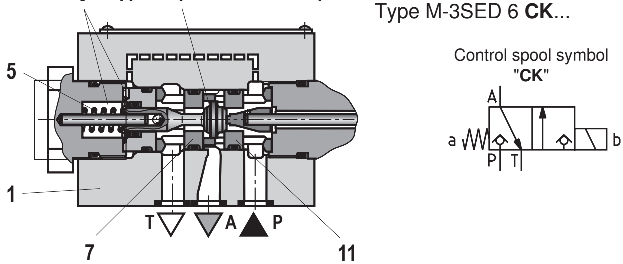
The initial position of the valve (normally open "UK" or normally closed "CK") is determined by the arrangement of the spring (5). The chamber (3) behind the control spool (4) is connected to port P and sealed against port T. Thus, the valve is pressure-compensated in relation to the actuating forces (solenoid and spring).

By means of the control spool (4), the ports P, A and T can be loaded with the maximum operating pressure (350 bar) and the flow can be directed in both directions (see control spool symbols).

In the initial position, the control spool (4) is pressed onto the seat (11) by the spring (5), in spool position, it is pressed onto the seat (7) by the solenoid (2). The flow is blocked in a leak-free manner.

Seat valves can be used according to the control spool symbols and the related operating pressures and flows (see performance limits page 10).





Function, section, control spool symbols: 4/2 directional seat valve

With a sandwich plate, the **Plus-1 plate**, under the 3/2 directional seat valve, the function of a 4/2 directional seat valve is achieved.

Function of the Plus-1 plate:

Initial position:

The main valve is not operated. The spring (5) holds the control spool (4) on the seat (11). Port P is blocked and A connected to T. Apart from that, one control line is connected from A to the large area of the control spool (8), which is thus unloaded to the tank. The pressure applied via P now pushes the ball (9) onto the seat (10). Now, P is connected to B, and A to T.

Transition position:

When the main valve is operated, the control spool (4) is shifted against the spring (5) and pressed onto the seat (7). During this, port T is blocked, P, A, and B are briefly connected to each other.

Spool position:

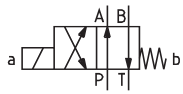
P is connected to A. As the pump pressure acts via A on the large area of the control spool (8), the ball (9) is pressed onto the seat (12). Thus, B is connected to T, and P to A. The ball (9) in the Plus-1 plate has a "positive spool overlap".

Important:

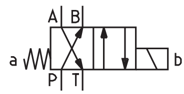
To prevent pressure intensification in conjunction with differential cylinders, the annulus area of the cylinder must be connected to A.

The use of the Plus-1 plate and the seat arrangement offer the following options:

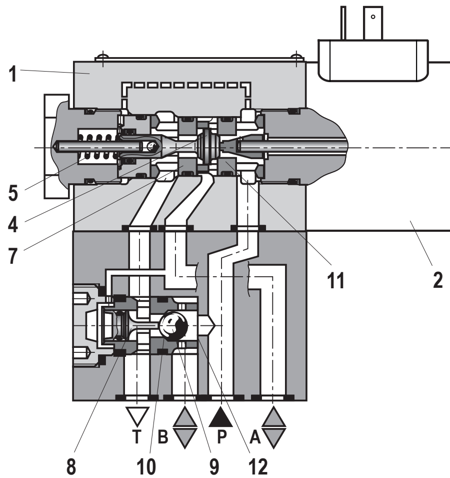
Control spool symbol "**D**"



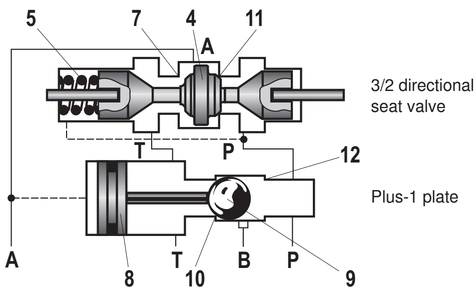
Control spool symbol "**Y**"



Type M-4SED 6 **Y**1X/350CG24N9XNZK4



Schematic illustration: **Initial position**



3

Function, section: Throttle insert, check valve insert

Throttle insert

The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

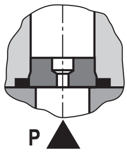
Examples:

– Accumulator operation,

– Use as pilot control valve with internal pilot fluid tapping.

3/2 directional seat valve (see page 4)
The throttle insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The throttle insert is inserted in port P of the Plus-1 plate.

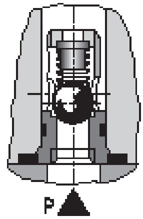


Check valve insert

The check valve insert allows free flow from P → A and closes A → P in a leak-free form.

3/2 directional seat valve (see page 4)
The check valve insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The check valve insert is inserted in port P of the Plus-1 plate.



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20 … +50
Storage temperature range		°C	+15 … +30
Admissible vibration load			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	3/2 directional seat valve	kg	2.2
	4/2 directional seat valve	kg	3.2
Surface protection			Galvanically coated

hydraulic

Maximum operating pressure	bar	See table on page 10
Maximum flow	l/min	25
Hydraulic fluid		Mineral oil (HL, HLP) according to DIN 51524 [1]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also data sheet 90221); HETG (rape seed oil) [1]; HEPG (polyglycols) [2]; HEES (synthetic esters) [2]; other hydraulic fluids on request, ignition temperature > 190 °C
Hydraulic fluid temperature range	°C	–20 … +80 (for NBR seals) [3]
		–15 … +80 (for FKM seals) [3]
Viscosity range	mm^2/s	2.8 … 500
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)		Class 20/18/15 [4]

[1] Suitable for NBR **and** FKM seals

[2] Suitable **only** for FKM seals

[3] Observe the "Special conditions for safe use" on page 7.

[4] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

Technical data

electric

Voltage type		Direct voltage (DC)
Nominal voltage	V	24
Voltage tolerance	%	±10
Admissible residual ripple	%	< 5
Duty cycle / operating mode according to VDE 0580		100 % / S1 (continuous operation)
Switching times according to ISO 6403	ms	See table on page 8
Switching frequency	Hz	Max. 1
Nominal power at ambient temperature 20 °C	W	23
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C	W	28.8
Protection class according to EN 60529		IP 65 [1]

[1] If suitable mating connectors are used (protection class at least IP 65) and in case of appropriate assembly.

Information on the explosion protection

Area of application as per directive 94/9/EC		II 3G	II 3D
Type of protection of the valve solenoid according to EN 60079-15:2010 / EN 60079-31:2009		Ex nA IIC T3 Gc	Ex tc IIIC T140°C Dc IP65
Maximum surface temperature [1]	°C	140	140
Type examination certificate Solenoid		BVS 12 ATEX E 062 X	
Type of protection Valve		c (EN 13463-5:2011)	
Special conditions for safe use		– Connection lines must be passed in a pull-relieved way. – The valve is to be installed so that no impact stresses > 4 J can take effect. – In order to avoid dangers caused by static charging, the base and/or subplate on which the valve is to be fitted must be electrically conductive and included in the equipotential bonding. – The valve solenoid must not be installed close to charge-generating processes. – Dust layers with a thickness > 50 mm are not admissible. – Maximum hydraulic fluid temperature: In case of bank assembly, as long as only one solenoid is energized at a time, and in case of individual assembly: +80 °C In case of bank assembly when more than one solenoid is energized at a time: +65 °C – The maximum temperature of the valve casing surface is 110 °C. This has to be considered when selecting the connection cable and/or contact of the connection cable with the casing surface is to be prevented.	
Ambient temperature range	°C	–20 … +50	

Requirements on the mating connector

Temperature at the connector of the valve solenoid	°C	≥ 100
Area of application as per directive 94/9/EC		II 3G; II 3D
Protection class in plugged condition		IP 65

[1] Surface temperature > 50 °C, provide contact protection

3

Switching times (installation position: Solenoid horizontal)

Pressure *p* in bar	**Flow q_V in l/min**	**Switching times *t* in ms** Control spool symbols UK, CK, D and Y					
		t_{on} without tank pressure				t_{off}	
						UK	**D**
		UK	**CK**	**D**	**Y**	**CK**	**Y**
70	25	40	45	45	50	10	10
140	25	45	45	50	50	10	15
210	25	50	45	55	50	15	20
280	25	55	50	60	55	20	20
315	25	60	50	65	55	20	20
350	25	70	50	75	55	20	25

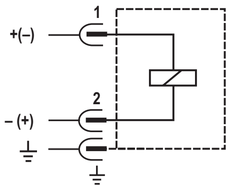
Electrical connection

The valves are equipped with a plug-in connector according to EN 175301-803, design A.

Information on the suitability of mating connectors is available on page 7.

Circuit diagram

Connection is polarity-independent



For protection of the valve solenoids, suitable measures are to be taken which limit the switch-off overvoltages to a maximum of 500 V.

Over-current fuse and switch-off voltage peak

Important:

A fuse appropriate for the solenoid's rated current (max. 3 x I_{rated} according to DIN 41571 and/or IEC 60127) or a protective motor switch with short-circuit and thermal instantaneous tripping must be connected to each valve solenoid as short-circuit protection. The cut-off capacity of the fuse must match or exceed the short-circuit current of the supply source.

This fuse or protective motor switch may only be fitted outside the explosive area or must be of an explosion-proof design.

When an inductivity is switched off, a voltage peak results which may cause failures or damage in the connected control electronics.

Voltage data in the valve type code	Nominal voltage Valve solenoid	Rated current Valve solenoid	Recommended pre-fuse characteristics medium time-lag according to DIN EN 60127-1: 2011
G24	24 V DC	0.95 A DC	1 A

General information

Seat valves can be used according to the control spool symbols and the related operating pressures and flows (see performance limits below).

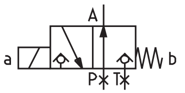
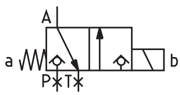
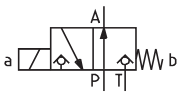
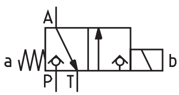
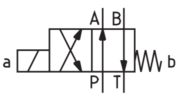
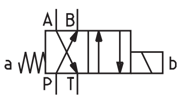
In order to guarantee safe functioning, the following points must imperatively be observed:

- Seat valves have negative spool overlap, i.e. leakage oil occurs during the switching process. This process takes, however, place within such a short time that it is irrelevant in nearly all applications.
- The specified maximum flow must not be exceeded (if necessary, use a throttle insert for the flow limitation).

Plus-1 plate:

- When the Plus-1 plate (4/2 directional function) is used, the following lower operating values are to be observed: $\boldsymbol{p}_{min}$ = 8 bar, $\boldsymbol{q}_V$ > 3 l/min.
- The ports P, A, B and T are clearly determined according to the tasks. They must not be exchanged or closed.
- Port T must always be connected.
- Pressure level and pressure distribution are to be observed.
- The flow is only permitted in the direction of arrow.

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

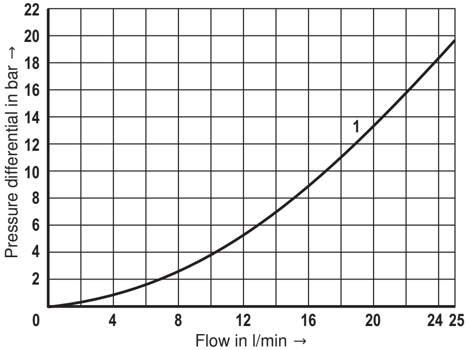
	Control spool symbol		Comment	Operating pressure in bar				Flow in l/min
				P	A	B	T	
2-way circuit	"UK"		With 2/2 way circuits, port P **or** T must be closed by the customer!	350	350		350	25
	"CK"			350	350		350	25
3-way circuit	"UK"			350	350		350	25
	"CK"			350	350		350	25
4-way circuit (flow only possible in the direction of arrow)	"D"		3/2 directional valve (symbol "UK") in connection with Plus-1 plate: $p_P \geq p_A \geq p_B \geq p_T$	350	350	350	P/A/B −40	25
	"Y"		3/2 directional valve (symbol "CK") in connection with Plus-1 plate: $p_P \geq p_A \geq p_B \geq p_T$	350	350	350	P/A/B −40	25

Important

The switching power limits were established while the solenoids were at operating temperature, at 10 % undervoltage and without tank pre-loading.

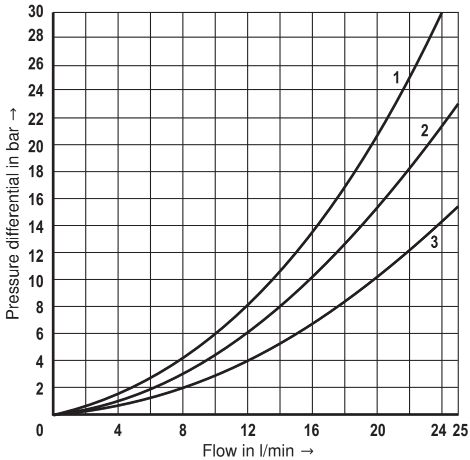
Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δ*p* - q_V characteristic curves
3/2 directional seat valve



1 M-3SED 6 **UK(CK)**…, P → A and A → T

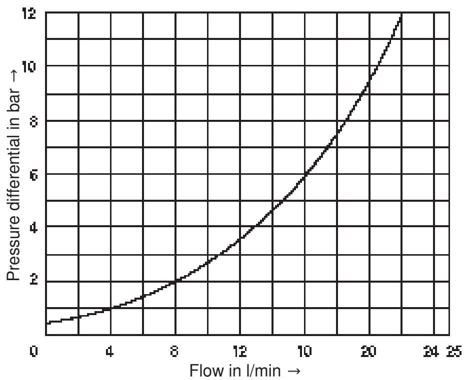
Δ*p* - q_V characteristic curves
4/2 directional seat valve



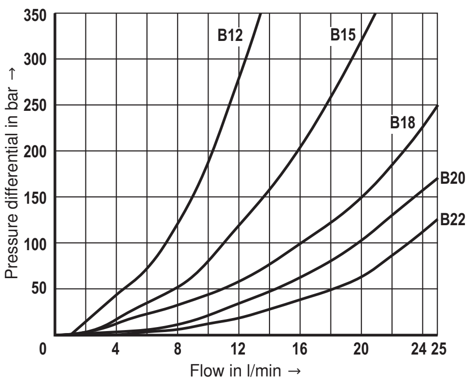
1 M-4SED 6 **D(Y)**…, A → T
2 M-4SED 6 **D(Y)**…, P → A
3 M-4SED 6 **D(Y)**…, B → T, P → B

3

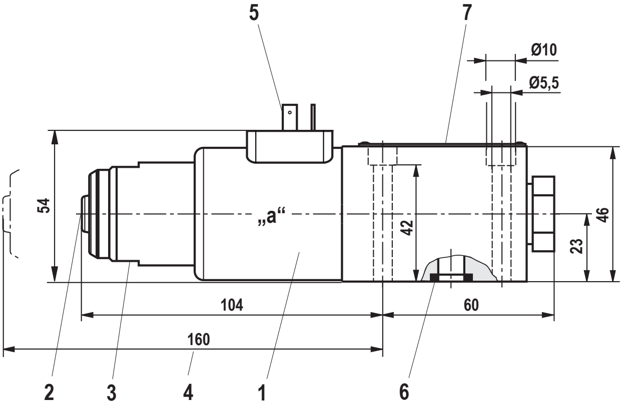
Δ*p* - q_V characteristic curves
Check valve insert

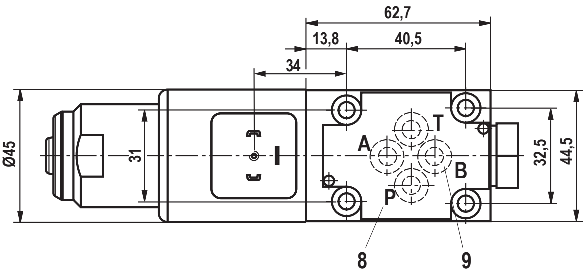


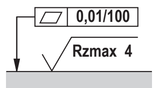
Δ*p* - q_V characteristic curves
Throttle insert



Device dimensions: 3/2 directional seat valve – design "UK" (dimensions in mm)







Required surface quality of the valve contact surface

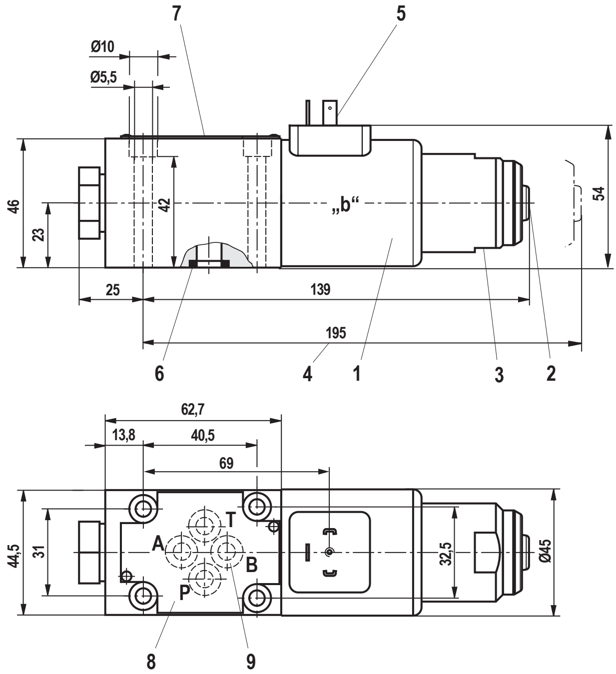
1 Solenoid coil
2 Manual override "N9"
3 Mounting nut with double edge SW32
4 Space required to remove the solenoid coil
5 Plug-in connector according to EN 175301-803, design A
6 Identical seal rings for ports A, B, T
Seal ring for port P
7 Name plate
8 Porting pattern according to DIN 24340-A6
9 Port B is designed as blind counterbore

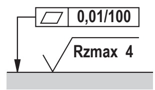
Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(must be ordered separately)

Subplates
G 341/01 FE/ZN (G 1/4)
G 342/01 FE/ZN (G 3/8)
G 502/01 FE/ZN (G 1/2)
with dimensions as in the data sheet 45052
(must be ordered separately)

Important:
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Device dimensions: 3/2 directional seat valve – design "CK" (dimensions in mm)





Required surface quality of the valve contact surface

1 Solenoid coil
2 Manual override "N9"
3 Mounting nut with double edge SW32
4 Space required to remove the solenoid coil
5 Plug-in connector according to EN 175301-803, design A
6 Identical seal rings for ports A, B, T
Seal ring for port P
7 Name plate
8 Porting pattern according to DIN 24340-A6
9 Port B is designed as blind counterbore

Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(must be ordered separately)

Subplates

G 341/01 FE/ZN (G 1/4)
G 342/01 FE/ZN (G 3/8)
G 502/01 FE/ZN (G 1/2)

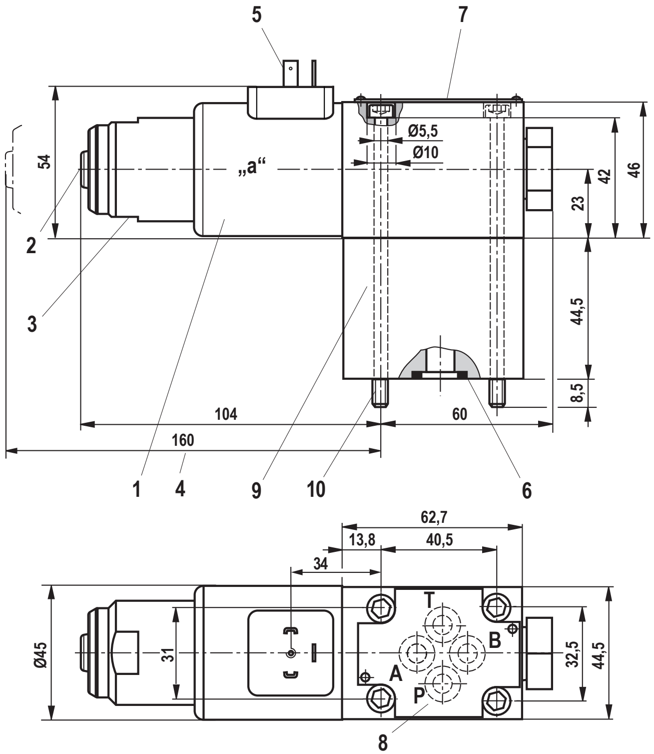
with dimensions as in the data sheet 45052
(must be ordered separately)

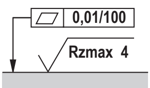
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Device dimensions: 4/2 directional seat valve – design "D" (dimensions in mm)





Required surface quality of the valve contact surface

- **1** Solenoid coil
- **2** Manual override "N9"
- **3** Mounting nut with double edge SW 32
- **4** Space required to remove the solenoid coil
- **5** Plug-in connector according to EN 175301-803, design A
- **6** Identical seal rings for ports A, B, T
  Seal ring for port P
- **7** Name plate
- **8** Porting pattern according to DIN 24340-A6
- **9** Plus-1 plate
- **10** Valve mounting screws
  For reasons of stability, exclusively use the following valve mounting screws:
  4 hexagon socket head cap screws
  ISO 4762-M5x95-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the scope of delivery)

Subplates

G 341/01 FE/ZN (G 1/4)
G 342/01 FE/ZN (G 3/8)
G 502/01 FE/ZN (G 1/2)

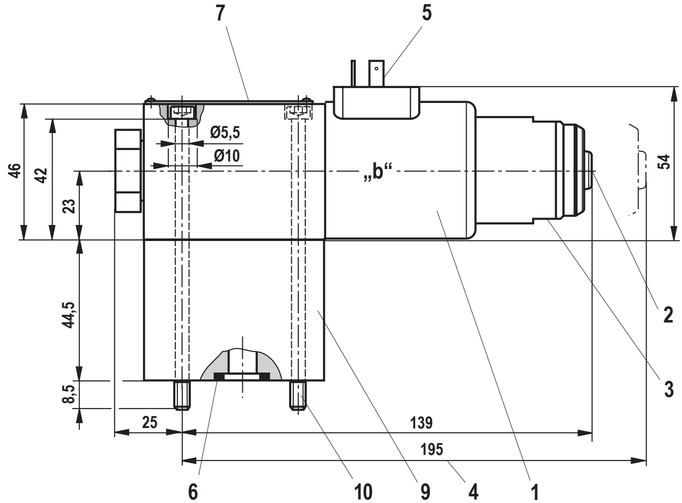
with dimensions as in the data sheet 45052
(must be ordered separately)

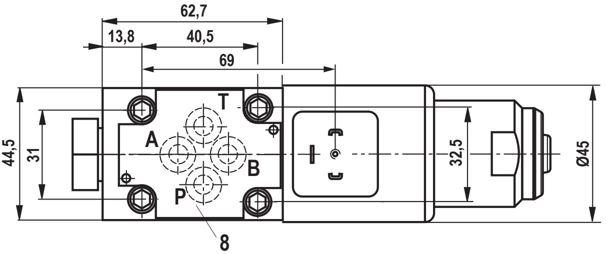
Important:

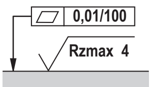
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Device dimensions: 4/2 directional seat valve – design "Y" (dimensions in mm)







Required surface quality of the valve contact surface

1 Solenoid coil
2 Manual override "N9"
3 Mounting nut with double edge SW 32
4 Space required to remove the solenoid coil
5 Plug-in connector according to EN 175301-803, design A
6 Identical seal rings for ports A, B, T
Seal ring for port P
7 Name plate
8 Porting pattern according to DIN 24340-A6
9 Plus-1 plate
10 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x95-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)

Subplates

G 341/01 FE/ZN (G 1/4)
G 342/01 FE/ZN (G 3/8)
G 502/01 FE/ZN (G 1/2)

with dimensions as in the data sheet 45052 (must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

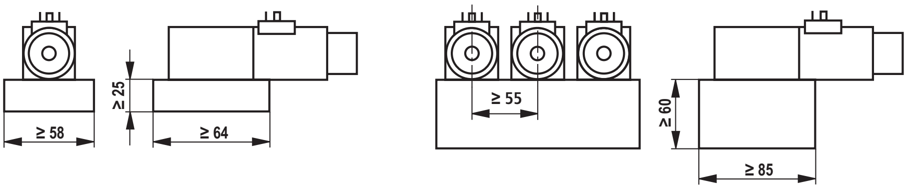
3

Installation conditions (dimensions in mm)

	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram

Individual assembly Bank assembly



Important:

With regard to the hydraulic fluid temperature, observe the "Special conditions for safe use" on page 7.

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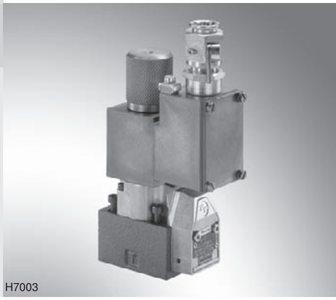
2/2, 3/2 and 4/2 directional seat valves with solenoid actuation

RE 22058-XE-B2/09.13
Replaces: 01.10

Type M-.SEW 6...XE...

Size 6
Component series 3X
Maximum operating pressure 420 bar
Maximum flow 25 l/min



Actual product may differ

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
- Type of protection of the valve solenoid: Ex e mb IIC T4 Gb according to EN 60079-7: 2007 / EN 60079-18: 2009

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 22058-XE-B0**
Part II	Data sheet 22058-XE-B2	
Part III	Product-specific instructions 22058-XE-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

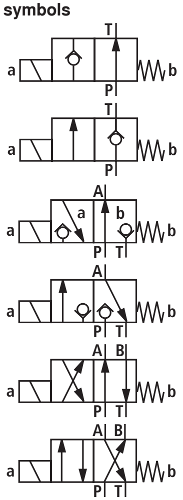
- Direct operated directional seat valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to DIN 24340-A6, **without** locating hole
- Subplates available in FE/ZN version (see pages 12/13)
- Blocked port is tight
- Safe switching also with longer standstill periods under pressure
- Air-gap DC and AC solenoids
- Solenoid coil can be rotated by 90°
- Electrical connection as individual connection with cable gland
- With concealed manual override, optional

Ordering code and scope of delivery

M–		SEW	6		3X/	420	M			XE	Z2/		

2 main ports **= 2**
3 main ports **= 3**
4 main ports **= 4**
Seat valve
Size 6 **= 6**

Main ports	2	3	4	
Control spool symbols				
	•	–	–	**= P**
	•	–	–	**= N**
	–	•	–	**= U**
	–	•	–	**= C**
	–	–	•	**= D**
	–	–	•	**= Y**
	• = available			



Component series 30 to 39 **= 3X**
(30 to 39: Unchanged installation and connection dimensions)
Operating pressure up to 420 bar **= 420**
Solenoid (air-gap) **= M**

G24 = Direct voltage 24 V
W230 R = AC voltage W 230 V, 50/60 Hz
For further ordering codes for other voltages, see page 9

N9 = With concealed manual override
no code = Without manual override

XE = Explosion protection "Increased safety", for details, see information on the explosion protection on page 7

Electrical connection
Z2 = Solenoid with terminal box and cable gland, For details see chapter Electrical connection

no code = Without check valve insert, without throttle insert
P = With check valve insert
B08 = Throttle Ø 0.8 mm
B12 = Throttle Ø 1.2 mm
B15 = Throttle Ø 1.5 mm
B18 = Throttle Ø 1.8 mm
B20 = Throttle Ø 2.0 mm
B22 = Throttle Ø 2.2 mm

no code = NBR seals
V = FKM seals
Important: Observe compatibility of seals with hydraulic fluid used!

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in Part III

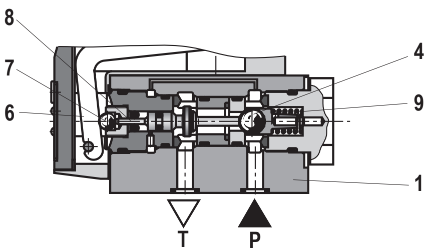
Function, section, control spool symbols: 2/2, 3/2 directional seat valve

General:
The directional valve type M-.SEW...XE... is a directional seat valve with solenoid actuation. It controls the start, stop and direction of flow.
It basically comprises a housing (1), the solenoid (2), the hardened valve system (3) and the control spool (8).

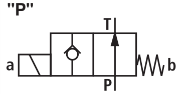
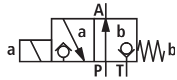
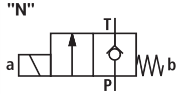
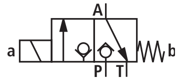
Basic principle:
In the initial position, the control spool (8) is pressed onto the seat by the spring (9) and in spool position by the solenoid (2). The force of the solenoid (2) acts via the angled lever (6) and the ball (7) on the control spool (8) that is sealed on two sides. The chamber between the two sealing elements is connected to port P. Thus, the valve system (3) is pressure-compensated in relation to the actuating forces (solenoid or return spring).

Important:
- The 3/2 directional seat valves have a "negative spool overlap". Therefore, port T must always be connected. That means that during the switching process – from the starting of the opening of one valve seat to the closing of the other valve seat – ports P–A–T are connected with each other. This process takes, however, place within such a short time that it is irrelevant in nearly all applications.
- The manual override (10) allows for the switching of the valve without solenoid energization.
- It has to be made sure that the specified maximum flow is not exceeded! A throttle insert must be used for limiting the flow, if necessary (see page 6).

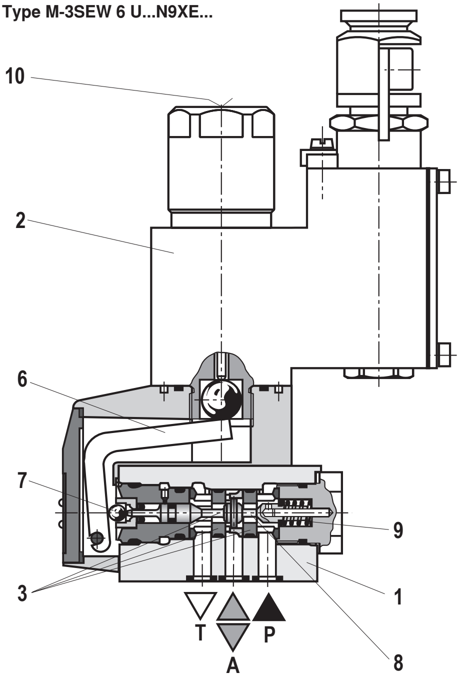
Type M-2SEW 6 N...XE...



The seat arrangement offers the following options:

	2/2 directional seat valve	**3/2 directional seat valve**
Control spool symbol	"P" 	"U" 
Initial position	P and T connected	P and A connected, T blocked in a leak-free form
Spool position	P blocked in a leak-free form	P blocked in a leak-free form, A and T connected
Control spool symbol	"N" 	"C" 
Initial position	P blocked in a leak-free form	P blocked in a leak-free form, A and T connected
Spool position	P and T connected	P and A connected, T blocked in a leak-free form

Type M-3SEW 6 U...N9XE...



Function, section, control spool symbols: 4/2 directional seat valve

With a sandwich plate, the **Plus-1 plate,** under the 3/2 directional seat valve, the function of a 4/2 directional seat valve is achieved.

Function of the Plus-1 plate:

Initial position:

The main valve is not operated. The spring (9) holds the ball (4) on the seat (11). Port P is blocked and A is connected to T. Apart from that, one control line is connected from A to the large area of the control spool (12), which is thus unloaded to the tank. The pressure applied via P now pushes the ball (13) onto the seat (14). Now, P is connected to B, and A to T.

Transition position:

When the main valve is operated, the control spool (8) is shifted against the spring (9) and pressed onto the seat (15). During this, port T is blocked, P, A, and B are briefly connected to each other.

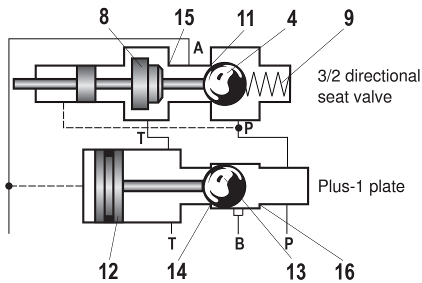
Spool position:

P is connected to A. As the pump pressure acts via A on the large area of the control spool (12), the ball (13) is pressed onto the seat (16). Thus, B is connected to T, and P to A. The ball (13) in the Plus-1 plate has a "positive spool overlap".

Important:

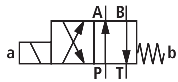
To prevent pressure intensification in conjunction with differential cylinders, the annulus area of the cylinder must be connected to A.

Schematic illustration: Initial position

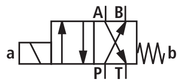


The use of the Plus-1 plate and the seat arrangement offer the following options:

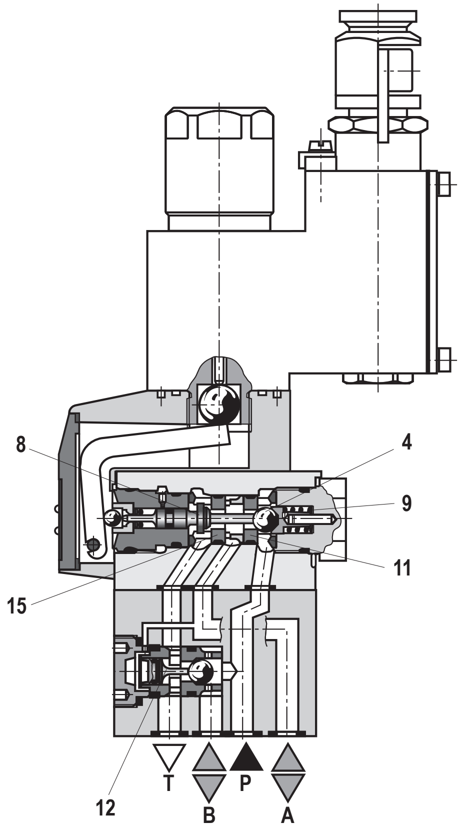
Control spool symbol "D":



Control spool symbol "Y":



Type M-4SEW 6 Y...N9XE...



Function, section: Throttle insert, check valve insert

Throttle insert

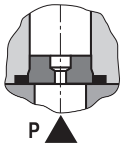
The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

Examples:

- Accumulator operation,
- Use as pilot control valve with internal pilot fluid tapping.

3/2 directional seat valve (see page 4)
The throttle insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The throttle insert is inserted in port P of the Plus-1 plate.

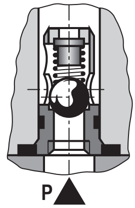


Check valve insert

The check valve insert allows a free flow from P to A and closes A to P in a leak-free form.

3/2 directional seat valve (see page 4)
The check valve insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The check valve insert is inserted in port P of the Plus-1 plate.



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20 … +70 [1]
Storage temperature range		°C	–20 … +50
Admissible vibration load			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	2/2 and 3/2 directional seat valve	kg	3.2
	4/2 directional seat valve	kg	4.1
Surface protection			Galvanic coating

hydraulic

Maximum operating pressure	bar	See table on page 10
Maximum flow	l/min	25
Hydraulic fluid		Mineral oil (HL, HLP) according to DIN 51524 [2]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also RE 90221); HETG (rape seed oil) [2]; HEPG (polyglycols) [3]; HEES (synthetic esters) [3]; flame-resistant hydraulic fluid HFC according to ISO 12922 [4] Other hydraulic fluids upon request Ignition temperature > 180 °C
Hydraulic fluid temperature range	°C	–20 ... +80 (NBR seals)
		–15 ... +80 (FKM seals)
Viscosity range	mm^2/s	2.8 … 500
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)		Class 20/18/15 [5]

1) Observe the "Special conditions for safe use" on page 7.

2) Suitable for NBR **and** FKM seals

3) Suitable **only** for FKM seals

4) Only in connection with NBR seals, max. admissible pressure 210 bar, Δp < 15 bar, hydraulic fluid temperature max. 60 °C
More information is available from our sales staff.

5) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

Technical data

electric

Voltage type		Direct voltage	Alternating voltage 50/60 Hz
Available voltages	V	24, 48, 96, 110	110, 230
Voltage tolerance (nominal voltage)	%	–5 / +10	
Admissible residual ripple	%	< 5	–
Duty cycle/operating mode according to VDE 0580		100 % / S1 (continuous operation)	
Switching time according to ISO 6403		See table below	
Switching frequency	1/h	up to 15000	up to 7200
Nominal power at ambient temperature 20 °C	W	17	
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C	W	20.6	
Protection class according to EN 60529		IP 66 [1]	

[1] If the electrical connection is correctly installed

Information on the explosion protection

Area of application as per directive 94/9/EC		II 2G
Type of protection Valve		c (EN 13463-5:2011)
Maximum surface temperature [1] Temperature class	°C	135 T4
Type of protection Valve solenoid according to EN 60079-7:2007 / EN 60079-18:2009		Ex e mb IIC T4 Gb
Type examination certificate Solenoid		KEMA 02ATEX2240 X
"IECEx Certificate of Conformity" Solenoid		IECEx DEK 12.0068X
Ambient temperature range	°C	–20 … +70 [2]
Special conditions for safe use		– Maximum ambient temperature: In case of bank assembly, as long as only one solenoid is energized at a time, and in case of individual assembly: +70 °C In case of bank assembly when more than one solenoid is energized at a time: +60 °C – The maximum temperature of the valve casing surface is 120 °C. This has to be considered when selecting the connection cable and contact of the connection cable with the casing surface is to be prevented.

[1] Surface temperature > 50 °C, provide contact protection

[2] Observe the "Special conditions for safe use".

Switching times *t* in ms (Installation position: Solenoid horizontal)

		DC solenoid						AC solenoid							
		Control spool symbols U, C, D, Y						Control spool symbols U, C, D, Y							
		t_{on} without tank pressure				t_{off}		t_{on} without tank pressure				t_{off}			
Pressure *p* in bar	**Flow q_V in l/min**	U	C	D	Y	U C	D Y	U	C	D	Y	U	C	D	Y
70	25	30	40	30	40	15	15	25	40	25	40	45	65	45	65
140	25	30	50	30	50	15	15	25	40	25	40	65	65	65	65
280	25	35	60	35	60	15	15	25	45	25	45	75	65	75	65
320	25	40	70	40	70	15	15	25	45	25	45	80	65	80	65
420	25	45	70	45	70	15	15	30	45	30	45	100	65	100	65

3

Electrical connection

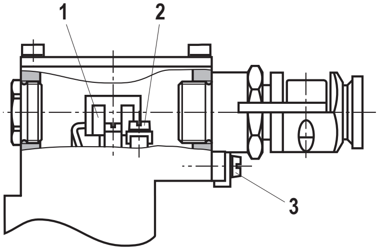
The type-examination tested valve solenoid of the valve is equipped with a terminal box and a type-tested cable gland.

The connection is polarity-independent.

Solenoids to be connected to AC voltage are equipped with an integrated rectifier.

Important

When establishing the electrical connection, the protective earthing conductor (PE ⏚) has to be connected properly.



Properties of the connection terminals

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 … 2.5 mm^2 Finely stranded 0.75 … 1.5 mm^2
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm^2 Finely stranded max. 1.5 mm^2
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm^2 Finely stranded 4 mm^2

Cable gland

Type approval		II 2G Ex e IIC Gb
Threaded connection		M20 x 1.5
Protection class according to EN 60529		IP66 [1)]
Line diameter	mm	9 … 11
Sealing		Outer sheath sealing

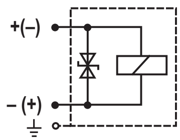
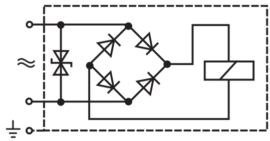
Connection line

Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–30 … > +110

[1)] If installed properly

Electrical connection

Circuit diagrams

Direct voltage, polarity-independent	Alternating voltage
	

Over-current fuse and switch-off voltage peaks

Important:

Corresponding to the rated current, a fuse according to DIN 41571 and EN / IEC 60127 has to be connected ahead of every valve solenoid (max. 3 x I_{rated}).

The shut-off threshold of the fuse has to match the prospective short-circuit current of the supply source.

The prospective short-circuit current of the supply source may amount to a maximum of 1500 A.

This fuse may only be installed outside the explosive area or must be of an explosion-proof design.

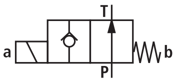
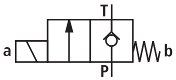
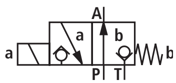
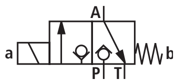
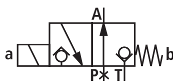
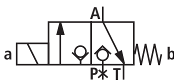
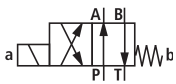
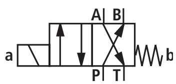
When inductivities are switched off, voltage peaks are the result which may cause faults in the connected control electronics. For this reason, the valve solenoids comprise an interference protection circuit which dampens this voltage peak to the voltage value shown in the table.

Voltage data in the valve type code	Nominal voltage valve solenoid	Rated current valve solenoid	Rated current external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Rated voltage of external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Maximum voltage value upon switch-off	Interference protection circuit
G24	24 V DC	0.708 A DC	800 mA	250 V	–90 V	Suppressor diode bi-directional
G48	48 V DC	0.354 A DC	400 mA	250 V	–200 V	
G96	96 V DC	0.177 A DC	200 mA	250 V	–370 V	
G110	110 V DC	0.155 A DC	200 mA	250 V	–390 V	
W110R	110 V AC	0.163 A AC	200 mA	250 V	–3 V	Bridge rectifier and suppressor diode
W230R	230 V AC	0.078 A AC	80 mA	250 V	–3 V	

General information

- In order to switch the valve safely or maintain it in its spool position, the pressure situation must be as follows: P ≥ A ≥ T (for design reasons).
- The ports P, A and T (3/2 directional seat valve) as well as P, A, B and T (4/2 directional seat valve) are clearly determined according to their tasks. They must not be exchanged or closed. The flow is only permitted in the direction of the arrow.
- When the Plus-1 plate (4/2 directional function) is used, the following minimum operating values have to be observed: p_{min} = 8 bar; q_V > 3 l/min.
- The specified maximum flow must not be exceeded (if necessary, use a throttle insert for flow limitation)!

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

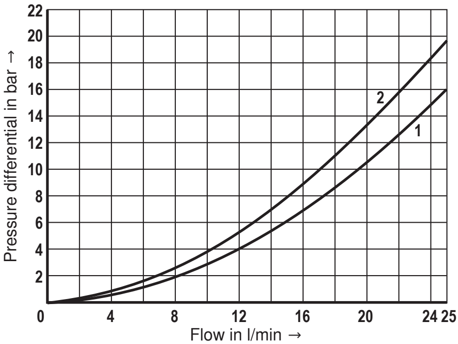
	Control spool symbol		Comment	Operating pressure in bar P	A	B	T	Flow in l/min
2-way circuit	"P"		Pressure at P ≥ T	420			100	25
2-way circuit	"N"		Pressure at P ≥ T	420			100	25
3-way circuit	"U"		Pressure at P ≥ A ≥ T	420	420		100	25
3-way circuit	"C"		Pressure at P ≥ A ≥ T	420	420		100	25
2-way circuit (only for unloading)	"U"		Before switching from the initial position to the spool position, pressure must be applied to port A. Pressure at A ≥ T		420		100	25
2-way circuit (only for unloading)	"C"		Pressure at A ≥ T		420		100	25
4-way circuit (flow only possible in the direction of arrow)	"D"		Valve (symbol "U") in connection with Plus-1 plate P > A ≥ B > T	420	420	420	100	25
4-way circuit (flow only possible in the direction of arrow)	"Y"		Valve (symbol "C") in connection with Plus-1 plate P > A ≥ B > T	420	420	420	100	25

Important

The switching power limits were established while the solenoids were at operating temperature, at 10 % undervoltage and without tank preloading.

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

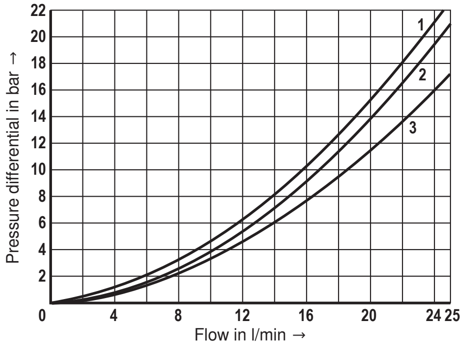
Δ*p* - q_V characteristic curves – 2/2 directional seat valve



1 M-2SEW 6 **N** …, P → T

2 M-2SEW 6 **P** …, P → T

Δ*p* - q_V characteristic curves – 3/2 directional seat valve

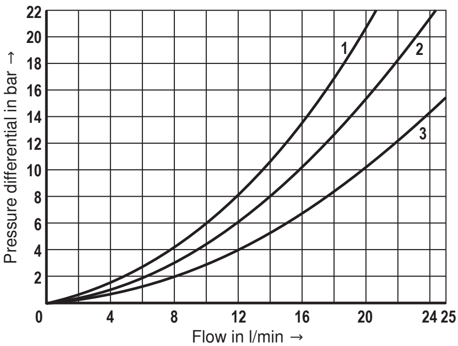


1 M-3SEW 6 **U(C)**…, A → T

2 M-3SEW 6 **U**…, P → A

3 M-3SEW 6 **C**…, P → A

Δ*p* - q_V characteristic curves – 4/2 directional seat valve

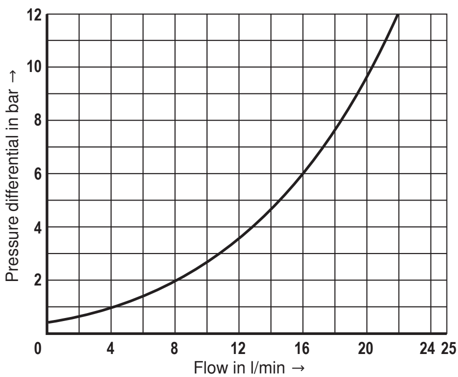


1 M-4SEW 6 **D(Y)**…, A → T

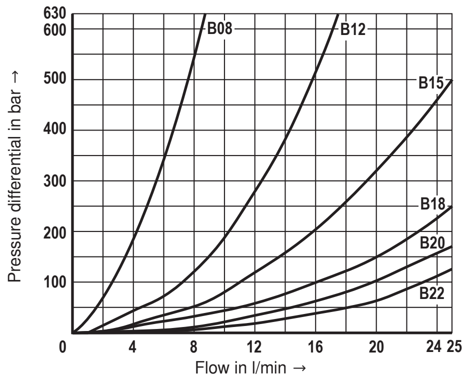
2 M-4SEW 6 **D(Y)**…, P → A

3 M-4SEW 6 **D(Y)**…, P → B, B → T

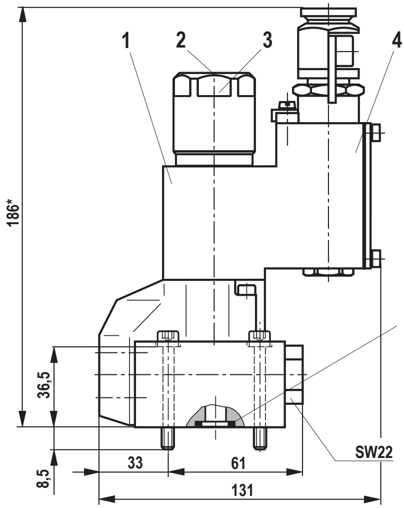
Δ*p* - q_V characteristic curves – check valve insert

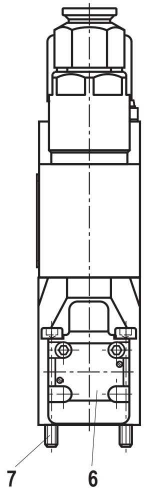


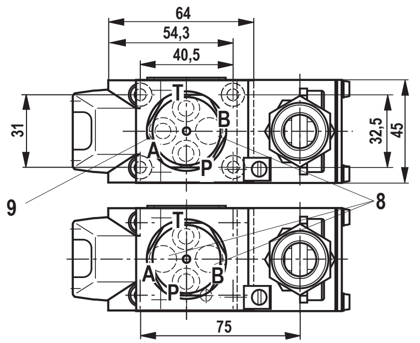
Δ*p* - q_V characteristic curves – throttle insert

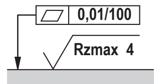


Dimensions: 2/2 and 3/2 directional seat valve (dimensions in mm)









Required surface quality of the valve contact surface

* Plus 80 mm for detaching the solenoid coil

1 Solenoid coil
2 Concealed manual override "N9"
3 Mounting nut with hexagon SW32
4 Terminal box
5 Identical seal rings for ports A, B, and T, seal ring for port P
6 Name plate
7 **Valve mounting screws**
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762 M5x45-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)

8 **Important**
With 3/2 directional seat valves, port B is available as blind counterbore.
With 2/2 directional seat valves, ports A and B are available as blind counterbores.
9 Porting pattern according to DIN 24340-A6

Subplates

G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

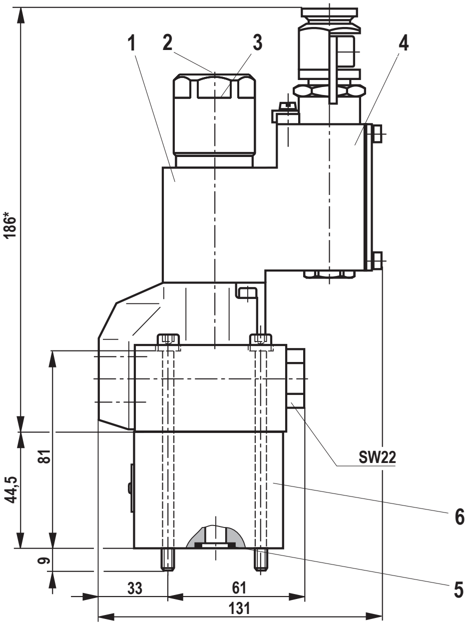
with dimensions as in the data sheet 45052
(must be ordered separately)

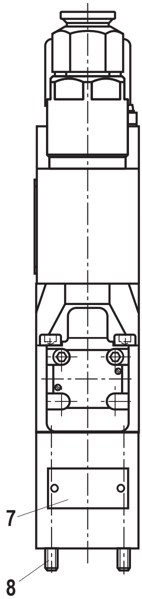
Important:

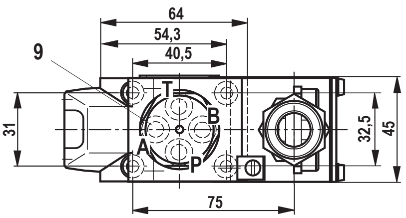
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

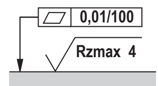
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Dimensions: 4/2 directional seat valve (dimensions in mm)









Required surface quality of the valve contact surface

* Plus 80 mm for detaching the solenoid coil

1 Solenoid coil
2 Concealed manual override "N9"
3 Mounting nut with hexagon SW32
4 Terminal box
5 Identical seal rings for ports A, B, and T, seal ring for port P
6 Plus-1 plate
7 Name plate
8 **Valve mounting screws**
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762 M5x90-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)
9 Porting pattern according to DIN 24340-A6

Subplates

G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

with dimensions as in the data sheet 45052 (must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

3

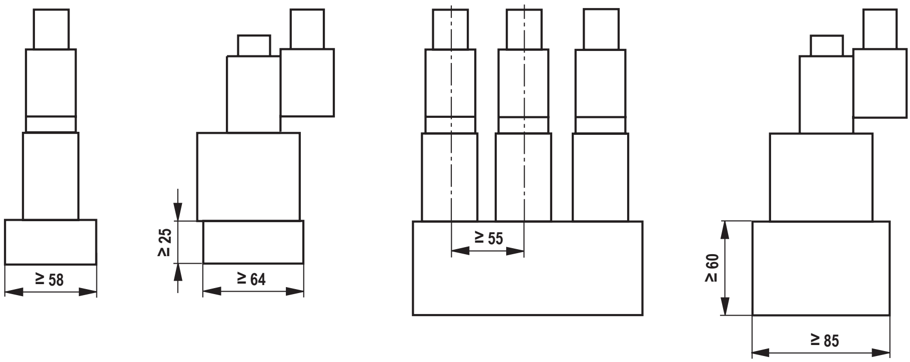
Installation conditions (dimensions in mm)

	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram

Individual assembly

Bank assembly



Important:

Observe the "Special conditions for safe use" on page 7.

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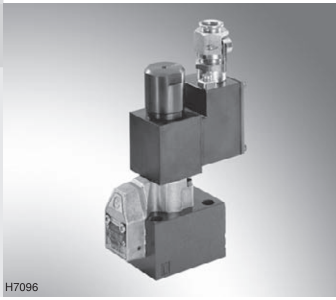
3/2 and 4/2 directional seat valves with solenoid actuation

RE 22075-XE-B2/09.13
Replaces: 01.10

Type M-.SEW 10...XE...

Size 10
Component series 1X
Maximum operating pressure 420 bar
Maximum flow 40 l/min



Actual product may differ

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

– Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
– Type of protection of the valve solenoid: Ex e mb IIC T4 Gb according to EN 60079-7: 2007 / EN 60079-18: 2009

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	
Part II	Data sheet 22075-XE-B2	**Operating instructions 22075-XE-B0**
Part III	Product-specific instructions 22075-XE-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Direct operated directional seat valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to DIN 24340-A10 and ISO 4401-05-04-0-05
- Subplates available in FE/ZN version (see pages 12/13)
- Blocked port is tight
- Safe switching also with longer standstill periods under pressure
- Air-gap DC and AC solenoids
- Solenoid coil can be rotated by 90°
- Electrical connection as individual connection with cable gland
- With concealed manual override, optional

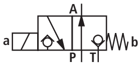
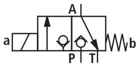
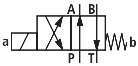
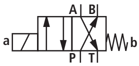
Ordering code and scope of delivery

M–		SEW	10		1X /	420	M			XE	Z2 /	

3 main ports = **3**
4 main ports = **4**

Seat valve

Size 10 = **10**

Main ports	3	4	
Control spool symbols			
	•	–	**= U**
	•	–	**= C**
	–	•	**= D**
	–	•	**= Y**
	• = available		

Component series 10 to 19 (10 to 19: Unchanged installation and connection dimensions) = **1X**

Operating pressure up to 420 bar = **420**

Solenoid (air-gap) = **M**

G24 = Direct voltage 24 V
W230 R = AC voltage W 230 V, 50/60 Hz
For further ordering codes for other voltages, see page 9

N9 = With concealed manual override
no code = Without manual override

XE = Explosion protection "increased safety", for details, see information on the explosion protection, page 7

Electrical connection
Z2 = Solenoid with terminal box and cable gland, for details see chapter Electrical connection

no code = Without check valve insert, without throttle insert
P = With check valve insert
B12 = Throttle Ø 1.2 mm
B15 = Throttle Ø 1.5 mm
B18 = Throttle Ø 1.8 mm
B20 = Throttle Ø 2.0 mm
B22 = Throttle Ø 2.2 mm

no code = NBR seals
V = FKM seals
Important:
Observe compatibility of seals with hydraulic fluid used!

3

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in Part III

Function, section, control spool symbols: 3/2 directional seat valve

General:
The directional valve type M-.SEW...XE is a directional seat valve with solenoid actuation. It controls the start, stop and direction of flow.
It basically comprises a housing (1), the solenoid (2), the hardened valve system (3) and the control spool (8).

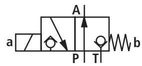
Basic principle:
In the initial position, the control spool (8) is pressed onto the seat by the spring (9) and in spool position by the solenoid (2). The force of the solenoid (2) acts via the angled lever (6) and the ball (7) on the control spool (8) that is sealed on two sides. The chamber between the two sealing elements is connected to port P. Thus, the valve system (3) is pressure-compensated in relation to the actuating forces (solenoid or return spring).

Important:

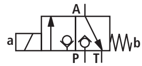
- The 3/2 directional seat valves have a "negative spool overlap". Therefore, port T must always be connected. That means that during the switching process – from the starting of the opening of one valve seat to the closing of the other valve seat – ports P–A–T are connected with each other. This process takes, however, place within such a short time that it is irrelevant in nearly all applications.
- The manual override (10) allows for the switching of the valve without solenoid energization.
- Make sure that the specified maximum flow is not exceeded. Use a throttle insert for flow limitation, if necessary (see below).

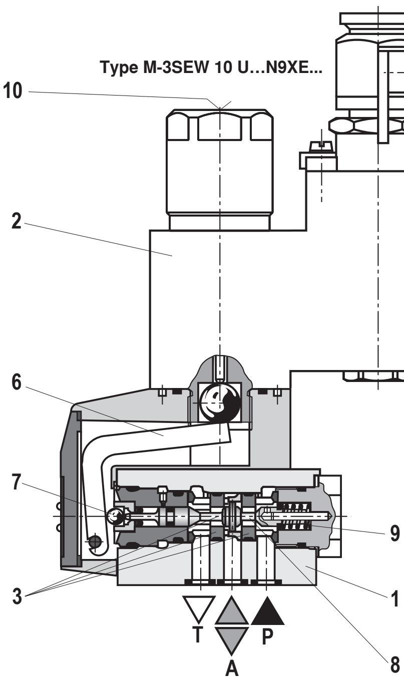
The seat arrangement offers the following options:

Control spool symbol "U":



Control spool symbol "C":





Throttle insert

The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

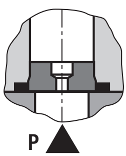
Examples:

– Accumulator operation,

– Use as pilot control valve with internal pilot fluid tapping.

3/2 directional seat valve
The throttle insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The throttle insert is inserted in port P of the Plus-1 plate.

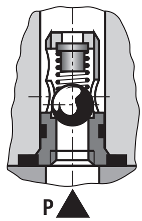


Check valve insert

The check valve insert allows free flow from P to A and closes A to P in a leak-free way.

3/2 directional seat valve
The check valve insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The check valve insert is inserted in port P of the Plus-1 plate.



Function, section, control spool symbols: 4/2 directional seat valve

With a sandwich plate, the **Plus-1 plate,** under the 3/2 directional seat valve, the function of a 4/2 directional seat valve is achieved.

Function of the Plus-1 plate:

Initial position:
The main valve is not operated. The spring (9) holds the ball (4) on the seat (11). Port P is blocked and A connected to T. Apart from that, one control line is connected from A to the large area of the control spool (12), which is thus unloaded to the tank. The pressure applied via P now pushes the ball (13) onto the seat (14). Now, P is connected to B, and A to T.

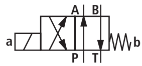
Transition position:
When the main valve is operated, the control spool (8) is shifted against the spring (9) and pressed onto the seat (15). During this, port T is blocked, P, A, and B are briefly connected to each other.

Spool position:
P is connected to A. As the pump pressure acts via A on the large area of the control spool (12), the ball (13) is pressed onto the seat (16). Thus, B is connected to T, and P to A. The ball (13) in the Plus-1 plate has a "positive spool overlap".

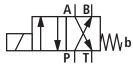
Important:
To prevent pressure intensification in conjunction with differential cylinders, the annulus area of the cylinder must be connected to A.

The use of the Plus-1 plate and the seat arrangement offer the following options:

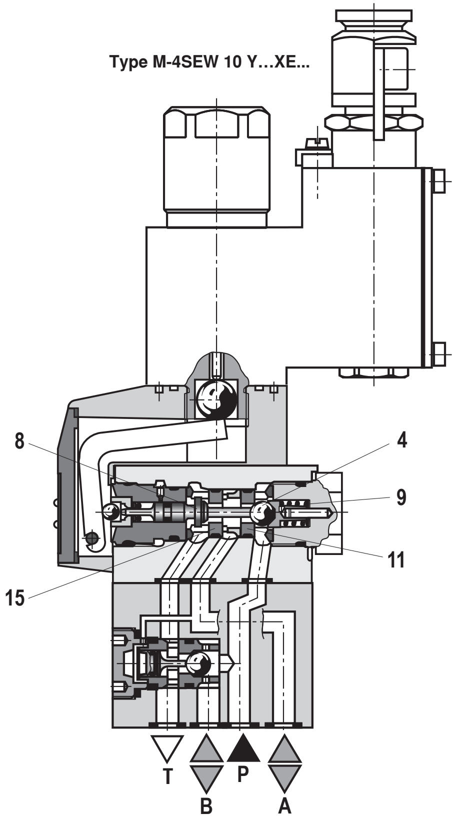
Control spool symbol "D":



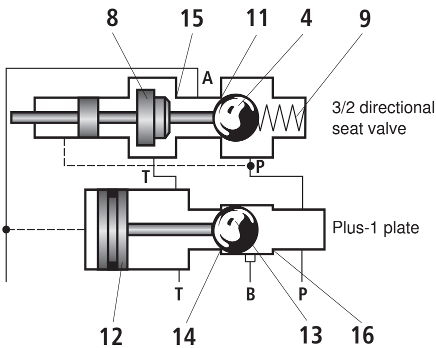
Control spool symbol "Y":



Type M-4SEW 10 Y…XE...



Schematic illustration: Initial position



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20 … +70 [1]
Storage temperature range		°C	–20 … +50
Admissible vibration load			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	3/2 directional seat valve	kg	3.8
	4/2 directional seat valve	kg	5.3
Surface protection			Galvanized coating

hydraulic

Maximum operating pressure	bar	See table on page 10
Maximum flow	l/min	40
Hydraulic fluid		Mineral oil (HL, HLP) according to DIN 51524 [2]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also RE 90221); HETG (rape seed oil) [2]; HEPG (polyglycols) [3]; HEES (synthetic esters) [3]; flame-resistant hydraulic fluid HFC according to ISO 12922 [4] Other hydraulic fluids upon request Ignition temperature > 180 °C
Hydraulic fluid temperature range	°C	–20 ... +80 (NBR seals)
		–15 ... +80 (FKM seals)
Viscosity range	mm^2/s	2.8 … 500
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)		Class 20/18/15 [5]

electric

Voltage type		Direct voltage	Alternating voltage 50/60 Hz
Available voltages	V	24, 48, 96, 110	110, 230
Voltage tolerance (nominal voltage)	%	–5 / +10	
Admissible residual ripple	%	< 5	–
Duty cycle/operating mode according to VDE 0580		100 % / S1 (continuous operation)	
Switching time according to ISO 6403		See table page 7	
Switching frequency	1/h	up to 15000	up to 7200
Nominal power at ambient temperature 20 °C	W	17	
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C	W	20.6	
Protection class according to EN 60529		IP 66 [6]	

[1] Observe the "Special conditions for safe use" on page 7.

[2] Suitable for NBR **and** FKM seals

[3] Suitable **only** for FKM seals

[4] Only in connection with NBR seals, max. admissible pressure 210 bar, Δp < 15 bar, hydraulic fluid temperature max. 60 °C
More information is available from our sales staff.

[5] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

[6] If the electrical connection is correctly installed.

Information on the explosion protection

Area of application as per directive 94/9/EC		II 2G
Type of protection Valve		c (EN 13463-5:2011)
Maximum surface temperature [1] Temperature class	°C	135 T4
Type of protection Valve solenoid according to EN 60079-7:2007 / EN 60079-18:2009		Ex e mb IIC T4 Gb
Type examination certificate Solenoid		KEMA 02ATEX2240 X
"IECEx Certificate of Conformity" Solenoid		IECEx DEK 12.0068X
Ambient temperature range	°C	–20 … +70 [2]
Special conditions for safe use		– Maximum ambient temperature: In case of bank assembly, as long as only one solenoid is energized at a time, and in case of individual assembly: +70 °C In case of bank assembly when more than one solenoid is energized at a time: +60 °C – The maximum temperature of the valve casing surface is 120 °C. This has to be considered when selecting the connection cable and contact of the connection cable with the casing surface is to be prevented.

[1] Surface temperature > 50 °C, provide contact protection

[2] Observe the "Special conditions for safe use".

3

Switching times *t* in ms (Installation position: Solenoid horizontal)

Pressure *p* in bar	Flow q_V in l/min	DC solenoid						AC solenoid							
		Control spool symbols U, C, D and Y						Control spool symbols U, C, D and Y							
		t_{on} without tank pressure				t_{off} U	t_{off} D	t_{on} without tank pressure				t_{off}			
		U	C	D	Y	C	Y	U	C	D	Y	U	C	D	Y
140	40	25	50	25	50	12	17	25	50	25	50	50	45	55	50
280	40	25	55	25	55	15	20	25	70	25	70	70	45	75	50
320	40	25	55	25	55	15	20	25	75	25	75	75	45	80	50
420	40	30	60	30	60	20	25	30	75	30	75	75	45	80	50

Electrical connection

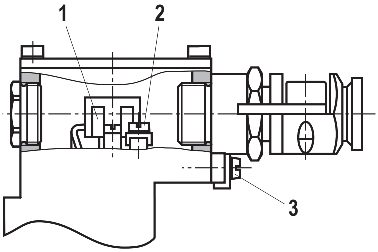
The type-examination tested valve solenoid of the valve is equipped with a terminal box and a type-tested cable gland.

The connection is polarity-independent.

Solenoids to be connected to AC voltage are equipped with an integrated rectifier.

Important

When establishing the electrical connection, the protective earthing conductor (PE ⏚) has to be connected properly.



Properties of the connection terminals

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 … 2.5 mm^2 Finely stranded 0.75 … 1.5 mm^2
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm^2 Finely stranded max. 1.5 mm^2
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm^2 Finely stranded 4 mm^2

Cable gland

Type approval		II 2G Ex e IIC Gb
Threaded connection		M20 x 1.5
Protection class according to EN 60529		IP66 [1)]
Line diameter	mm	9 … 11
Sealing		Outer sheath sealing

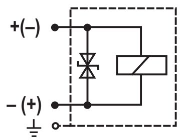
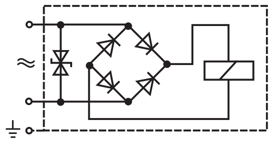
Connection line

Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–30 … > +110

[1)] If installed properly

Electrical connection

Circuit diagrams

Direct voltage, polarity-independent	Alternating voltage
	

Over-current fuse and switch-off voltage peaks

Important:

Corresponding to the rated current, a fuse according to DIN 41571 and EN / IEC 60127 has to be connected ahead of every valve solenoid (max. 3 x I_{rated}).

The shut-off threshold of the fuse has to match the prospective short-circuit current of the supply source.

The prospective short-circuit current of the supply source may amount to a maximum of 1500 A.

This fuse may only be installed outside the explosive area or must be of an explosion-proof design.

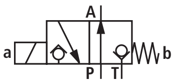
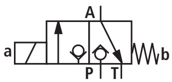
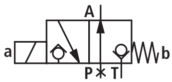
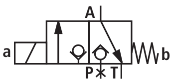
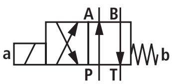
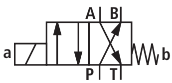
When inductivities are switched off, voltage peaks are the result which may cause faults in the connected control electronics. For this reason, the valve solenoids comprise an interference protection circuit which dampens this voltage peak to the voltage value shown in the table.

Voltage data in the valve type code	Nominal voltage valve solenoid	Rated current valve solenoid	Rated current external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Rated voltage of external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Maximum voltage value upon switch-off	Interference protection circuit
G24	24 V DC	0.708 A DC	800 mA	250 V	–90 V	Suppressor diode bi-directional
G48	48 V DC	0.354 A DC	400 mA	250 V	–200 V	
G96	96 V DC	0.177 A DC	200 mA	250 V	–370 V	
G110	110 V DC	0.155 A DC	200 mA	250 V	–390 V	
W110R	110 V AC	0.163 A AC	200 mA	250 V	–3 V	Bridge rectifier and suppressor diode
W230R	230 V AC	0.078 A AC	80 mA	250 V	–3 V	

General information

- In order to switch the valve safely or maintain it in its spool position, the pressure situation must be as follows: P ≥ A ≥ T (for design reasons).
- The ports P, A and T (3/2 directional seat valve) as well as P, A, B and T (4/2 directional seat valve) are clearly determined according to their tasks. They must not be exchanged or closed. The flow is only permitted in the direction of the arrow.
- When the Plus-1 plate (4/2 directional function) is used, the following minimum operating values have to be observed: p_{min} = 8 bar; q_V > 3 l/min.
- The specified maximum flow must not be exceeded (if necessary, use a throttle insert for flow limitation)!

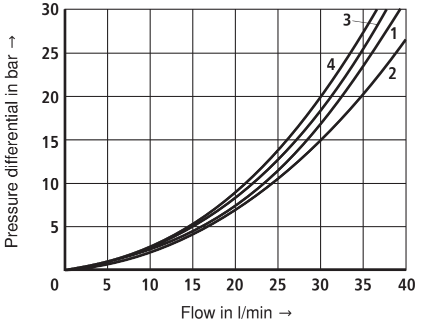
Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

	Control spool symbol	Comment	Operating pressure in bar				Flow in l/min
			P	A	B	T	
3-way circuit	"U" 	Pressure at P ≥ A ≥ T	420	420		100	40
	"C" 		420	420		100	40
2-way circuit (only for unloading)	"U" 	Before switching from the initial position to the spool position, pressure must be applied to port A. Pressure at A ≥ T		420		100	40
	"C" 	Pressure at A ≥ T		420		100	40
4-way circuit (flow only possible in the direction of arrow)	"D" 	Valve (symbol "U") in connection with Plus-1 plate P > A ≥ B > T	420	420	420	100	40
	"Y" 	Valve (symbol "C") in connection with Plus-1 plate P > A ≥ B > T	420	420	420	100	40

Important:
The switching power limits were established while the solenoids were at operating temperature, at 10% undervoltage and without tank preloading.

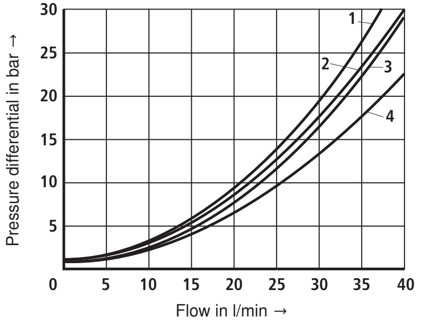
Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δ*p* - *q*$_V$ characteristic curves – 3/2 directional seat valve



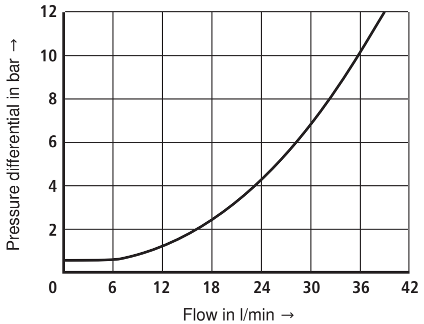
1 M-3SEW 10 **C**..., P → A
2 M-3SEW 10 **C**..., A → T
3 M-3SEW 10 **U**..., P → A
4 M-3SEW 10 **U**..., A → T

Δ*p* - *q*$_V$ characteristic curves – 4/2 directional seat valve

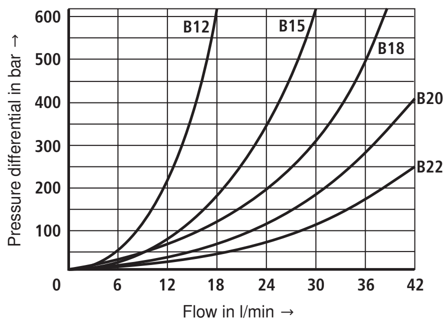


1 M-4SEW 10 **D(Y)**..., A → T
2 M-4SEW 10 **D(Y)**..., P → A
3 M-4SEW 10 **D(Y)**..., P → B
4 M-4SEW 10 **D(Y)**..., B → T

Δ*p* - *q*$_V$ characteristic curves – check valve insert

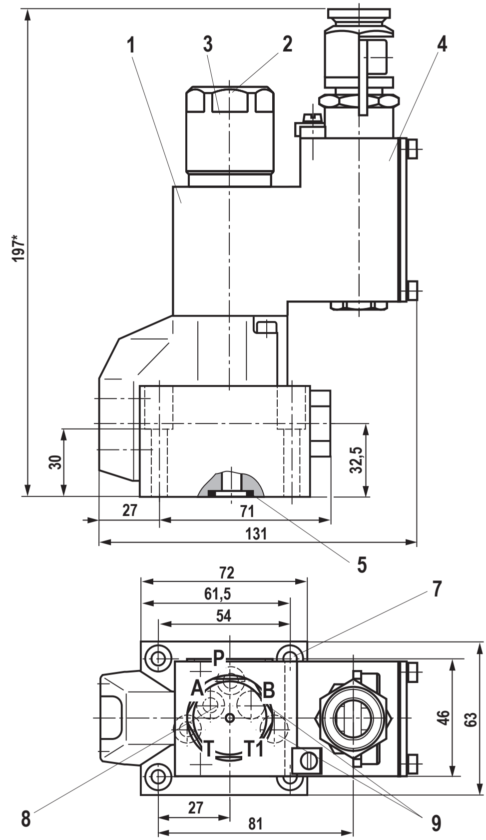


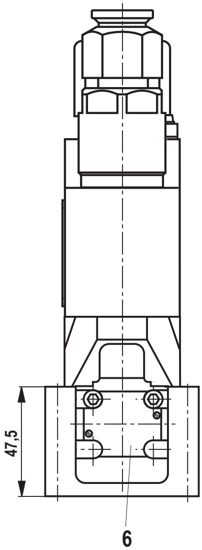
Δ*p* - *q*$_V$ characteristic curves – throttle insert

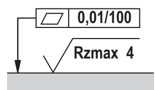


3

Dimensions: 3/2 directional seat valve (dimensions in mm)







Required surface quality of the valve contact surface

* Plus 80 mm for detaching the solenoid coil

1 Solenoid coil

2 Concealed manual override "N9"

3 Mounting nut with hexagon SW32

4 Terminal box

5 Identical seal rings for ports A, B, T and T1 seal ring for port P

6 Name plate

7 **Valve mounting screws**
For reasons of stability, exclusively use the following valve mounting screws:

4 hexagon socket head cap screws
ISO 4762-M6x40-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(must be ordered separately)
Mat. no.: **R913000058**

8 Porting pattern according to DIN 24340-A10 and ISO 4401-05-04-0-05

9 **Important:**
With 3/2 directional seat valves, ports B and T1 are designed as blind counterbore.

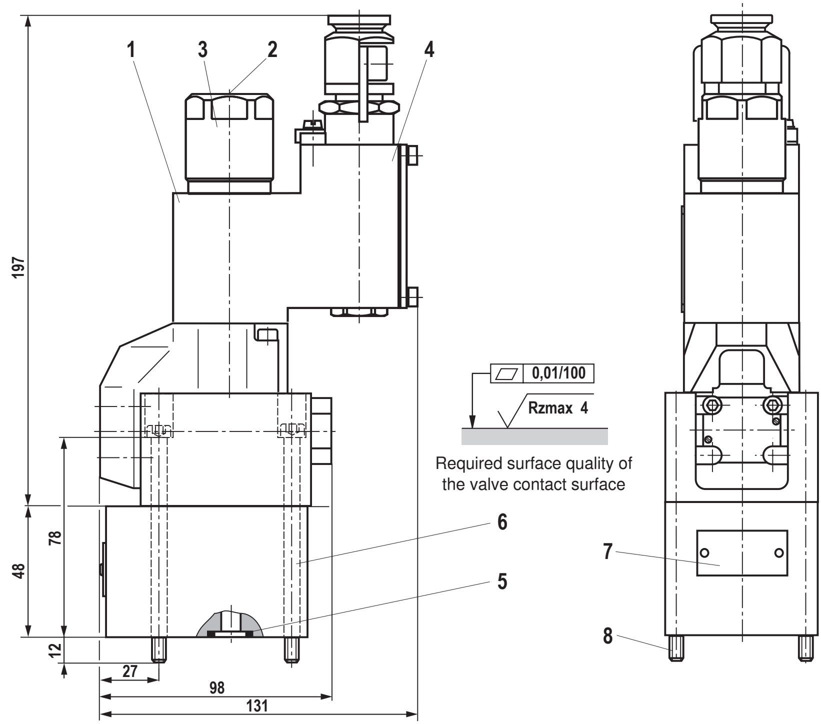
Subplates
G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)
with dimensions as in the data sheet 45054
(must be ordered separately)

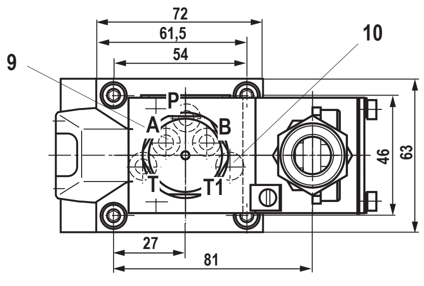
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Dimensions: 4/2 directional seat valve (dimensions in mm)





* Plus 80 mm for detaching the solenoid coil

1 Solenoid coil
2 concealed manual override "N9"
3 Mounting nut with hexagon SW32
4 Terminal box
5 Identical seal rings for ports A, B, T and T1 seal ring for port P
6 Plus-1 plate
7 Name plate

8 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x90-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)

9 Porting pattern according to DIN 24340-A10 and ISO 4401-05-04-0-05

10 Important
With 4/2 directional seat valves, port T1 is designed as blind counterbore.

Subplates
G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)
with dimensions as in the data sheet 45054
(must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

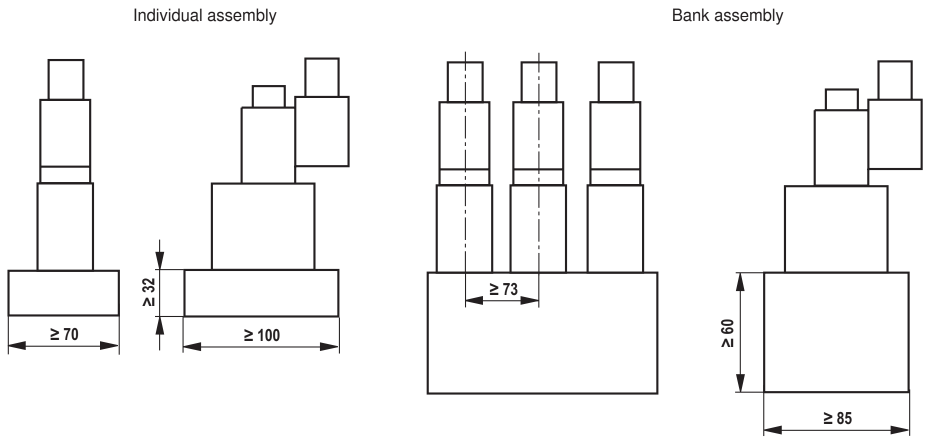
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

3

Installation conditions (dimensions in mm)

	Individual assembly	Bank assembly
Dimensions of the subplate	Minimum dimensions Length ≥ 100, width ≥ 70, height ≥ 32	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 73 mm	

Schematic diagram



Important:

Observe the "Special conditions for safe use" on page 7.

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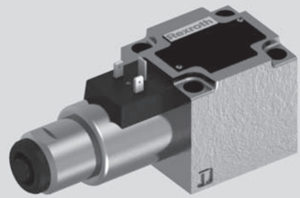
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

3/2 and 4/2 directional seat valves with solenoid actuation

RE 22045-XN-B2/08.12
Replaces: 07.10

Type M-.SED 10...XN...



Size 10
Component series 1X
Maximum operating pressure 350 bar
Maximum flow 40 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 3G; II 3D**
- Type of protection of the valve solenoid
  Ex nA IIC T3 Gc according to EN 60079-15:2010 and
  Ex tc IIIC T140°C Dc IP65 according to EN 60079-31:2009

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 22045-XN-B0**
Part II	Data sheet 22045-XN-B2	
Part III	Product-specific instructions 22045-XN-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

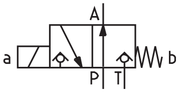
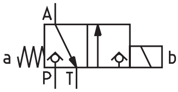
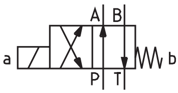
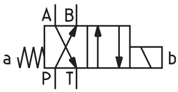
- Direct operated directional seat valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to ISO 4401-05-04-0-05 and NFPA T3.5.1 R2-D05
- Subplates available in FE/ZN version (see pages 11 to 14)
- Blocked connection tight in a leak-free form
- Safe switching also with longer standstill periods under pressure
- Wet-pin DC solenoids
- Solenoid coil rotatable by 90 °
- Electrical connection as individual connection with connector according to EN 175301-803, design A
- With manual override, optional

Ordering code and scope of delivery

M–	SED	10		1X / 350	C	G24		XN	K4 /		

3 main ports = **3**
4 main ports = **4**

Size = **10**

Main ports	3	4	
Control spool symbols			
	•	–	= **UK**
	•	–	= **CK**
	–	•	= **D**
	–	•	= **Y**
	• = Available		

Component series 10 to 19 (10 to 19: Unchanged installation and connection dimensions) = **1X**

Operating pressure up to 350 bar = **350**

Solenoid, wet-pin = **C**

Seal material
no code = NBR seals
V = FKM seals
Important: Observe compatibility of seals with hydraulic fluid used!

no code = Without check valve insert, without throttle insert
P = With check valve insert
B12 = Throttle Ø 1.2 mm
B15 = Throttle Ø 1.5 mm
B18 = Throttle Ø 1.8 mm
B20 = Throttle Ø 2.0 mm
B22 = Throttle Ø 2.2 mm

Electrical connection
K4 = Solenoid without mating connector
For details see chapter Electrical connection

XN = Explosion protection "Non-sparking", Details see information on the explosion protection page 7

N9 = With manual override
no code = Without manual override

G24 = Direct voltage 24 V

3

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in part III

Function, section, control spool symbols: 3/2 directional seat valve

General:

The directional valve type M-.SED is a direct operated directional seat valve with solenoid actuation. It controls the start, stop and direction of flow and basically comprises a housing (1), the solenoid (2), the valve seats (7) and (11) and the control spool (4).

The manual override (6) allows for the switching of the valve without solenoid energization.

Basic principle:

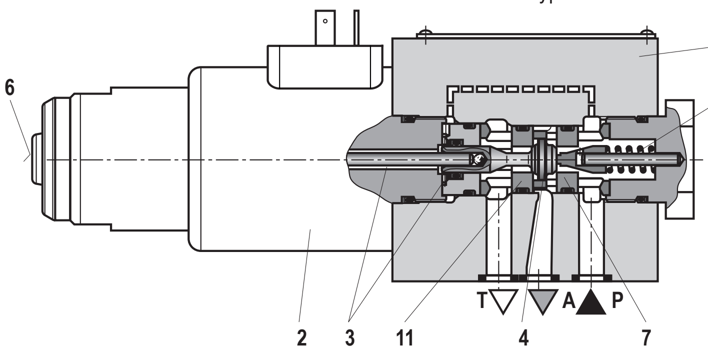
The initial position of the valve (normally open "UK" or normally closed "CK") is determined by the arrangement of the spring (5). The chamber (3) behind the control spool (4) is connected to port P and sealed against port T. Thus, the valve is pressure-compensated in relation to the actuating forces (solenoid and spring).

By means of the control spool (4), the ports P, A and T can be loaded with the maximum operating pressure (350 bar) and the flow can be directed in both directions (see control spool symbols).

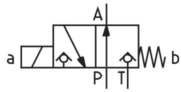
In the initial position, the control spool (4) is pressed onto the seat (11) by the spring (5), in spool position, it is pressed onto the seat (7) by the solenoid (2). The flow is blocked in a leak-free manner.

Seat valves can be used according to the control spool symbols and the related operating pressures and flows (see performance limits page 9).

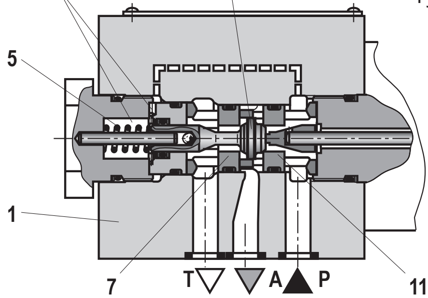
Type M-3SED 10 **UK**1X/350CG24N9XNK4



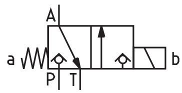
Control spool symbol
"**UK**"



Type M-3SED 10 **CK**...



Control spool symbol
"**CK**"



Function, section, control spool symbols: 4/2 directional seat valve

With a sandwich plate, the **Plus-1 plate**, under the 3/2 directional seat valve, the function of a 4/2 directional seat valve is achieved.

Function of the Plus-1 plate:

Initial position:

The main valve is not operated. The spring (5) holds the control spool (4) on the seat (11). Port P is blocked and A connected to T. Apart from that, one control line is connected from A to the large area of the control spool (8), which is thus unloaded to the tank. The pressure applied via P now pushes the ball (9) onto the seat (10). Now, P is connected to B, and A to T.

Transition position:

When the main valve is operated, the control spool (4) is shifted against the spring (5) and pressed onto the seat (7). During this, port T is blocked, P, A, and B are briefly connected to each other.

Spool position:

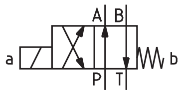
P is connected to A. As the pump pressure acts via A on the large area of the control spool (8), the ball (9) is pressed onto the seat (12). Thus, B is connected to T, and P to A. The ball (9) in the Plus-1 plate has a "positive spool overlap".

Important:

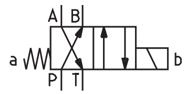
To prevent pressure intensification in conjunction with differential cylinders, the annulus area of the cylinder must be connected to A.

The use of the Plus-1 plate and the seat arrangement offer the following options:

Control spool symbol "**D**"

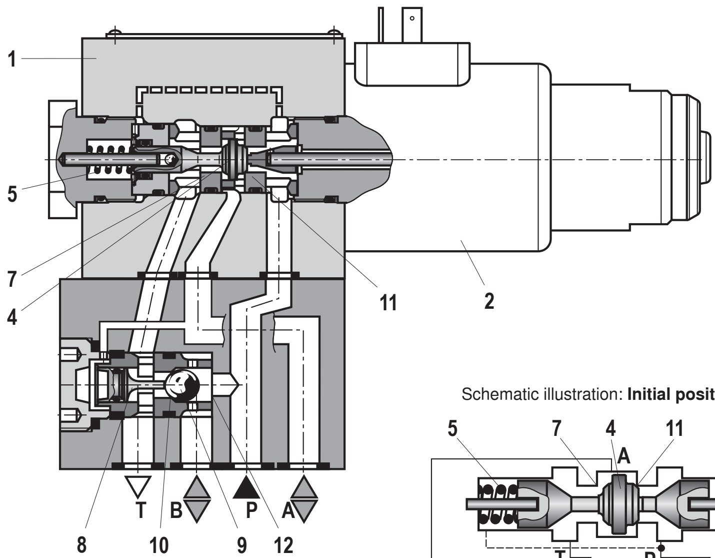


Control spool symbol "**Y**"

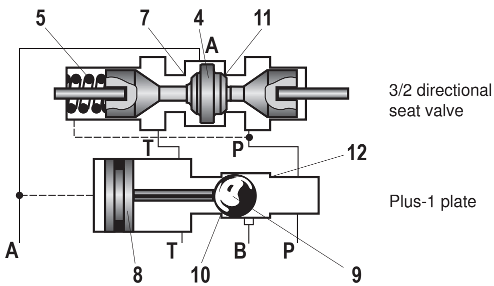


3

Type M-4SED 10 **Y**1X/350CG24N9XNK4



Schematic illustration: **Initial position**



Function, section: Throttle insert, check valve insert

Throttle insert

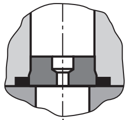
The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

Examples:

- Accumulator operation,
- Use as pilot control valve with internal pilot fluid tapping.

3/2 directional seat valve (see page 4)
The throttle insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The throttle insert is inserted in port P of the Plus-1 plate.

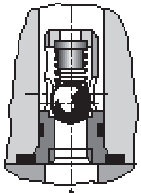


Check valve insert

The check valve insert allows free flow from P → A and closes A → P in a leak-free form.

3/2 directional seat valve (see page 4)
The check valve insert is inserted in port P of the seat valve.

4/2 directional seat valve (see page 5)
The check valve insert is inserted in port P of the Plus-1 plate.



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20 … +50
Storage temperature range		°C	+15 … +30
Admissible vibration load			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	3/2 directional seat valve	kg	3.3
	4/2 directional seat valve	kg	4.7
Surface protection			Galvanically coated

hydraulic

Maximum operating pressure	bar	See table on page 9
Maximum flow	l/min	40
Hydraulic fluid		Mineral oil (HL, HLP) according to DIN 51524 [1]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also data sheet 90221); HETG (rape seed oil) [1]; HEPG (polyglycols) [2]; HEES (synthetic esters) [2]; other hydraulic fluids on request, ignition temperature > 190 °C
Hydraulic fluid temperature range	°C	–20 … +80 (for NBR seals) [3]
		–15 … +80 (for FKM seals) [3]
Viscosity range	mm^2/s	2.8 … 500
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)		Class 20/18/15 [4]

[1] Suitable for NBR **and** FKM seals

[2] Suitable **only** for FKM seals

[3] Observe the "Special conditions for safe use" on page 7.

[4] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter

Technical data

electric

Voltage type			Direct voltage (DC)
Nominal voltage		V	24
Voltage tolerance		%	±10
Admissible residual ripple		%	< 5
Duty cycle / operating mode according to VDE 0580			100 % / S1 (continuous operation)
Switching times according to ISO 6403	On	ms	40 … 80
	Off	ms	10 … 25
Switching frequency		Hz	Max. 1
Nominal power at ambient temperature 20 °C		W	23
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C		W	28.8
Protection class according to EN 60529			IP 65 [1]

[1] If suitable mating connectors are used (protection class at least IP 65) and in case of appropriate assembly.

Information on the explosion protection

Area of application as per directive 94/9/EC		II 3G	II3 D
Type of protection of the valve solenoid according to EN 60079-15: 2010 / EN 60079-31: 2009		Ex nA IIC T3 Gc	Ex tc IIIC T140°C Dc IP65
Maximum surface temperature [1]	°C	140	140
Type examination certificate Solenoid		BVS 12 ATEX E 062 X	
Type of protection Valve		c (EN 13463-5: 2011)	
Special conditions for safe use		– Connection lines must be passed in a pull-relieved way. – The valve is to be installed so that no impact stresses > 4 J can take effect. – In order to avoid dangers caused by static charging, the base and/or subplate on which the valve is to be fitted must be electrically conductive and included in the equipotential bonding. – The valve solenoid must not be installed close to charge-generating processes. – Dust layers with a thickness > 50 mm are not admissible. – Maximum hydraulic fluid temperature: In case of bank assembly, as long as only one solenoid is energized at a time, and in case of individual assembly: +80 °C In case of bank assembly when more than one solenoid is energized at a time: +65 °C – The maximum temperature of the valve casing surface is 110 °C. This has to be considered when selecting the connection cable and/or contact of the connection cable with the casing surface is to be prevented.	
Ambient temperature range	°C	–20 … +50	

Requirements on the mating connector

Temperature at the connector of the valve solenoid	°C	≥ 100
Area of application as per directive 94/9/EC		II 3G; II 3D
Protection class in plugged condition		IP 65

[1] Surface temperature > 50 °C, provide contact protection

3

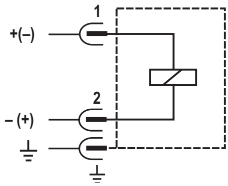
Electrical connection

The valves are equipped with a plug-in connector according to EN 175301-803, design A.

Information on the suitability of mating connectors is available on page 7.

Circuit diagram

Connection is polarity-independent



For protection of the valve solenoids, suitable measures are to be taken which limit the switch-off overvoltages to a maximum of 500 V.

Over-current fuse and switch-off voltage peak

Important:

A fuse appropriate for the solenoid's rated current (max. 3 x I_{rated} according to DIN 41571 and/or IEC 60127) or a protective motor switch with short-circuit and thermal instantaneous tripping must be connected to each valve solenoid as short-circuit protection. The cut-off capacity of the fuse must match or exceed the short-circuit current of the supply source.

This fuse or protective motor switch may only be fitted outside the explosive area or must be of an explosion-proof design.

When an inductivity is switched off, a voltage peak results which may cause failures or damage in the connected control electronics.

Voltage data in the valve type code	Nominal voltage Valve solenoid	Rated current Valve solenoid	Recommended pre-fuse characteristics medium time-lag according to DIN EN 60127-1: 2011
G24	24 V DC	0.95 A DC	1 A

General information

Seat valves can be used according to the control spool symbols and the related operating pressures and flows (see performance limits below).

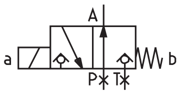
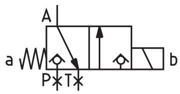
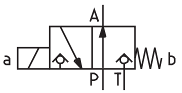
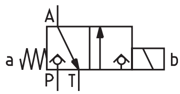
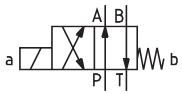
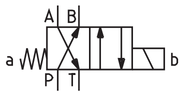
In order to guarantee safe functioning, the following points must imperatively be observed:

- Seat valves have negative spool overlap, i.e. leakage oil occurs during the switching process. This process takes, however, place within such a short time that it is irrelevant in nearly all applications.
- The specified maximum flow must not be exceeded (if necessary, use a throttle insert for the flow limitation)!

Plus-1 plate:

- When the Plus-1 plate (4/2 directional function) is used, the following lower operating values are to be observed: $\boldsymbol{p}_{min}$ = 8 bar, $\boldsymbol{q}_V$ > 3 l/min.
- The ports P, A, B and T are clearly determined according to the tasks. They must not be exchanged or closed!
- Port T must always be connected.
- Pressure level and pressure distribution are to be observed!
- The flow is only permitted in the direction of arrow!

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

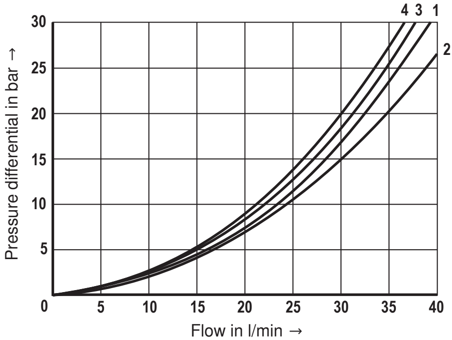
	Control spool symbol	Comment	Operating pressure in bar				Flow in l/min
			P	A	B	T	
2-way circuit	**"UK"** 	With 2/2 way circuits, port P **or** T must be closed by the customer!	350	350		350	40
	"CK" 		350	350		350	40
3-way circuit	**"UK"** 		350	350		350	40
	"CK" 		350	350		350	40
4-way circuit (flow only possible in the direction of arrow)	**"D"** 	3/2 directional valve (symbol "UK") in connection with Plus-1 plate: $p_P \geq p_A \geq p_B \geq p_T$	350	350	350	P/A/B −40	40
	"Y" 	3/2 directional valve (symbol "CK") in connection with Plus-1 plate: $p_P \geq p_A \geq p_B \geq p_T$	350	350	350	P/A/B −40	40

Important

The switching power limits were established while the solenoids were at operating temperature, at 10 % undervoltage and without tank pre-loading.

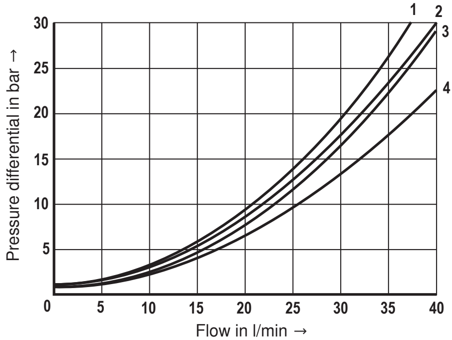
Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δ*p* - *q*$_V$ characteristic curves
3/2 directional seat valve



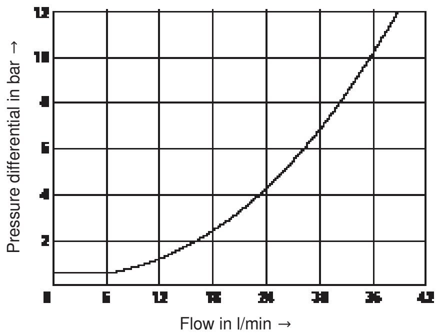
1 M-**3**SED 10 **CK**..., P → A
2 M-**3**SED 10 **CK**..., A → T
3 M-**3**SED 10 **UK**..., P → A
4 M-**3**SED 10 **UK**..., A → T

Δ*p* - *q*$_V$ characteristic curves
4/2 directional seat valve

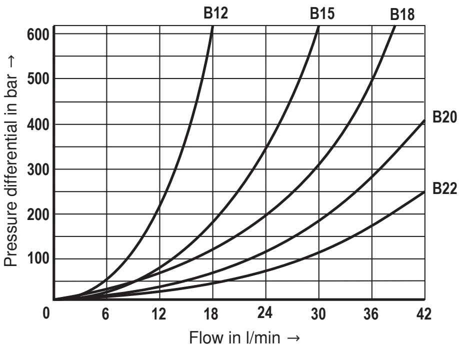


1 M-**4**SED 10 **D**/**Y**..., A → T
2 M-**4**SED 10 **D**/**Y**..., P → A
3 M-**4**SED 10 **D**/**Y**..., P → B
4 M-**4**SED 10 **D**/**Y**..., B → T

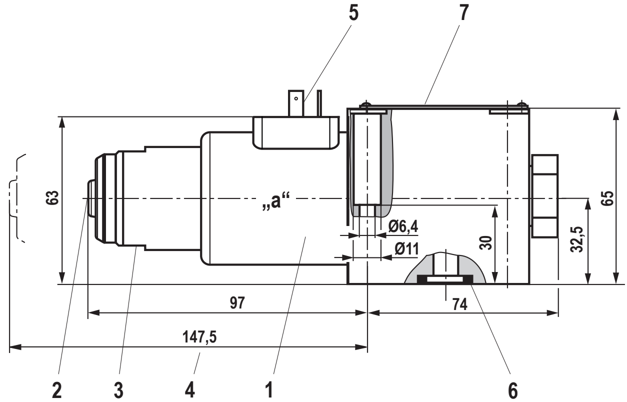
Δ*p* - *q*$_V$ characteristic curve
Check valve insert

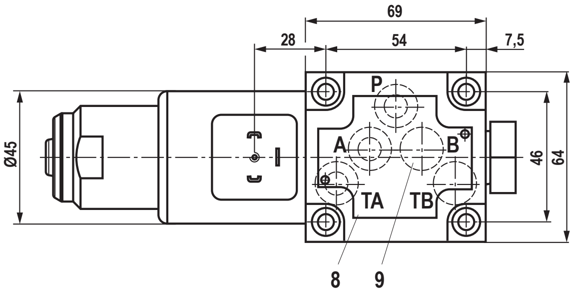


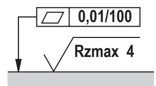
Δ*p* - *q*$_V$ characteristic curves
Throttle insert



Device dimensions: 3/2 directional seat valve – design "UK" (dimensions in mm)







Required surface quality of the valve contact surface

3

1 Solenoid coil
2 Manual override "N9"
3 Mounting nut with double edge SW32
4 Space required to remove the solenoid coil
5 Plug-in connector according to EN 175301-803, design A
6 Identical seal rings for ports A, B, T
Seal ring for port P
7 Name plate
8 Porting pattern according to ISO 4401-05-04-0-05 and NFPA T3.5.1 R2-D05
9 **Important**
With 3/2 directional seat valves, ports B and TB are designed as blind counterbore

Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x40-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(must be ordered separately)

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

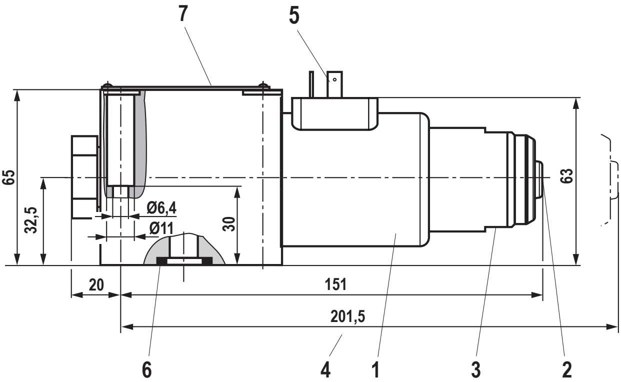
with dimensions as in the data sheet 45054
(must be ordered separately)

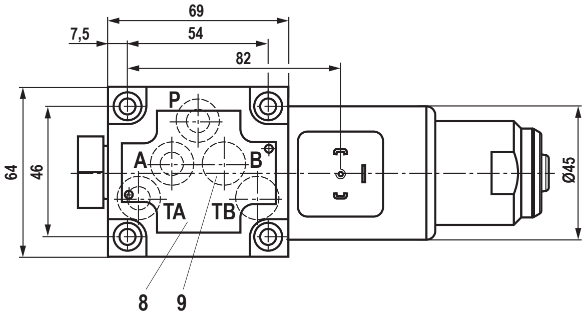
Important:

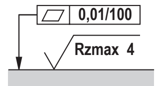
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Device dimensions: 3/2 directional seat valve – design "CK" (dimensions in mm)







Required surface quality of the valve contact surface

1 Solenoid coil
2 Manual override "N9"
3 Mounting nut with double edge SW32
4 Space required to remove the solenoid coil
5 Plug-in connector according to EN 175301-803, design A
6 Identical seal rings for ports A, B, T
Seal ring for port P
7 Name plate
8 Porting pattern according to ISO 4401-05-04-0-05 and NFPA T3.5.1 R2-D05
9 **Important**
With 3/2 directional seat valves, ports B and TB are designed as blind counterbore

Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x40-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(must be ordered separately)

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

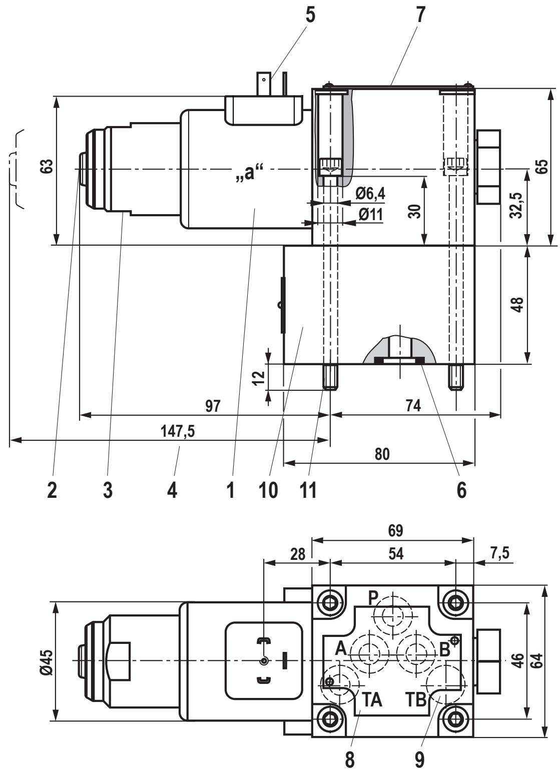
with dimensions as in the data sheet 45054
(must be ordered separately)

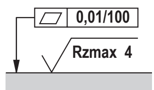
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Device dimensions: 4/2 directional seat valve – design "D" (dimensions in mm)





Required surface quality of the valve contact surface

1 Solenoid coil
2 Manual override "N9"
3 Mounting nut with double edge SW32
4 Space required to remove the solenoid coil
5 Plug-in connector according to EN 175301-803, design A
6 Identical seal rings for ports A, B, T
Seal ring for port P
7 Name plate
8 Porting pattern according to ISO 4401-05-04-0-05 and NFPA T3.5.1 R2-D05
9 **Important**
With 4/2 directional seat valves, port TB is designed as blind counterbore
10 Plus-1 plate
11 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x90-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with dimensions as in the data sheet 45054
(must be ordered separately)

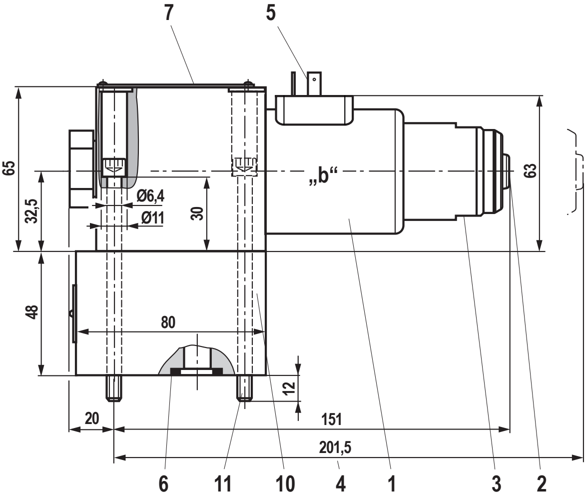
Important:

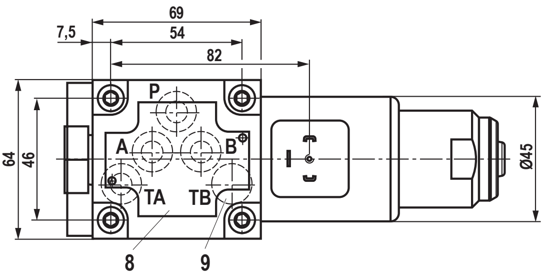
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

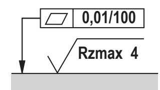
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

3

Device dimensions: 4/2 directional seat valve – design "Y" (dimensions in mm)







Required surface quality of the valve contact surface

- **1** Solenoid coil
- **2** Manual override "N9"
- **3** Mounting nut with double edge SW32
- **4** Space required to remove the solenoid coil
- **5** Plug-in connector according to EN 175301-803, design A
- **6** Identical seal rings for ports A, B, T
  Seal ring for port P
- **7** Name plate
- **8** Porting pattern according to ISO 4401-05-04-0-05 and NFPA T3.5.1 R2-D05
- **9** **Important**
  With 4/2 directional seat valves, port TB is designed as blind counterbore
- **10** Plus-1 plate
- **11** Valve mounting screws
  For reasons of stability, exclusively use the following valve mounting screws:
  4 hexagon socket head cap screws
  ISO 4762-M6x90-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the scope of delivery)

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with dimensions as in the data sheet 45054
(must be ordered separately)

Important:

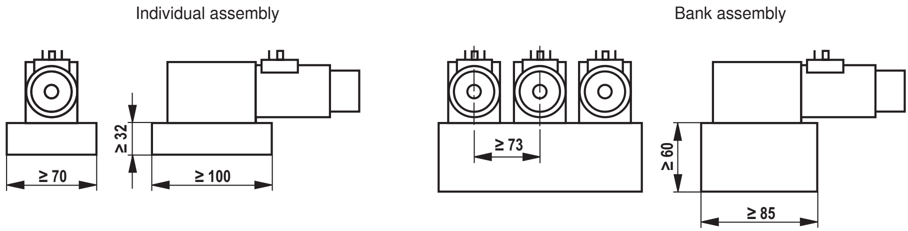
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Installation conditions (dimensions in mm)

	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 100, width ≥ 70, height ≥ 32	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 73 mm	

Schematic diagram



Important:

With regard to the hydraulic fluid temperature, observe the "Special conditions for safe use" on page 7.

Notes

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97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

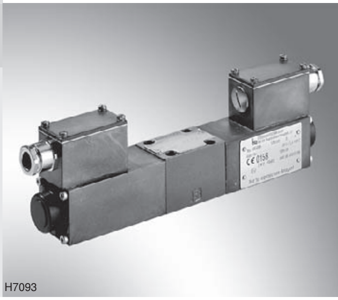
Rexroth
Bosch Group

4/3, 4/2 and 3/2 directional valves with wet-pin DC solenoids

RE 23177-XH-B2/11.12
Replaces: 04.12

Type WE 6 ../.B..X...

Size 6
Component series 5X
Maximum operating pressure 210 bar
Maximum flow 20 l/min



H7093

ATEX units
For explosive areas

Part II Data sheet

Information on explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **I M2; II 2G**
- Type of protection of the valve solenoids: Ex ib I Mb / Ex ib IIC T6 Gb according to EN 60079-0:2009 / EN 60079-11:2007

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 23177-XH-B0**
Part II	Data sheet 23177-XH-B2	
Part III	Product-specific instructions 23177-XH-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Contents	**Page**

Features

- Direct operated directional spool valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to ISO 4401-03-02-0-05
- Subplates available in FE/ZN version (see page 10)
- Wet-pin DC solenoids
- Electrical connection optionally with:
  - Individual connection with cable gland
  - 2 m connection line
  - Connector
- With manual override

Ordering code and scope of delivery

	WE	6		5X /		B		N		/		

3 main ports	**= 3**
4 main ports	**= 4**
Size 6	**= 6**
Control spool symbol e.g. C, E, EA, EB etc. possible versions see below	
Component series 50 to 59 (50 to 59: unchanged installation and connection dimensions)	**= 5X**
Spring return	**= no code**
Without spring return	**= O**
High-power solenoid wet-pin	**= B**
Solenoid, direct voltage 12 V	
Nominal power supply 120 mA	**= G12-12**
Nominal power supply 130 mA	**= G12-13**
Nominal power supply 190 mA	**= G12-19**
Depending on the electrical connection, see page 7	

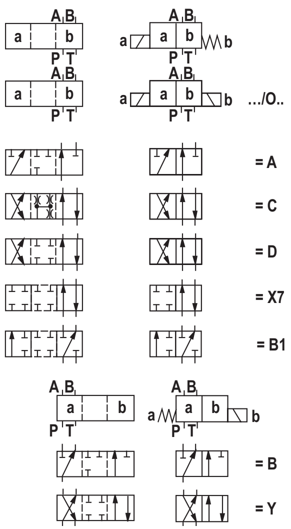
N =	**With** manual override (standard)
XH =	Explosion protection "Intrinsically safe", for component group II (all, except for mining)
XM =	Explosion protection "Intrinsically safe" for component group I (mining)
	Details see information on the explosion protection page 6
	Electrical connection
CKL =	Solenoid with 2 m connection line
Z2 =	Solenoid with terminal box and cable gland
K20L =	Solenoid with connector
	For details see chapter Electrical connection
no code =	Without throttle insert
B08 =	Throttle Ø 0.8 mm
B10 =	Throttle Ø 1.0 mm
B12 =	Throttle Ø 1.2 mm
	Use if flow > performance limit of the valve, effective in channel P
no code =	NBR seals
V =	FKM seals
	Important: Observe compatibility of seals with hydraulic fluid used!

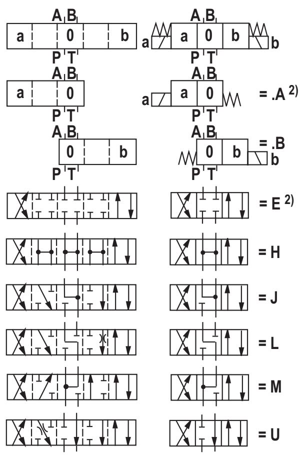
Important:
For possible combinations for the ordering code "Solenoid", "Electrical connection" and "Explosion protection" please refer to the table on page 7.

Included in the scope of delivery:
Valve operating instructions with declaration of conformity in part III

3

Control spool symbols





2) **Example:** Control spool symbol E with spool position "a" → ordering code ..EA..

Function, section

Directional valves of type WE are solenoid operated directional spool valves. They control the start, stop and direction of a fluid flow.

The directional valves basically consist of housing (1), one or two solenoids (2), control spool (3), and one or two return springs (4).

In the de-energized condition, control spool (3) is held in the central position or in the initial position by the return springs (4) (except for impulse spool). The control spool (3) is actuated by wet-pin solenoids (2).

To ensure proper functioning, care must be taken that the pressure chamber of the solenoid is filled with oil.

The force of solenoid (2) acts via plunger (5) on control spool (3) and pushes the latter from its rest position to the required end position. This enables the necessary direction of flow from P → A and B → T or P → B and A → T.

After solenoid (2) was de-energized, return spring (4) pushes control spool (3) back to its rest position.

A manual override (6) allows control spool (3) to be moved without solenoid energization.

Type 4WE 6.. 5X/O...X (only possible with symbols A, C and D)

This version is a directional valve with two spool positions and two solenoids without detent. In the de-energized condition, there is no defined spool position.

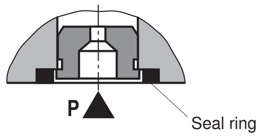
Important:

The tank line must not be allowed to run empty. With corresponding installation conditions, a pre-charge valve (pre-charging pressure approx. 2 bar) must be installed.

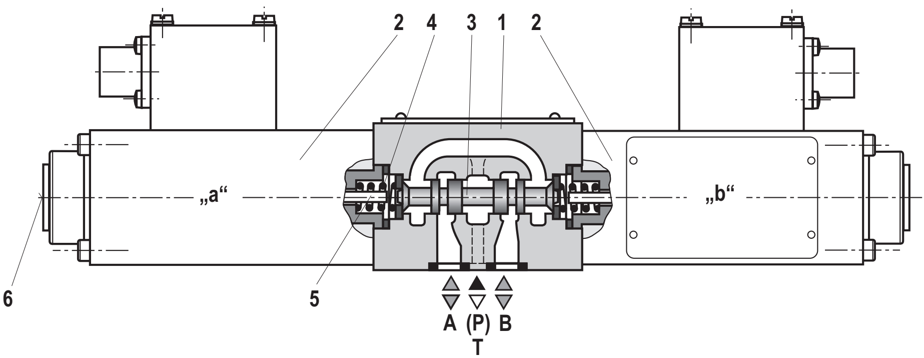
Throttle insert (valve type 4WE 6..5X/…X.../B..)

The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

It is inserted in channel P of the directional valve.



Example: Type 4WE 6 E5X/.B.X.K20L/..



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20 … +50
Storage temperature range		°C	+15… +30
Admissible vibration load			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight		kg	2.6 (with 1 solenoid); 4.2 (with 2 solenoids)
Surface protection	Valve body		Galvanically coated
	Solenoid		Galvanically coated

hydraulic

Maximum surface temperature		°C	See information on the explosion protection, page 6
Maximum operating pressure	Port A, B, P	bar	210
	Port T	bar	100 With symbols A and B, port T must be used as leakage oil connection if the operating pressure exceeds the admissible tank pressure.
Maximum flow		l/min	20
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 [1]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also data sheet 90221); HETG (rape seed oil) [1]; HEPG (polyglycols) [2]; HEES (synthetic esters) [2]; flame-resistant hydraulic fluid HFC according to ISO 12922 [3] Other hydraulic fluids upon request Ignition temperature > 130 °C
Hydraulic fluid temperature range		°C	–20 ... +80 (NBR seals)
			–15 ... +50 (FKM seals)
Viscosity range		mm^2/s	2.8 … 500
Maximum admissible degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)			Class 20/18/15 [4]

[1] Suitable for NBR **and** FKM seals

[2] Suitable **only** for FKM seals

[3] Only in connection with NBR seals
For more information, please ask our sales staff.

[4] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see www.boschrexroth.com/filter.

Technical data

electric

Nominal voltage		V	12		
Voltage type			Direct voltage (DC)		
Admissible residual ripple		%	< 5		
Voltage tolerance		%	±10		
Duty cycle / operating mode according to VDE 0580			100 % / S1 (DB)		
Information on the rated current in the ordering code			**G12-12**	**G12-13**	**G12-19**
Rated current		mA	120	130	190
Coil resistance with solenoid temperature 20 °C		Ω	89		59
Minimum current for achieving the hydraulic switching power		mA	88	96	143
Switching times according to ISO 6403	On	ms	145		105
	Off	ms	80		100
Switch-off voltage peak Solenoid		V	Max. –3		
Protection class according to EN 60529 [1]			IP 65		

Information on explosion protection

Ordering code		**G12-12**		**G12-13**		**G12-19**
Ordering code		XM	XH	XM	XH	XM
Area of application as per directive 94/9/EC		I M2	II 2G	I M2	II 2G	I M2
Type of protection valve solenoid according to EN 60079-0:2009 / EN 60079-11:2007		Ex ib I Mb	Ex ib IIC T6 Gb	Ex ib I Mb	Ex ib IIC T6 Gb	Ex ib I Mb
Maximum surface temperature [2]	°C	80		80		80
Temperature class		–	T6	–	T6	–
Type examination certificate Solenoid		BVS 08 ATEX E 023				
"IEC Certificate of Conformity" Solenoid		IECEx BVS 07.0008				
Type of protection Valve		c (EN 13463-5:2011)				
Special operating conditions for a safe application		In case of valves with two solenoids, maximally one of the solenoids may be energized at a time.				

[1] With correctly installed electrical connection

[2] Surface temperature > 50 °C, provide contact protection

Technical data

Information on explosion protection (continued)

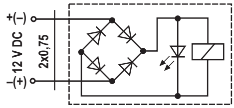
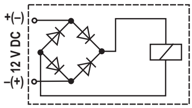
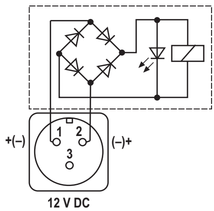
<table>
<tr><td colspan="8">Safety-related maximum values of the solenoids depending on the component group and the type of the electrical connection</td></tr>
<tr><td colspan="2">Component group</td><td colspan="3">I (mining)</td><td colspan="3">II (all, except for mining)</td></tr>
<tr><td colspan="2">Ordering code for explosion protection</td><td colspan="3">XM</td><td colspan="3">XH</td></tr>
<tr><td colspan="2">Ordering code for solenoid</td><td>G12-12</td><td>G12-13</td><td>G12-19</td><td>G12-12</td><td>G12-13</td><td>G12-19</td></tr>
<tr><td colspan="8">Electrical connection CKL</td></tr>
<tr><td>Maximum voltage U_i</td><td>V DC</td><td rowspan="6">Version not available</td><td>15</td><td>15</td><td rowspan="6">Version not available</td><td>27</td><td rowspan="6">Version not available</td></tr>
<tr><td>Maximum current I_i</td><td>A</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>Maximum input power P</td><td>W</td><td></td><td></td><td>3</td></tr>
<tr><td>Effective inner inductivity L_i [1)]</td><td>nH/m</td><td>820</td><td>820</td><td>820</td></tr>
<tr><td>Effective inner capacity C_i [1)]</td><td>pF/m</td><td>145</td><td>145</td><td>145</td></tr>
<tr><td>Ambient temperature range</td><td>°C</td><td>–20…+50</td><td>–20…+50</td><td>–20…+50</td></tr>
<tr><td colspan="8">Electrical connection Z2</td></tr>
<tr><td>Maximum voltage U_i</td><td>V DC</td><td>15</td><td rowspan="5">Version not available</td><td rowspan="5">Version not available</td><td>27</td><td rowspan="5">Version not available</td><td rowspan="5">Version not available</td></tr>
<tr><td>Maximum current I_i</td><td>A</td><td>2</td><td>2</td></tr>
<tr><td>Effective inner inductivity L_i</td><td>nH</td><td>Neglectable</td><td>Neglectable</td></tr>
<tr><td>Effective inner capacity C_i</td><td>pF</td><td>Neglectable</td><td>Neglectable</td></tr>
<tr><td>Ambient temperature range</td><td>°C</td><td>–20…+50</td><td>–20…+50</td></tr>
<tr><td colspan="8">Electrical connection K20L</td></tr>
<tr><td>Maximum voltage U_i</td><td>V DC</td><td rowspan="5">Version not available</td><td rowspan="5">Version not available</td><td>15</td><td rowspan="5">Version not available</td><td rowspan="5">Version not available</td><td rowspan="5">Version not available</td></tr>
<tr><td>Maximum current I_i</td><td>A</td><td>2</td></tr>
<tr><td>Effective inner inductivity L_i</td><td>nH</td><td>Neglectable</td></tr>
<tr><td>Effective inner capacity C_i</td><td>pF</td><td>Neglectable</td></tr>
<tr><td>Ambient temperature range</td><td>°C</td><td>–20…+50</td></tr>
</table>

[1)] Measured with connection line 2 x 0.75 mm^2, maximum length 10 m

3

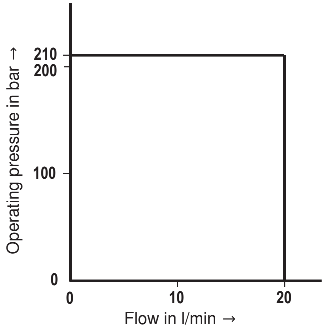
Electrical connection

The type-examination tested valve solenoid of the valve is equipped with an electrical connection according to the following table. The electrical connection of the solenoid is polarity-independent.

Ordering code for the electrical connection	Type of connection Description		Circuit diagram	Ordering code for the solenoid, availability
CKL	– Electrical connection via non-exchangeable, two-core connection line, blue – Operating display via light emitting diode (LED), red			**G12-13** (130 mA) **G12-19** (190 mA)
	Connection line, two-core			
	Line cross-section	mm^2	0.75 finely stranded	
	Line diameter	mm	approx. 5.6	
	Length	m	2	
Z2	– Electrical connection via 2-pole terminal in terminal box – with cable gland – without operating display			**G12-12** (120 mA)
	Cable gland			
	Threaded connection		M20x1.5	
	Line diameter	mm	6.5...9.5 [1)]	
	Sealing		Outer sheath sealing	
	Connection terminal Solenoid			
	For line cross-section	mm^2	0.75 … 1.5	
K20L	– Electrical connection via connector, 3-pole with pin contacts, type 845-11-1125-001, FCI/Souriau – Operating display via light emitting diode (LED), red – Suitable mating connector, type 845-11-8522-001, FCI/Souriau, must be ordered separately			**G12-19** (190 mA)

1) Larger diameters upon request

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)



Important:

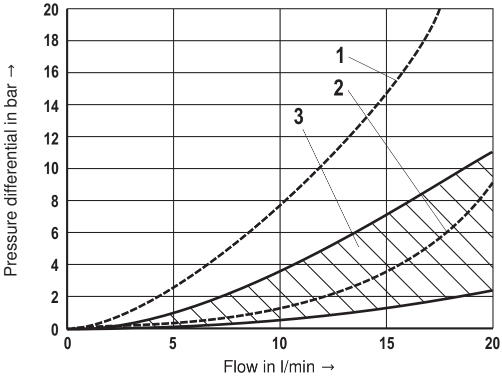
The specified switching power limits are valid for operation with two directions of flow (e.g. from P → A and simultaneous return flow from B → T).

Due to the flow forces acting within the valves, the admissible switching power limit may be considerably lower with only one direction of flow (e.g. from P → A while port B is blocked)!

(In such cases, please consult us.)

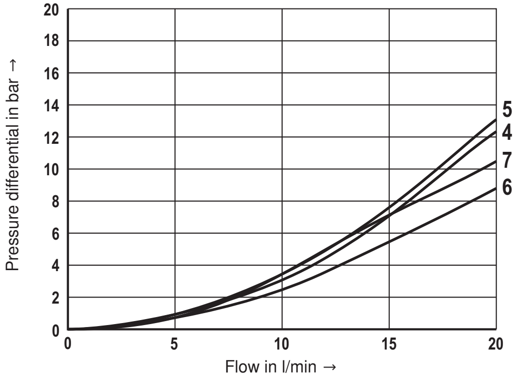
The switching power limit was established while the solenoids were at operating temperature, at 10 % undervoltage and without tank pre-loading.

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C and p = 100 bar)



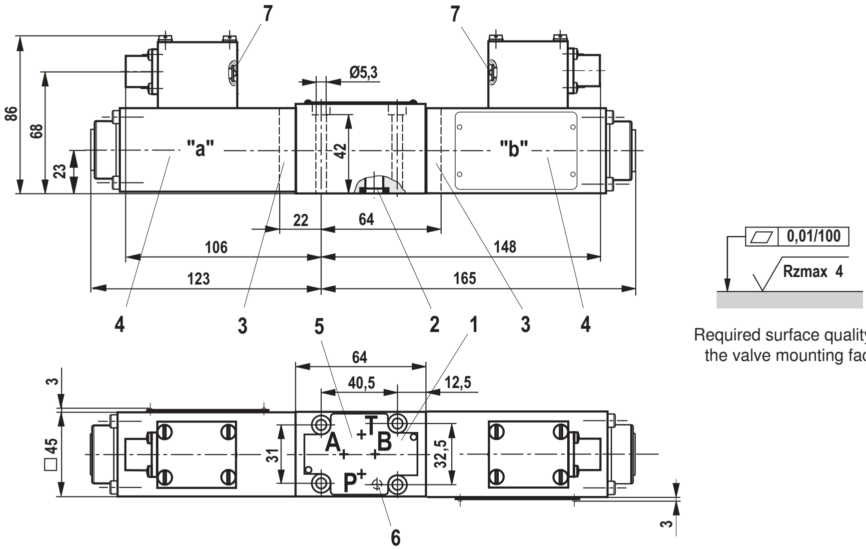
Characteristic curve selection

Control spool symbols	Characteristic curves for direction of flow			
	P–A	P–B	A–T	B–T
D,Y	1	1	2	2
A, B, C, E, H, J, L, M, U	3			
B1	5	4	–	–
X7	7	–	–	6



Unit dimensions (dimensions in mm)

Type WE 6../.B.X.K20L/...



Required surface quality of the valve mounting face

1. **1** Name plate
2. **2** Identical seal rings for ports A, B, P, T
3. **3** Cover for valves with one solenoid
4. **4** Valve solenoid
5. **5** Porting pattern according to ISO 4401-03-02-0-05
6. **6** Receiving hole for locating pin according to ISO 4401-03-02-0-05, (locating pin must be ordered separately, mat. no. **R900005694)**
7. **7** Red LED for displaying the operating condition, or plug screw (see also page 11)

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 – 0.14 according to VDA 235-101)

Mat. no. **R913000064**
(must be ordered separately)

Subplates

(**without** locating hole)	G 341/01 FE/ZN (G1/4)
	G 342/01 FE/ZN (G3/8)
	G 502/01 FE/ZN (G1/2)
(**with** locating hole)	G 341/60 FE/ZN (G1/4)
	G 342/60 FE/ZN (G3/8)
	G 502/60 FE/ZN (G1/2)

with dimensions as in the data sheet 45052
(must be ordered separately)

Important:

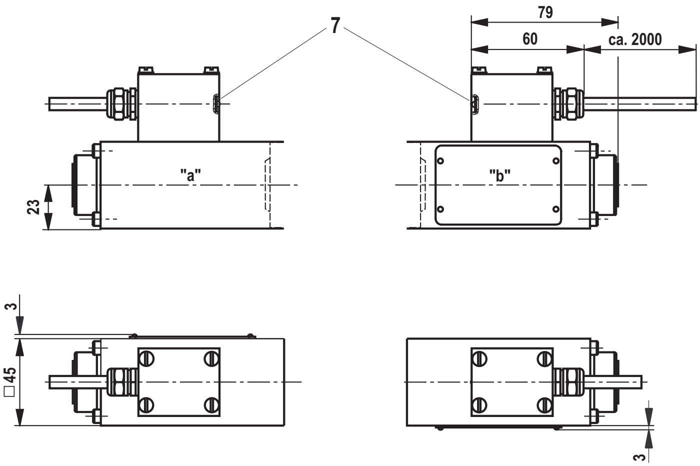
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

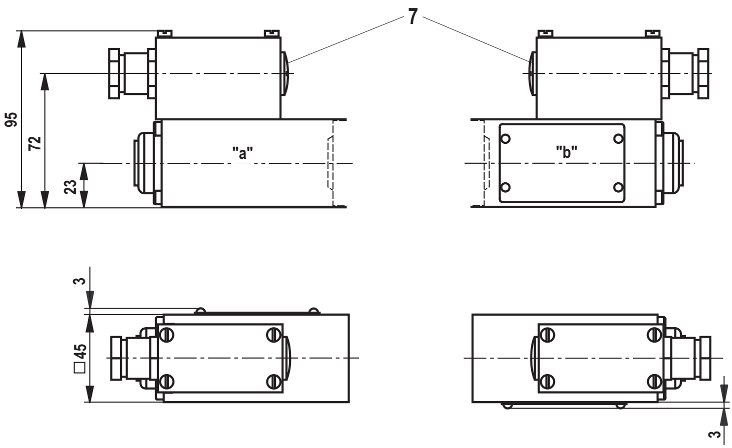
Unit dimensions (dimensions in mm)

Item explanations see page 10

Type WE 6../.B.X.CKL/... (readily assembled with 2 x 2 m connection line)



Type WE 6../.B.X.Z2/... (with terminal box and cable gland)

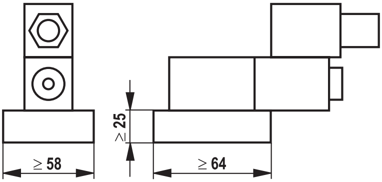


Installation conditions (dimensions in mm)

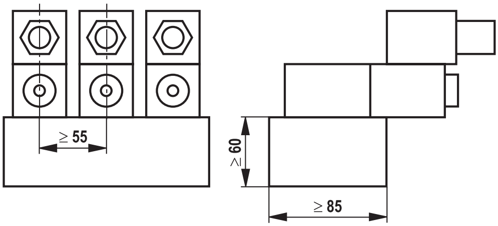
	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Heat conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram

Individual assembly



Bank assembly



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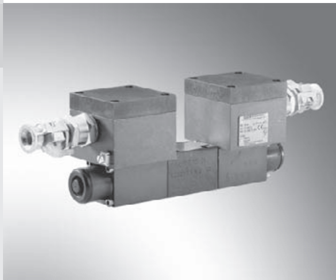
4/3, 4/2 and 3/2 directional valves with DC solenoids

RE 23178-XD-B2/05.12
Replaces: 11.09

Type WE 6 ../.B..XD...

Size 6
Component series 6X
Maximum operating pressure 315 bar
Maximum flow 60 l/min


H7120

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **I M2; II 2G**
- Types of protection of the valve solenoid:
  Ex d I Mb / Ex d IIC T4 Gb
  according to EN 60079-0:2009 / EN 60079-1:2007

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 23178-XD-B0**
Part II	Data sheet 23178-XD-B2	
Part III	Product-specific instructions 23178-XD-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Direct operated directional spool valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to ISO 4401-03-02-0-05
- Subplates available in FE/ZN version (see page 12)
- Wet-pin DC solenoids in hydraulic fluid
- Electrical connection with individual connection and cable gland
- With manual override, optional

Ordering code and scope of delivery

	WE	6		6X /		B		N	XD	Z2 /	

3 main ports = **3**
4 main ports = **4**

Size 6 = **6**

Control spool symbol
e.g. C, E, EA, EB etc.
possible versions
see page 4

Component series 60 to 69 = **6X**
(60 to 69: Unchanged installation and connection dimensions)

Spring return = **no code**
Without spring return = **O**
Without spring return with detent = **OF**

High-power solenoid
(switching in hydraulic fluid) = **B**

Direct voltage 24 V = **G24**
Direct voltage 110 V = **G110**

With manual override (standard) = **N**

XD = Explosion protection "pressure-resistant encapsulation", details see information on the explosion protection page 7

Electrical connection

Z2 = Solenoid with terminal box and cable gland,
For details see chapter Electrical connection

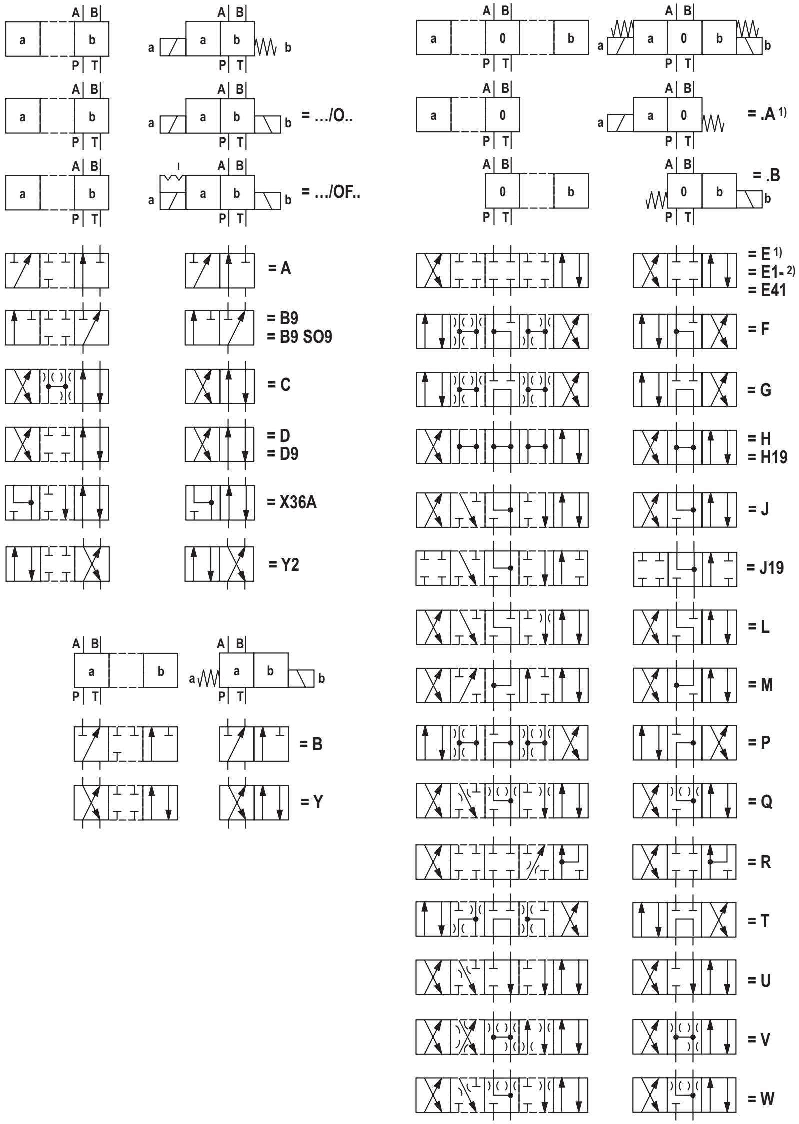
no code = Without throttle insert
B08 = Throttle Ø 0.8 mm
B10 = Throttle Ø 1.0 mm
B12 = Throttle Ø 1.2 mm
Use if flow > performance limit of the valve, effective in channel P

no code = NBR seals
V = FKM seals
Important:
Observe compatibility of seals with hydraulic fluid used!

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in part III

Control spool symbols



[1] **Example:** Control spool E with spool position "a", ordering code ..EA..

[2] Symbol E1-: P – A/B pre-opening, **Caution in conjunction with single-rod cylinders due to pressure intensification!**

Function, section

Directional valves of type WE are solenoid operated directional spool valves. They control the start, stop and direction of a fluid flow.

The directional valves basically consist of housing (1), one or two solenoids (2), control spool (3), and one or two return springs (4).

In the de-energized condition, control spool (3) is held in the central position or in the initial position by the return springs (4) (except for impulse spools). The control spool (3) is actuated by wet-pin solenoids in hydraulic fluid (2).

To ensure proper functioning, care must be taken that the pressure chamber of the solenoid is filled with hydraulic fluid.

The force of solenoid (2) acts via plunger (5) on control spool (3) and pushes the latter from its rest position to the required end position. This enables the necessary direction of flow from P → A and B → T or P → B and A → T.

After solenoid (2) was de-energized, return spring (4) pushes control spool (3) back to its rest position.

An optional manual override (6) allows control spool (3) to be moved without solenoid energization.

Type 4WE 6.. 6X/O...XD (only possible with symbols A, C and D)

This version is a directional valve with two spool positions and two solenoids without detent. In the de-energized condition, there is no defined spool position.

Type 4WE 6.. 6X/OF... XD (impulse spool, only possible with symbols A, C and D)

This version is a directional valve with two spool positions, two solenoids and one detent. It alternately locks the two spools in position and the solenoid therefore needs not to be permanently energized.

Important:
Pressure peaks in the tank line to two or several valves can result in unintended spool movements in case of valves with detent! We therefore recommend that separate return lines be provided or a check valve installed in the tank line.

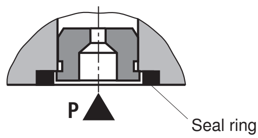
The tank line must not be allowed to run empty. With corresponding installation conditions, a pre-charge valve (pre-charging pressure approx. 2 bar) must be installed.

Throttle insert (type 4WE 6..6X/…XD../**B**..)

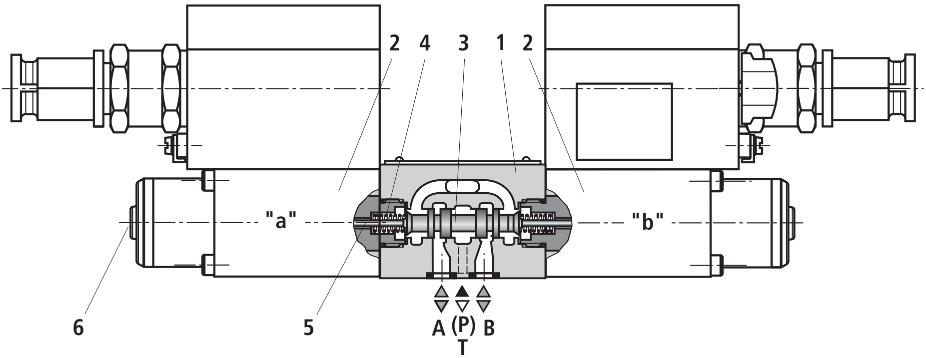
The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

It is inserted in channel P of the directional valve.

3



Type 4WE 6 E6X/.B..NXDZ2/V



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20 … +80
Storage temperature range		°C	+15… +30
Admissible vibration load			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight		kg	5.3 (with 1 solenoid); 9.4 (with 2 solenoids)
Surface protection	Valve body		Fe//ZnNi8//Cn//T0
	Solenoid		Fe//ZnNi8//An//T0

hydraulic

Maximum surface temperature		°C	See information on the explosion protection on page 7
Maximum operating pressure	Port P, A, B	bar	315
	Port T	bar	210 With symbols A and B, port T must be used as leakage oil connection if the operating pressure exceeds the admissible tank pressure.
Maximum flow		l/min	60
Flow cross-section (spool position 0)	with symbol Q		Approx. 6 % of the nominal cross-section
	with symbol W		Approx. 3 % of the nominal cross-section
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 [1]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also data sheet 90221); HETG (rape seed oil) [1]; HEPG (polyglycols) [2]; HEES (synthetic esters) [2]; flame-resistant hydraulic fluid HFC according to ISO 12922 [3] Ignition temperature > 180 °C
Hydraulic fluid temperature range		°C	–20 ... +80 (NBR seals)
			–15 ... +80 (FKM seals)
Viscosity range		mm^2/s	2.8 … 500
Maximum permitted degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)			Class 20/18/15 [4]

[1] Suitable for NBR **and** FKM seals

[2] Suitable **only** for FKM seals

[3] If HFC hydraulic fluid is used, the following parameters have to be complied with:
Pressure at P, A, B max. 160 bar, at T max. 3 bar
Ambient temperature 0 ... 36 °C
Hydraulic fluid temperature max. 55 °C
Duty cycle 60 %
Only NBR seals are admissible.
More information is available from our sales staff.

[4] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see www.boschrexroth.com/filter.

Technical data

electric

Voltage type			Direct voltage
Available voltages		V	24, 110
Voltage tolerance (nominal voltage)		%	±10
Admissible residual ripple		%	< 5
Duty cycle / operating mode according to VDE 0580			S1 (continuous operation)
Switching time according to ISO 6403	ON	ms	30 … 70
	OFF	ms	20 … 30
Switching frequency		1/h	up to 15000
Nominal power at ambient temperature 20 °C		W	13
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C		W	15.8
Protection class according to EN 60529 [1]			IP 65

Information on the explosion protection

Area of application as per directive 94/9/EC		I M2; II 2G
Type of protection Valve		c (EN 13463-5:2011)
Maximum surface temperature [2] Temperature class	°C	130 T4
Type of protection Solenoid according to EN 60079-0:2009 / EN 60079-1:2007		Ex d I Mb Ex d IIC T4 Gb
Type examination certificate Solenoid		BVS 03 ATEX E 300 X
Special operating conditions for a safe application		– In case of bank assembly, only one solenoid of all valves may be energized at a time. – In case of valves with two solenoids, maximally one of the solenoids may be energized at a time.
Ambient temperature range	°C	–20 … +80

3

[1] With correctly installed electrical connection

[2] Surface temperature > 50 °C, provide contact protection

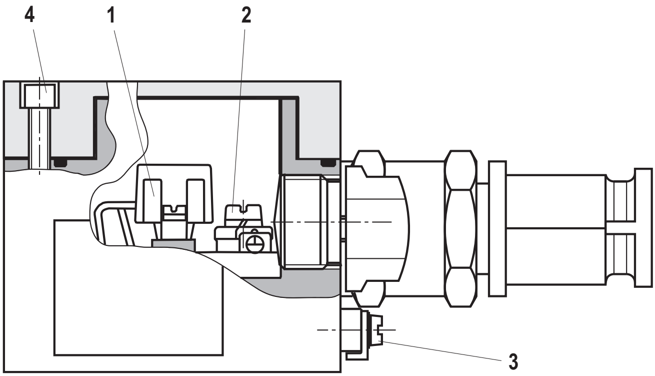
Electrical connection

The type-examination tested valve solenoid of the valve is equipped with one terminal box and a type-examination tested cable entry.

The connection is polarity-independent.

Important

When establishing the electrical connection, the protective earthing conductor (PE ⏚) has to be connected properly.



Properties of the connection terminals and mounting elements

Item	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire max. 2.5 mm^2 Finely stranded max. 2.5 mm^2
2	Connection for protective earthing conductor	Single-wire 0.75 … 2.5 mm^2 Finely stranded 0.75 … 1.5 mm^2
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm^2 Finely stranded min. 4 mm^2
4	Screws for cover	–

Cable gland

Line diameter	mm	9…12
Sealing		Outer sheath sealing

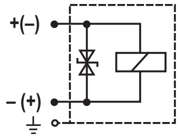
Connection line

Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–20 … > +110

Electrical connection

Circuit diagram

Direct voltage, polarity-independent



Overcurrent fuse and switch-off voltage peak

Important

A fuse appropriate for the solenoid's rated current (max. 3 x I_{rated} according to DIN 41571 and/or IEC 60127) or a protective motor switch with short-circuit and thermal instantaneous tripping must be connected to each valve solenoid as short-circuit protection. The cut-off capacity of this fuse must match or exceed the short-circuit current of the supply source.

This fuse or motor protection switch may only be fitted outside the explosive area or must be of an explosion-proof design.

When inductivities are switched off, voltage peaks result which may cause failures in the connected control electronics. For this reason, the valve solenoids comprise a suppressor circuit which dampens this voltage peak to the voltage value shown in the table.

3

Voltage data in the valve type code	Nominal voltage valve solenoid	Rated current valve solenoid	Recommended pre-fuse characteristics medium time-lag according to DIN 41571	Maximum voltage value upon switch-off	Suppressor circuit
G24	24 V DC	0.542 A DC	630 mA	–90 V	Suppressor diode bi-directional
G110	110 V DC	0.118 A DC	125 mA	–390 V	

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Important

The specified switching power limits are valid for operation with two directions of flow (e.g. from P → A and simultaneous return flow from B → T).

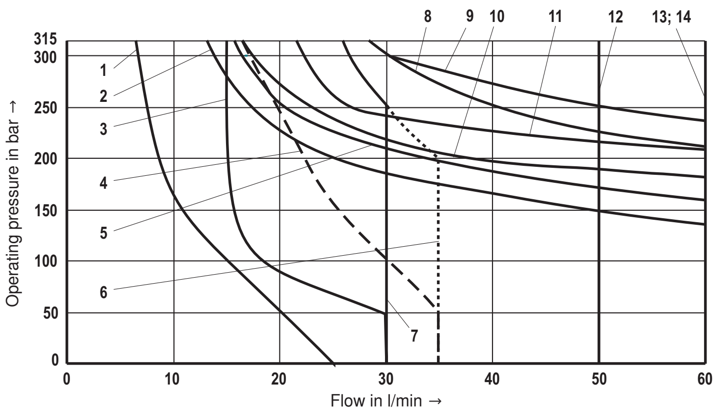
Due to the flow forces acting within the valves, the admissible switching power limit may be considerably lower with only one direction of flow (e.g. from P → A while port B is blocked)!

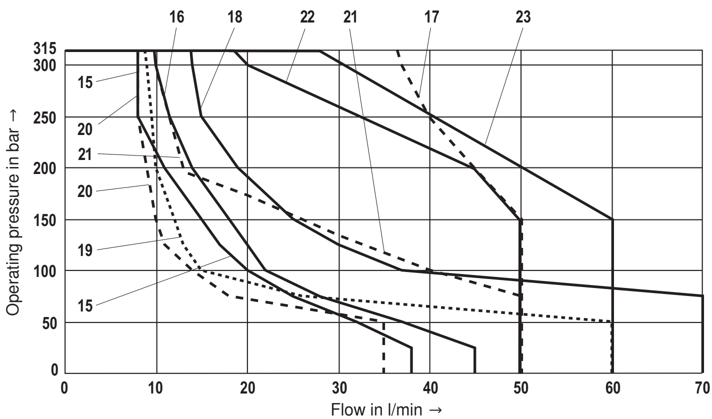
(In such cases, please consult us.)

The switching power limits were established while the solenoids were at operating temperature, at 10 % undervoltage and without tank pre-loading.

Performance limits of the valves with DC solenoids

Characteristic curve	Control spool symbol
1	A, B
2	J, L, U
3	V
4	F, P
5	A/O, A/OF
6	G
7	T
8	R [2]
9	E
10	Q, W
11	D, C, Y, Y2
12	H
13	M
14	E1 [1], D/OF, C/OF, D/O, C/O
15	B9
16	B9 SO9
17	H19
18	J19, P-A
19	J19, A-T
20	J19, B-T
21	X36A
22	D9
23	E41





[1] P–A/B pre-opening

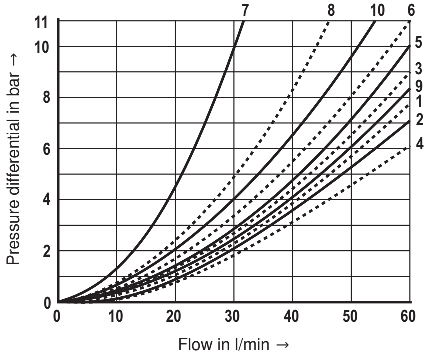
[2] Return flow from actuator to tank

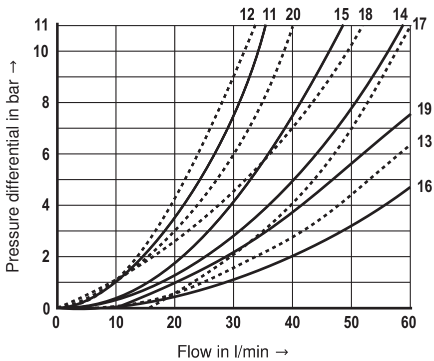
Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C and p = 100 bar)

Δp-q_V characteristic curves

Characteristic curve selection

Control spool symbol	Direction of flow					
	P – A	P – B	A – T	B – T	B – A	P – T
A, B	3	3	–	–	–	–
C	1	1	3	1	–	–
D, Y, Y2	5	5	3	3	–	–
E	3	3	1	1	–	–
F	1	3	1	1	–	–
T	10	10	9	9	–	8
H	2	4	2	2	–	9
J, Q	1	1	2	1	–	–
L	3	3	4	9	–	–
M	2	4	3	3	–	–
P	3	1	1	1	–	–
R	5	5	4	–	7	–
V	1	2	1	1	–	–
W	1	1	2	2	–	–
U	3	3	9	4	–	–
G	6	6	9	9	–	8
B9	11	11	–	–	–	–
B9 SO9	12	11	–	–	–	–
H19	14	14	13	13	15	–
J19	14	–	16	13	–	–
X36A	17	–	18	19	–	–
D9	8	20	8	15	–	–
E41	20	20	8	8	–	–





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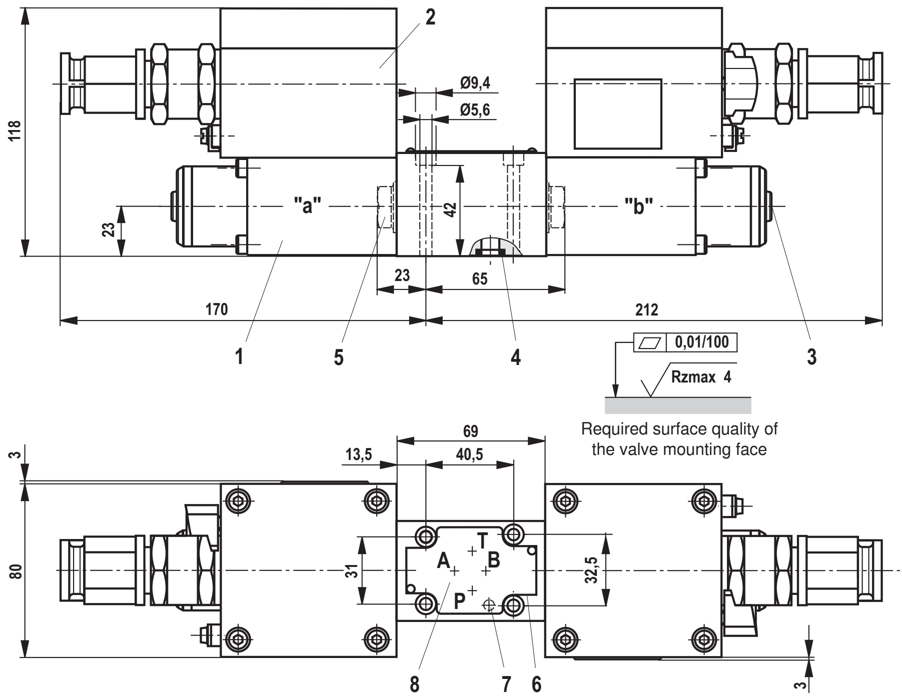
Unit dimensions (dimensions in mm)

Valve with manual override "N"



1 Solenoid
2 Terminal box
3 Manual override "N"
4 Identical seal rings for ports P, A, B, T
5 Plug screw for valves with one solenoid
6 Name plate
7 Receiving hole for locating pin according to ISO 4401-03-02-0-05, locating pin, mat. no. **R900005694** (must be ordered separately)
8 Porting pattern according to ISO 4401-03-02-0-05

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 – 0.14 according to VDA 235-101)
Material no. **R913000064** (must be ordered separately)

Subplates

(**without** locating hole)	G 341/01 FE/ZN (G1/4)
	G 342/01 FE/ZN (G3/8)
	G 502/01 FE/ZN (G1/2)
(**with** locating hole)	G 341/60 FE/ZN (G1/4)
	G 342/60 FE/ZN (G3/8)
	G 502/60 FE/ZN (G1/2)

with dimensions as in the data sheet 45052 (must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

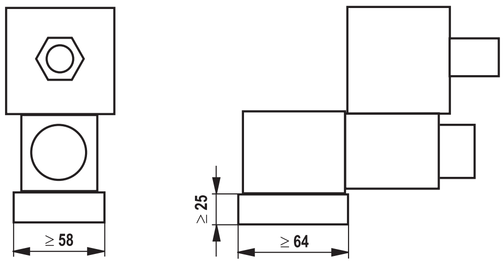
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Installation conditions (dimensions in mm)

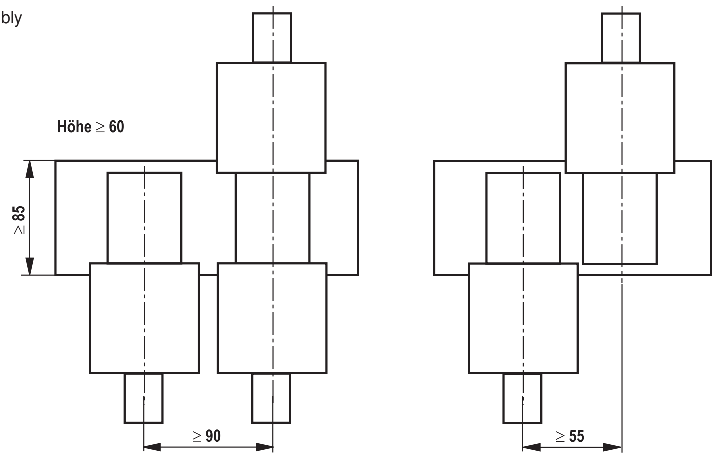
	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Heat conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	See schematic diagram below	

Schematic diagram

Individual assembly



Bank assembly



Important:
In case of bank assembly, only one solenoid of all valves may be energized at a time.

Notes

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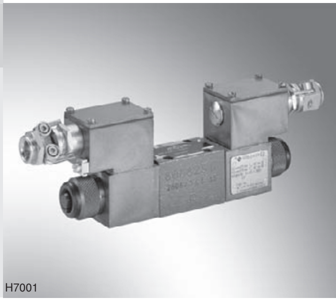
4/3, 4/2 and 3/2 directional valves with wet-pin DC or AC solenoids

RE 23178-XE-B2/09.13
Replaces: 11.09

Type WE 6 ../.E..XE...

Size 6
Component series 6X
Maximum operating pressure 350 bar
Maximum flow 70 l/min



Actual product may differ

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

– Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
– Type of protection of the valve solenoid: Ex e mb IIC T4 Gb according to EN 60079-7:2007 / EN 60079-18:2009

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	
Part II	Data sheet 23178-XE-B2	**Operating instructions 23178-XE-B0**
Part III	Product-specific instructions 23178-XE-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Direct operated directional spool valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to ISO 4401-03-02-0-05
- Subplates available in FE/ZN version (see page 14)
- Wet-pin DC or AC solenoids
- Solenoid coil can be rotated by 90°
- Electrical connection with individual connection and cable gland
- With manual override, optional

Ordering code and scope of delivery

	WE	6		6X /		E			XE	Z2 /		

3 main ports = **3**
4 main ports = **4**

Size 6 = **6**

Control spool symbol e.g. C, E, EA, EB etc.
Possible versions see page 4

Component series 60 to 69 = **6X**
(60 to 69: Unchanged installation and connection dimensions)

Spring return = **no code**
Without spring return = **O**
Without spring return with detent = **OF**

High-power solenoid, wet-pin, with detachable solenoid coil = **E**

Direct voltage 24 V = **G24**
AC voltage 230, V 50/60 Hz = **W230R**
For further ordering codes for other voltages, see page 9

With manual override (standard) = **N**
Without manual override = **no code**

XE = Explosion protection "increased safety", for details see information on the explosion protection on page 7

Electrical connection
Z2 = Solenoid with terminal box and cable gland, for details see chapter Electrical connection

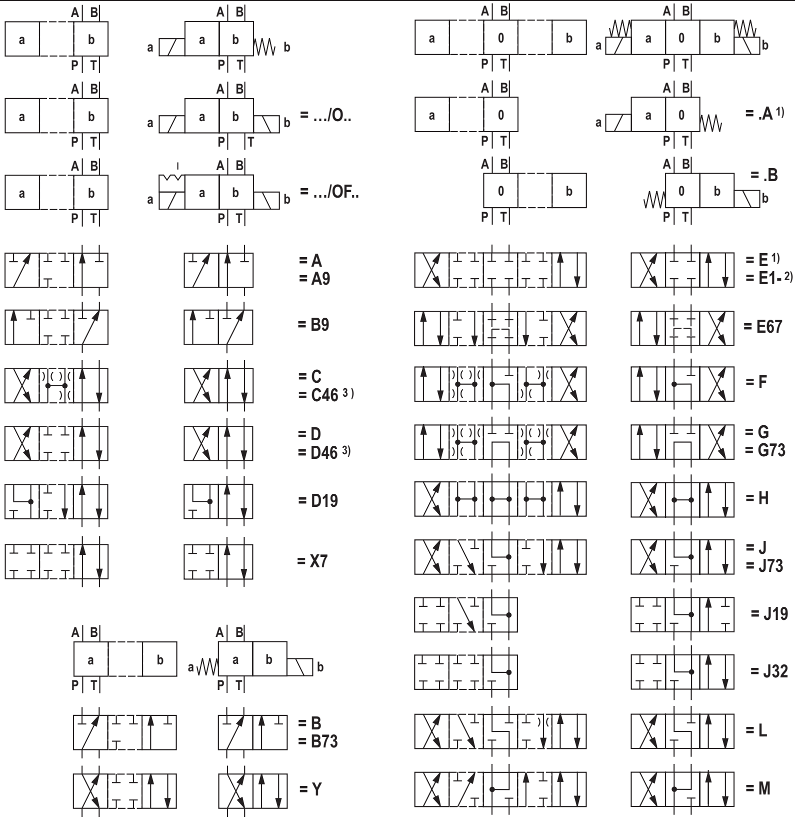
no code = Wthout throttle insert
B08 = Throttle Ø 0.8 mm
B10 = Throttle Ø 1.0 mm
B12 = Throttle Ø 1.2 mm
Use if flow > performance limit of the valve, effective in channel P

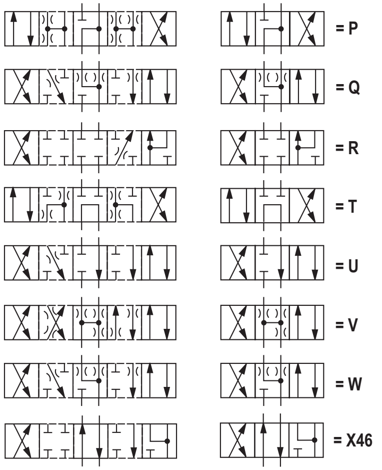
no code = NBR seals
V = FKM seals
Important:
Observe compatibility of seals with hydraulic fluid used!

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in Part III

Control spool symbols





[1] **Example:** Control spool E with spool position "a", ordering code **..EA..**

[2] Symbol E1-: P – A/B pre-opening, **caution in conjunction with differential cylinders due to pressure intensification!**

[3] For valves with AC solenoids and detent, only C46/OF and D46/OF are admissible.

Other control spool variants upon request

Function, section

Directional valves of type WE are solenoid-actuated directional spool valves. They control the start, stop and direction of a fluid flow.

The directional valves basically consist of housing (1), one or two solenoids (2), control spool (3), and one or two return springs (4).

In the de-energized condition, the control spool (3) is held in the central position or in the initial position by the return springs (4) (except for impulse spools). The control spool (3) is actuated by wet-pin solenoids (2).

To ensure proper functioning, make sure that the pressure chamber of the solenoid is filled with oil.

The force of the solenoid (2) acts via the plunger (5) on the control spool (3) and pushes the latter from its rest position to the required end position. This enables the required direction of flow from P → A and B → T or P → B and A → T.

After solenoid (2) was de-excitated, the return spring (4) pushes the control spool (3) back to its rest position.

An optional manual override (6) allows the control spool (3) to be moved without solenoid energization.

Type 4WE 6.. 6X/O...XE... (only possible with symbols A, C and D)

This version is a directional valve with two spool positions and two solenoids without detent.

In the de-energized condition, there is no defined spool position.

Type 4WE 6.. 6X/OF... XE... (impulse spool, only possible with symbols A, C and D)

This version is a directional valve with two spool positions, two solenoids and one detent. It alternately locks the two spool positions and the solenoid therefore does not need to be permanently energized.

Important:
Pressure peaks in the tank line to two or several valves can result in unintended control spool movements in case of valves with detent! We therefore recommend that separate return lines be provided or a check valve installed in the tank line.

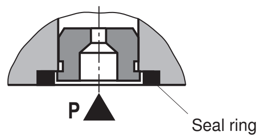
The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve (preload pressure approx. 2 bar) must be installed.

Throttle insert (type 4WE 6..6X/…XE../**B**..)

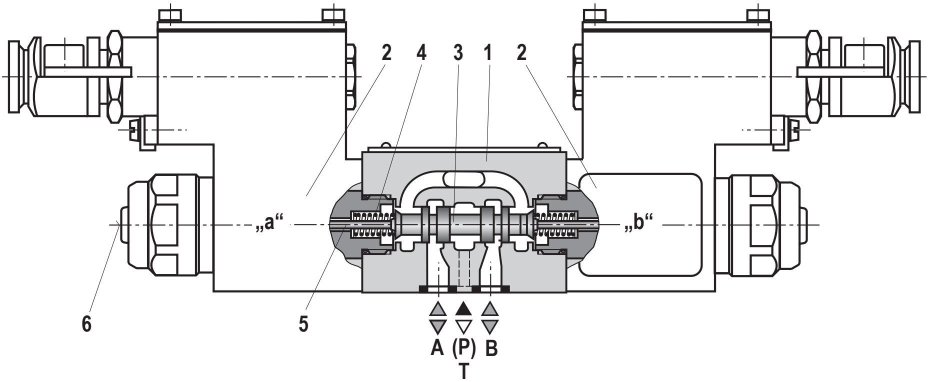
The use of a throttle insert is required when, due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

It is inserted in channel P of the directional valve.

3



Type 4WE 6 E6X/.E..NXE...



Technical data

general

Installation position	Any
Ambient temperature range	–20 … +70 [1]
Storage temperature range	–20 ... +50
Admissible vibration load	20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	2.6 (with 1 solenoid); 4.0 (with 2 solenoids)
Surface protection	Galvanized coating

hydraulic

Maximum operating pressure	Port A, B, P	bar	350	
	Port T	bar	210	With symbols A and B, port T must be used as leakage oil connection if the operating pressure exceeds the admissible tank pressure.
Maximum flow		l/min	70	
Flow cross-section (spool position 0)	with symbol Q		Approx. 6 % of the nominal cross-section	
	with symbol W		Approx. 3 % of the nominal cross-section	
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 [2]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also RE 90221); HETG (rape seed oil) [2]; HEPG (polyglycols) [3]; HEES (synthetic esters) [3]; flame-resistant hydraulic fluid HFC according to ISO 12922 [4], Other hydraulic fluids on request Ignition temperature > 180 °C	
Hydraulic fluid temperature range		°C	–20 ... +80 (NBR seals)	
			–15 ... +80 (FKM seals)	
Viscosity range		mm^2/s	2.8 … 500	
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15 [5]	

[1] Observe the "Special conditions for safe use" on page 7.

[2] Suitable for NBR **and** FKM seals

[3] Suitable **only** for FKM seals

[4] Only in connection with NBR seals, max. admissible pressure 210 bar, Δp < 15 bar, hydraulic fluid temperature max. 60 °C
More information is available from our sales staff.

[5] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

Technical data

electric

Voltage type			Direct voltage	Alternating voltage 50/60 Hz
Available voltages		V	24, 48, 96, 110	110, 230
Voltage tolerance (nominal voltage)		%	±10	
Admissible residual ripple		%	< 5	–
Duty cycle/operating mode according to VDE 0580			S1 (continuous operation)	
Switching time according to ISO 6403	ON	ms	30 … 55	40 … 80
	OFF	ms	10 … 15	40 … 50
Switching frequency		1/h	up to 15000	up to 7200
Nominal power at ambient temperature 20 °C		W	17	
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C		W	20.6	
Protection class according to EN 60529			IP 66 [1)]	

[1)] If installed properly

Important:

Solenoids for AC voltage are DC solenoids with integrated rectifier

3

Information on the explosion protection

Area of application in accordance with the Explosion Protection Directive 94/9/EC		II 2G
Type of protection Valve		c (EN 13463-5: 2011)
Maximum surface temperature [2)]	°C (Temperature class)	135 °C (T4)
Type of protection Solenoid according to EN 60079-7:2007 / EN 60079-18:2009		Ex e mb IIC T4 Gb
Type examination certificate Solenoid		KEMA 02ATEX2240 X
"IECEx Certificate of Conformity" Solenoid		IECEx DEK 12.0068X
Special conditions for safe use		– In case of valves with two solenoids, maximally one of the solenoids may be energized at a time. – Simultaneously energizing several valves in bank assembly is possible if the ambient temperature does not exceed 60 °C. – In case of bank assembly, if only one of the solenoids is energized at a time, and during individual operation, the maximum ambient temperature may not exceed 70 °C. – The maximum temperature of the valve casing surface is 120 °C. This has to be considered when selecting the connection cable and/or contact of the connection cable with the casing surface is to be prevented.
Ambient temperature range	°C	–20 … +70 [3)]

[1)] If the electrical connection is correctly installed

[2)] Surface temperature > 50 °C, provide contact protection

[3)] Observe the "Special conditions for safe use"

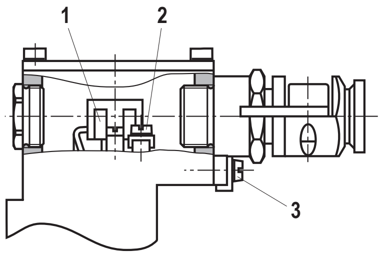
Electrical connection

The type-examination tested valve solenoid of the valve is equipped with a terminal box and a type-tested cable gland.

The connection is polarity-independent.

Solenoids to be connected to AC voltage are equipped with an integrated rectifier.

Important:
When establishing the electrical connection, the protective earthing conductor (PE ⏚) has to be connected properly.



Properties of the connection terminals

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 … 2.5 mm^2 Finely stranded 0.75 … 1.5 mm^2
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm^2 Finely stranded max. 1.5 mm^2
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm^2 Finely stranded 4 mm^2

Cable gland

Type approval		II 2G Ex e IIC Gb
Threaded connection		M20 x 1.5
Protection class according to EN 60529		IP66 [1)]
Line diameter	mm	9 … 11
Sealing		Outer sheath sealing

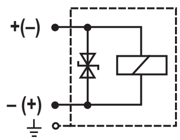
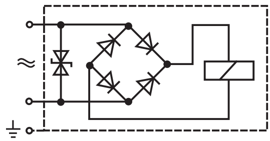
Connection line

Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–30 … > +110

1) If installed properly

Electrical connection

Circuit diagrams

Direct voltage, polarity-independent	Alternating voltage
	

Over-current fuse and switch-off voltage peaks

Important:

Corresponding to the rated current, a fuse according to DIN 41571 and EN / IEC 60127 has to be connected ahead of every valve solenoid (max. 3 x I_{rated}).

The shut-off threshold of the fuse has to match the prospective short-circuit current of the supply source.

The prospective short-circuit current of the supply source may amount to a maximum of 1500 A.

This fuse may only be installed outside the explosive area or must be of an explosion-proof design.

When inductivities are switched off, voltage peaks are the result which may cause faults in the connected control electronics. For this reason, the valve solenoids comprise an interference protection circuit which dampens this voltage peak to the voltage value shown in the table.

Voltage data in the valve type code	Nominal voltage valve solenoid	Rated current valve solenoid	Rated current external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Rated voltage of external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Maximum voltage value upon switch-off	Interference protection circuit
G24	24 V DC	0.708 A DC	800 mA	250 V	–90 V	Suppressor diode bi-directional
G48	48 V DC	0.354 A DC	400 mA	250 V	–200 V	
G96	96 V DC	0.177 A DC	200 mA	250 V	–370 V	
G110	110 V DC	0.155 A DC	200 mA	250 V	–390 V	
W110R	110 V AC	0.163 A AC	200 mA	250 V	–3 V	Bridge rectifier and suppressor diode
W230R	230 V AC	0.078 A AC	80 mA	250 V	–3 V	

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Important:

The specified switching power limits are valid for operation with two directions of flow (e.g. from P → A and simultaneous return flow from B → T).

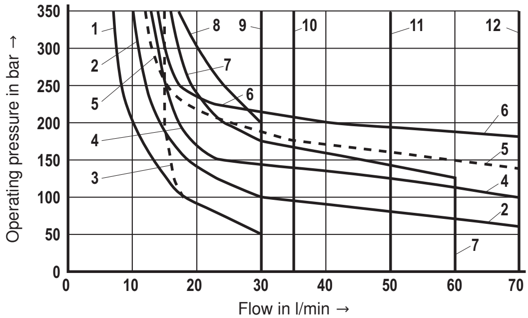
Due to the flow forces acting within the valves, the admissible switching power limit may be considerably lower with only one direction of flow (e.g. from P → A while port B is blocked).

(In such cases, please consult us.)

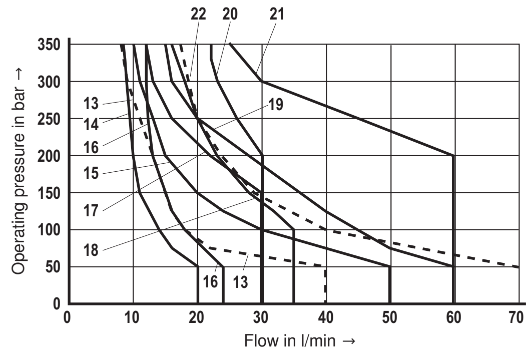
The switching power limits were established while the solenoids were at operating temperature, at 10% under-voltage and without tank preloading.

Performance limits of the valves with DC solenoids "G24"

Characteristic curve	Control spool symbol
1	A, B
2	J32, L, U
3	V
4	D, C, Y
5	Q, W
6	E
7	A/O, A/OF
8	F, P
9	T
10	G
11	H, D/O
12	E1 [1], R [2], M



Characteristic curve	Control spool symbol
13	A9 / B9
14	E67
15	J19, B-T
16	B73
17	X46
18	J73
19	J19, (A-T)
20	G73
21	X7
22	J19 (P-A)



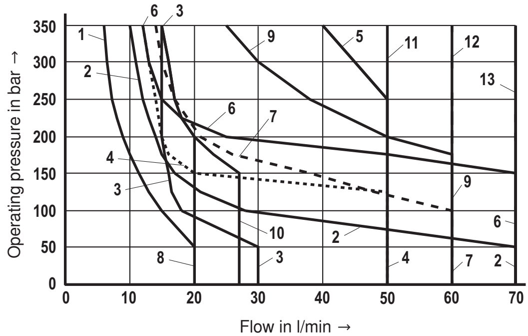
[1] P–A/B pre-opening

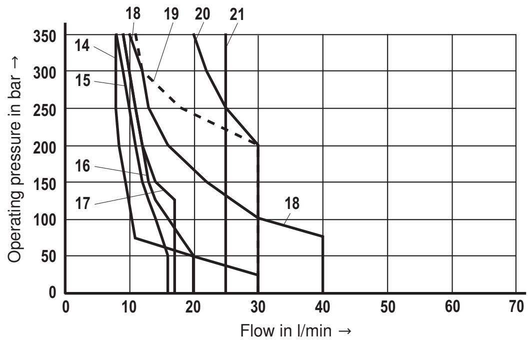
[2] Return flow from actuator to tank

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Performance limits of the valves with DC solenoids "G48", "G96" and "G110" as well as with AC solenoids "W110R" and "W230R"

Character-istic curve	Control spool symbol
1	A, B
2	J, L, U, Q, W
3	V
4	D, C, Y
5	C46/OF, D46/OF
6	E
7	A/O
8	F, P, T
9	R [2]
10	G
11	H
12	M, D/O, C/O
13	E1 [1]
14	B9
15	J32 (B-T)
16	J19, B-T
17	D19
18	J19, (A-T)
19	X7
20	G73
21	J32 (A-T)





[1] P–A/B pre-opening

[2] Return flow from actuator to tank

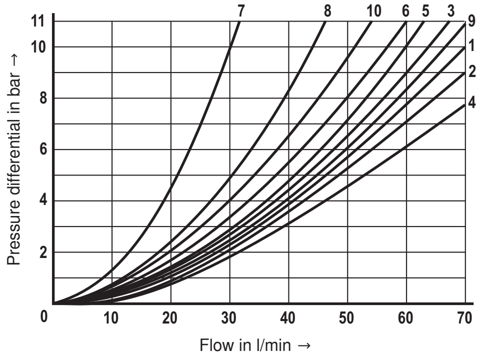
3

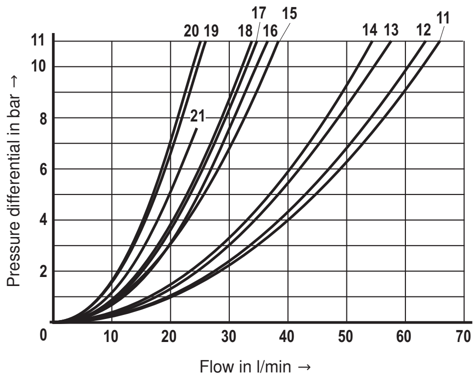
Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C and p = 100 bar)

Δp-q_V characteristic curves

Characteristic curve selection

Control spool symbol	Direction of flow					
	P – A	P – B	A – T	B – T	B – A	P – T
A, B	3	3	–	–	–	–
C46, C	1	1	3	1	–	–
D46, D, Y	5	5	3	3	–	–
E	3	3	1	1	–	–
F	1	3	1	1	–	–
T	10	10	9	9	–	8
H	2	4	2	2	–	9
J, Q	1	1	2	1	–	–
L	3	3	4	9	–	–
M	2	4	3	3	–	–
P	3	1	1	1	–	–
R	5	5	4	–	7	–
V	1	2	1	1	–	–
W	1	1	2	2	–	–
U	3	3	9	4	–	–
G	6	6	9	9	–	8
G73	20	20	19	19	–	16
E67	14	13	11	12	–	–
B9	17	15	–	–	–	–
B73	18	21	–	–	–	–



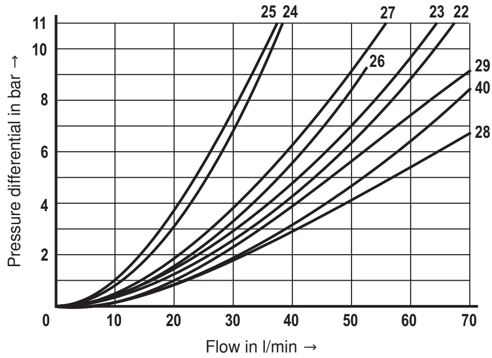


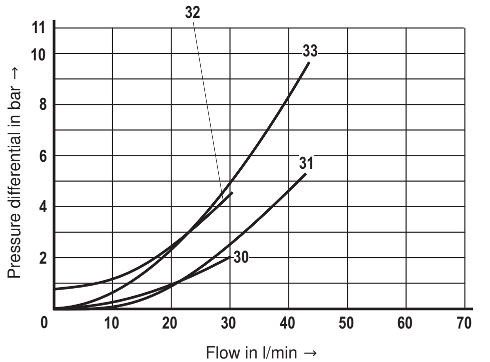
Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C and p = 100 bar)

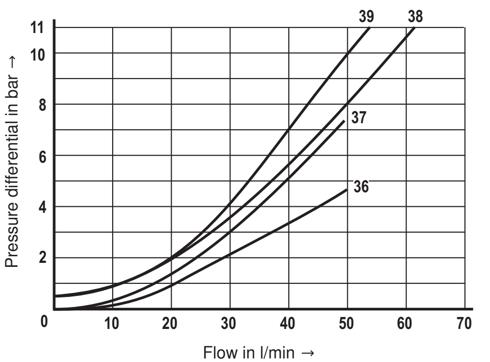
Δp-q_V characteristic curves (continued)

Characteristic curve selection

Control spool symbol	Direction of flow					
	P – A	P – B	A – T	B – T	B – A	P – T
J73	24	25	23	22	–	–
J19	27	–	39	39	–	–
X7	29	–	–	28	–	–
X46	32	33	31	30	–	–
J32	22	–	–	40	–	–
D19	36	–	38	37	–	–







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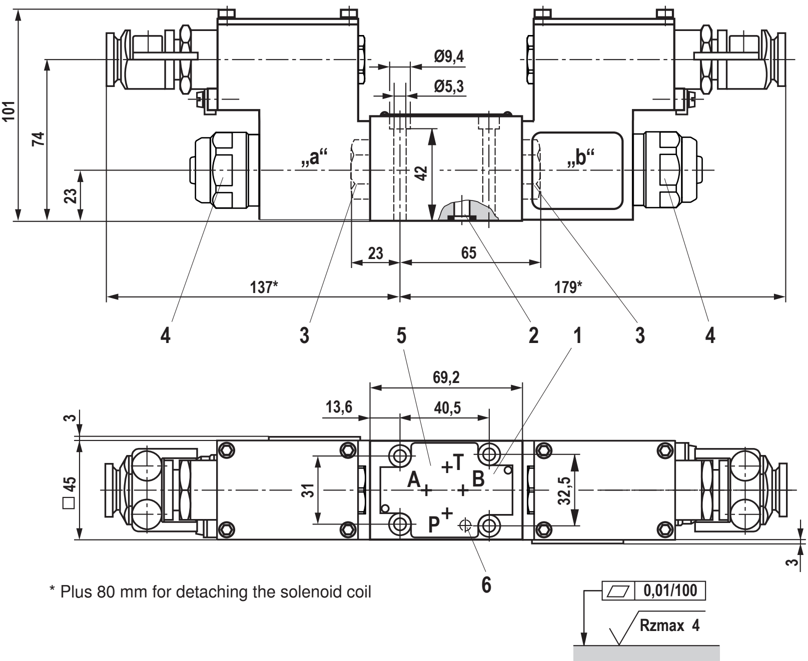
Dimensions (dimensions in mm)



* Plus 80 mm for detaching the solenoid coil

Required surface quality of the valve contact surface

1. **1** Name plate
2. **2** Identical seal rings for ports A, B, P, T
3. **3** Plug screw for valves with one solenoid
4. **4** Mounting nut with hexagon SW32 tightening torque M_A = 4 + 1 Nm
5. **5** Porting pattern according to ISO 4401-03-02-0-05
6. **6** Receiving hole for locating pin according to ISO 4401-03-02-0-05, locating pin, mat. no. **R900005694** (must be ordered separately)

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 – 0.14 according to VDA 235-101)

Material no. **R913000064**
(must be ordered separately)

Subplates

(**without** locating hole)	G 341/01 FE/ZN (G1/4)
	G 342/01 FE/ZN (G3/8)
	G 502/01 FE/ZN (G1/2)
(**with** locating hole)	G 341/60 FE/ZN (G1/4)
	G 342/60 FE/ZN (G3/8)
	G 502/60 FE/ZN (G1/2)

with dimensions as in the data sheet 45052
(must be ordered separately)

Important:

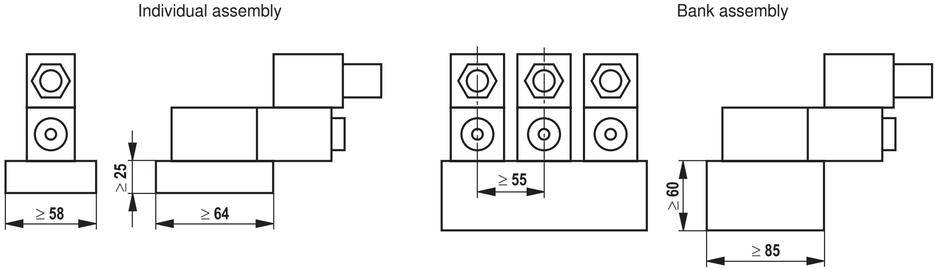
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Installation conditions (dimensions in mm)

	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram



Important:
Observe the "Special conditions for safe use" on page 7.

Notes

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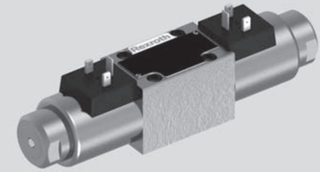
4/3, 4/2 and 3/2 directional valves with wet-pin DC solenoids

RE 23178-XN-B2/08.12
Replaces: 04.10

Type WE 6 ../.E..XN...



Size 6
Component series 6X
Maximum operating pressure 350 bar
Maximum flow 80 l/min

ATEX units
For explosive areas

Part II   Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 3G; II 3D**
- Type of protection of the valve solenoid
  Ex nA IIC T3 Gc according to EN 60079-15:2010 and
  Ex tc IIIC T140°C Dc IP65 according to EN 60079-31:2009

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 23178-XN-B0**
Part II	Data sheet 23178-XN-B2	
Part III	Product-specific instructions 23178-XN-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Direct operated directional spool valve with solenoid actuation for proper use in explosive atmospheres
- Porting pattern according to ISO 4401-03-02-0-05
- Subplates available in FE/ZN version (see page 10)
- Wet-pin DC solenoids
- Solenoid coil rotatable by 90 °
- Electrical connection as individual connection with connector according to EN 175301-803, design A
- With manual override, optional

Ordering code and scope of delivery

	WE	6		6X /		E	G24		XN	K4 /		

- 3 main ports **= 3**
- 4 main ports **= 4**

- Size **= 6**

- Control spool symbol e.g. C, E, EA, EB etc. possible version see page 4

- Component series 60 to 69 **= 6X**
  (60 to 69: Unchanged installation and connection dimensions)

- Spring return **= no code**
- Without spring return **= O**
- Without spring return, with detent **= OF**

- High-power solenoid, wet-pin, with detachable valve solenoid **= E**

- Direct voltage 24 V **= G24**

- With manual override (standard) **= N9**
- Without manual override **= no code**

- **XN =** Explosion protection "Non-sparking", Details see information on the explosion protection page 7

Electrical connection

- **K4 =** Solenoid without mating connector
  For details see chapter Electrical connection

- **no code =** Without throttle insert
- **B08 =** Throttle Ø 0.8 mm
- **B10 =** Throttle Ø 1.0 mm
- **B12 =** Throttle Ø 1.2 mm

Use if flow > performance limit of the valve, effective in channel P

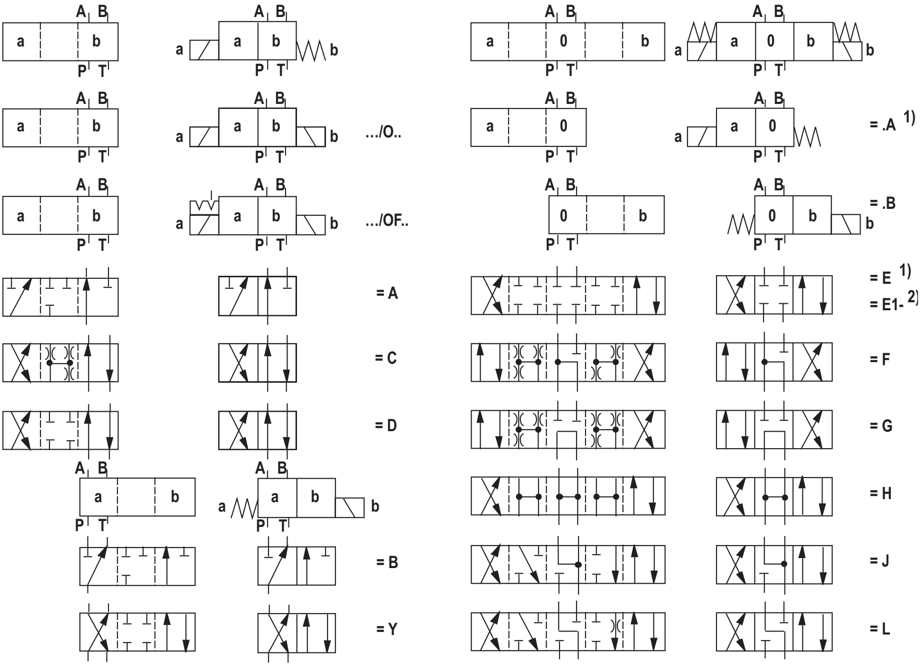
- **no code =** NBR seals
- **V =** FKM seals

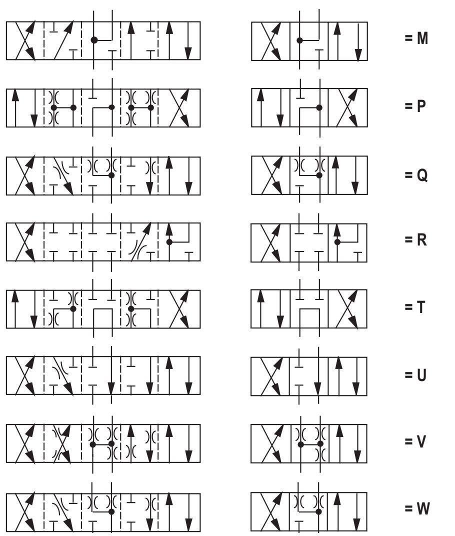
Important:
Observe compatibility of seals with hydraulic fluid used.

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in part III

Control spool symbols





1) **Example:** Control spool E with spool position "a", ordering code ..**EA**..

2) Control spool E1- : P → A/B pre-opening, **Caution in conjunction with differential cylinders due to pressure intensification!**

Other control spool variants upon request

Function, section

Directional valves of type WE are solenoid operated directional spool valves. They control the start, stop and direction of a fluid flow.

The directional valves basically consist of housing (1), one or two solenoids (2), control spool (3), and one or two return springs (4).

In the de-energized condition, control spool (3) is held in the central position or in the initial position by the return springs (4) (except for impulse spools). The control spool (3) is actuated by wet-pin solenoids in hydraulic fluid (2).

To ensure proper functioning, care must be taken that the pressure chamber of the solenoid is filled with hydraulic fluid.

The force of solenoid (2) acts via plunger (5) on control spool (3) and pushes the latter from its rest position to the required end position. This enables the necessary direction of flow from P → A and B → T or P → B and A → T

After solenoid (2) was de-energized, return spring (4) pushes control spool (3) back to its rest position.

An optional manual override (6) allows control spool (3) to be moved without solenoid energization.

Type 4WE 6 ..6X/O...XN... (only possible with control spool symbols A, C and D)

This version is a directional valve with two spool positions and two solenoids without detent.

In the de-energized condition, there is no defined spool position.

Type 4WE 6 ..6X/OF... XN... (impulse spool, only possible with control spool symbols A, C and D)

This version is a directional valve with two spool positions, two solenoids and one detent. It alternately locks the two spools in position and the solenoid therefore needs not to be permanently energized.

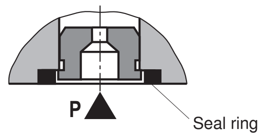
Important:
Pressure peaks in the tank line to two or several valves can result in unintended spool movements in case of valves with detent! We therefore recommend that separate return lines be provided or a check valve installed in the tank line.

The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve (preload pressure approx. 2 bar) must be installed.

Throttle insert (valve type 4WE 6 ..6X/…XN../**B**..)

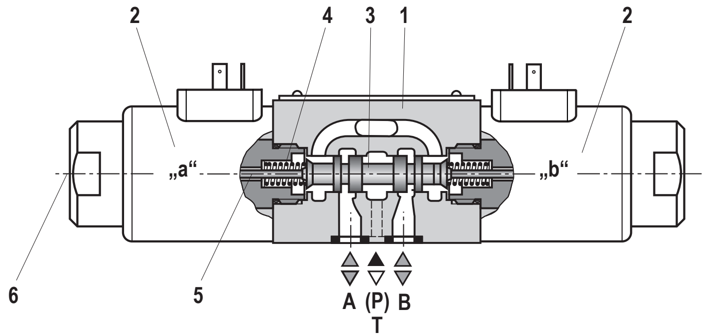
The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, which exceed the performance limit of the valve.

It is inserted in channel P of the directional valve.



3

Type 4WE 6 E6X/...E..XNK4...



Technical data

general

Installation position			Any
Ambient temperature range		°C	–20… +50
Storage temperature range		°C	+15… +30
Admissible vibration load			20 … 2000 Hz amplitude 0.05 g^2/Hz (10 g RMS)
Weight	with 1 solenoid	kg	2.3
	with 2 solenoids	kg	2.85
Surface protection			Galvanically coated

hydraulic

Maximum operating pressure	Port A, B, P	bar	350	
	Port T	bar	210	With symbols A and B, port T must be used as leakage oil connection if the operating pressure exceeds the admissible tank pressure.
Maximum flow		l/min	80	
Flow cross-section (spool position 0)	Control spool Q		Approx. 6 % of the nominal cross-section	
	Control spool W		Approx. 3 % of the nominal cross-section	
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 [1]; fast bio-degradable hydraulic fluids according to VDMA 24568 (see also RE 90221); HETG (rape seed oil) [1]; HEPG (polyglycols) [2]; HEES (synthetic esters) [2]; Flame-resistant hydraulic fluid HFC according to ISO 12922 [3], other hydraulic fluids on request, ignition temperature > 190 °C	
Hydraulic fluid temperature range		°C	–20 … +80 (for NBR seals) [4]	
			–15 … +80 (for FKM seals) [4]	
Viscosity range		mm^2/s	2.8 … 500	
Maximum permitted degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)			Class 20/18/15 [5]	

1) Suitable for NBR **and** FKM seals

2) Suitable **only** for FKM seals

3) Only in connection with NBR seals, max. admissible pressure 210 bar, Δp < 15 bar, hydraulic fluid temperature max. 60 °C
More information is available from our sales staff.

4) Observe the "Special conditions for safe use" on page 7.

5) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

Technical data

electric

Voltage type			Direct voltage (DC)
Nominal voltage		V	24
Voltage tolerance		%	±10
Admissible residual ripple		%	< 5
Duty cycle / operating mode according to VDE 0580			100 % / S1 (continuous operation)
Switching times according to ISO 6403	On	ms	25 … 45
	Off	ms	10 … 25
Switching frequency		1/h	up to 15000
Nominal power at ambient temperature 20 °C		W	23
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C		W	28.8
Protection class according to EN 60529			IP 65 [1]

[1] If suitable mating connectors are used (protection class at least IP 65) and in case of appropriate assembly.

Information on the explosion protection

Area of application as per directive 94/9/EC		II 3G	II 3D
Type of protection of the valve solenoid according to EN 60079-15: 2006 / EN 61241-1: 2007		Ex nA IIC T3 Gc	Ex tc IIIC T140°C Dc IP65
Maximum surface temperature [1]	°C	140	140
Type examination certificate Solenoid		BVS 12 ATEX E 062 X	
Type of protection Valve		c (EN 13463-5:2011)	
Special conditions for safe use		– Connection lines must be passed in a pull-relieved way. – The valve is to be installed so that no impact stresses > 4 J can take effect. – In order to avoid dangers caused by static charging, the base and/or subplate on which the valve is to be fitted must be electrically conductive and included in the equipotential bonding. – The valve solenoid must not be installed close to charge-generating processes. – Dust layers with a thickness > 50 mm are not admissible. – In case of valves with two solenoids, maximally one of the solenoids may be energized at a time. – Maximum hydraulic fluid temperature: In case of bank assembly, as long as only one solenoid is energized at a time, and in case of individual assembly: +80 °C In case of bank assembly when more than one solenoid is energized at a time: +65 °C – The maximum temperature of the valve casing surface is 110 °C. This has to be considered when selecting the connection cable and/or contact of the connection cable with the casing surface is to be prevented.	
Ambient temperature range	°C	–20 … +50	

Requirements on the mating connector

Temperature at the connector of the valve solenoid	°C	≥ 100
Area of application as per directive 94/9/EC		II 3G; II 3D
Protection class in plugged condition		IP 65

[1] Surface temperature > 50 °C, provide contact protection

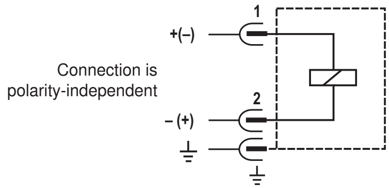
3

Electrical connection

The valves are equipped with a plug-in connector according to EN 175301-803, design A.

Information on the suitability of mating connectors is available on page 7.

Circuit diagram



For protection of the valve solenoids, suitable measures are to be taken which limit the switch-off overvoltages to a maximum of 500 V.

Over-current fuse and switch-off voltage peak

Important:

A fuse appropriate for the solenoid's rated current (max. 3 x I_{rated} according to DIN 41571 and/or IEC 60127) or a protective motor switch with short-circuit and thermal instantaneous tripping must be connected to each valve solenoid as short-circuit protection. The cut-off capacity of the fuse must match or exceed the short-circuit current of the supply source.

This fuse or protective motor switch may only be fitted outside the explosive area or must be of an explosion-proof design.

When an inductivity is switched off, a voltage peak results which may cause failures or damage in the connected control electronics.

Voltage data in the valve type code	Nominal voltage Valve solenoid	Rated current Valve solenoid	Recommended pre-fuse characteristics medium time-lag according to DIN EN 60127-1: 2011
G24	24 V DC	0.95 A DC	1 A

Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

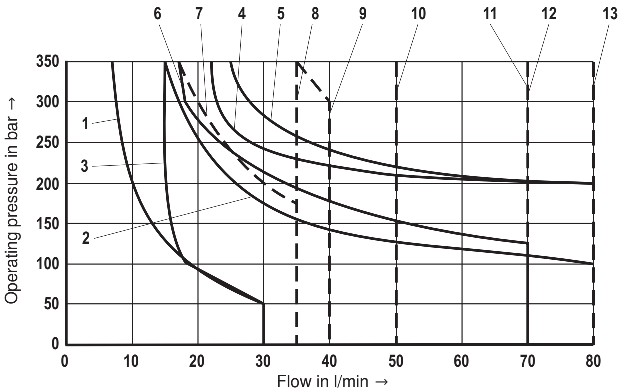
Important:

The specified switching power limits are valid for operation with two directions of flow (e.g. from P → A and simultaneous return flow from B → T).

Due to the flow forces acting within the valves, the admissible switching power limit may be considerably lower with only one direction of flow (e.g. from P → A while port B is blocked)!

(In such cases, please consult us.)

The switching power limit was established while the solenoids were at operating temperature, at 10 % under-voltage and without tank pre-loading.

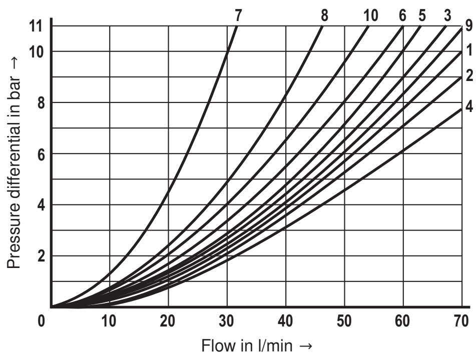


Control spool symbol	Characteristic curve
A,B	1
J,L,U	2
V	3
D,C,Y	4
Q,W	5
A/0, A/0F	6
F,P	7
T	8
G	9
H	10
D/0F, C/0F	11
M, D/0, C/0	12
E1, R, E	13

3

Characteristic curve (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δ_p - q_V characteristic curves

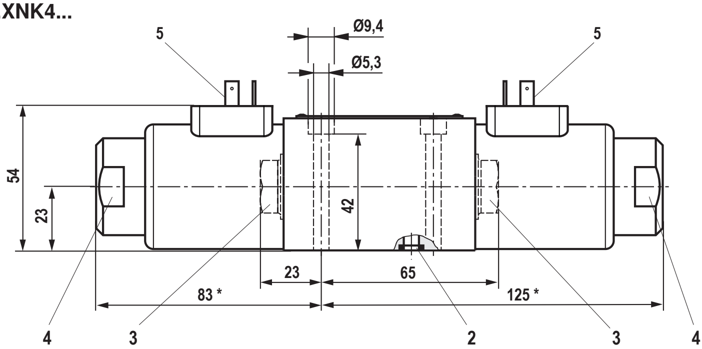


Characteristic curve selection

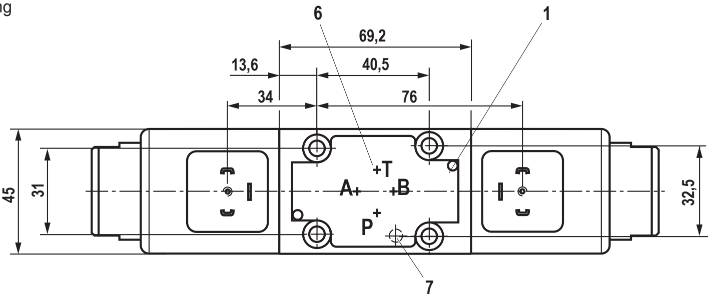
Control spool symbol	Direction of flow					
	P – A	P – B	A – T	B – T	B – A	P – T
A, B	3	3	–	–	–	–
C46, C	1	1	3	1	–	–
D46, D, Y	5	5	3	3	–	–
E	3	3	1	1	–	–
F	1	3	1	1	–	–
T	10	10	9	9	–	8
H	2	4	2	2	–	9
J, Q	1	1	2	1	–	–
L	3	3	4	9	–	–
M	2	4	3	3	–	–
P	3	1	1	1	–	–
R	5	5	4	–	7	–
V	1	2	1	1	–	–
W	1	1	2	2	–	–
U	3	3	9	4	–	–
G	6	6	9	9	–	8

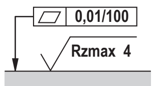
Device dimensions (dimensions in mm)

Type 4WE 6 ...6X/...E..XNK4...



* Plus 50.5 mm for detaching the solenoid coil





Required surface quality of the valve contact surface

1. Name plate
2. Identical seal rings for ports A, B, P, T
3. Plug screw for valves with one solenoid
4. Mounting nut with double edge SW32
   Tightening torque M_A = 8 + 1 Nm
5. Plug-in connector according to EN 175301-803, design A
6. Porting pattern according to ISO 4401-03-02-0-05
7. Receiving hole for locating pin according to ISO 4401-03-02-0-05, (locating pin must be ordered separately, mat. no. **R900005694)**

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 – 0.14 according to VDA 235-101)

Material no. **R913000064**
(must be ordered separately)

Subplates

(**without** locating hole)	G 341/01 FE/ZN (G1/4) G 342/01 FE/ZN (G3/8) G 502/01 FE/ZN (G1/2)
(**with** locating hole)	G 341/60 FE/ZN (G1/4) G 342/60 FE/ZN (G3/8) G 502/60 FE/ZN (G1/2)

with dimensions as in the data sheet 45052 (must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

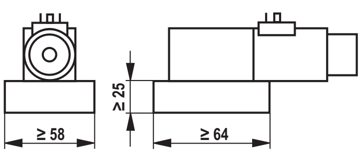
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Installation conditions (dimensions in mm)

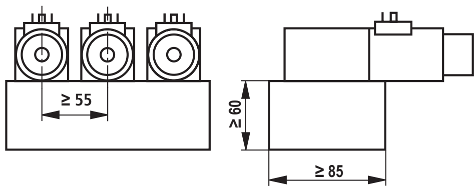
	Individual assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram

Individual assembly



Bank assembly



Important:

With regard to the hydraulic fluid temperature, observe the "Special conditions for safe use" on page 7.

3

Notes

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4/3, 4/2 and 3/2 directional valve with manual actuation

RE 22280-XC-B2/07.09

Type WMM 6...XC

Size 6
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 60 l/min

ATEX devices
For explosive areas

Part II Technical data sheet

Explosion protection information:

Area of application according to explosion protection directive and ignition protection type

– Area of application according to directive 94/9/EC **IM2, II2G, II2D, II3G, II3D**
– Ignition protection type of the valve: c (EN 13463-5:2004-03)

What you should know about these operating instructions

These operating instructions apply to Rexroth valves in explosion-proof design and consist of the following three parts:

Part I	General information RE 07010-X-B1	**RE 22280-XC-B0**
Part II	Technical data sheet RE 22280-XC-B2	
Part III	Product-specific instructions RE 22280-XC-B3	

Further information regarding the correct handling of hydraulic products of Rexroth is contained in our publication *“General product information on hydraulic products” RE 07008.*

Table of contents

Features

- Direct operated directional spool valve for the intended use in explosive atmospheres
- Actuating elements: Handle-operated lever
- Porting pattern according to DIN 24340 form A (without locating hole)
- Porting pattern according to ISO 4401-03-02-0-05 (with locating hole)

Ordering code and scope of delivery

	WMM	6		5X	/	XC			

3 main connections **= 3**
4 main connections **= 4**

Type of actuation
Handle-operated lever **= WMM**

Size 6 **= 6**

Spool symbols e.g. C, E, EA, EB, etc.
Possible designs see page 3

Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

with spring return **= No code**
with detent **= F**

XC = Valve in explosion-proof design, for details see explosion protection information page 6

No code = without throttle insert
B08 [2] **=** Throttle Ø 0.8 mm
B10 [2] **=** Throttle Ø 1.0 mm
B12 [2] **=** Throttle Ø 1.2 mm

Seal material
No code = NBR seals
V = FKM seals
Note:
Observe compatibility of seals with hydraulic fluid used!

No code = without locating hole
/60 [1] **=** with locating hole
/62 = **with** locating hole and grooved pin ISO 8741-3x8-St

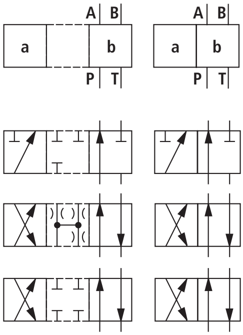
[1] Grooved pin ISO 8741-3x8-St-A2C, material no. **R900005076** (separate order)

[2] Application in case of flow > performance limit of the valve, effective in the P channel.

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in part III

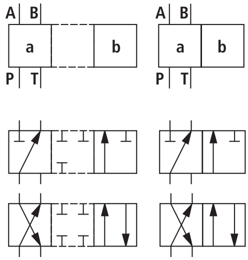
Spool symbols



= A

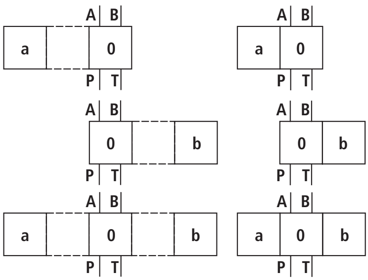
= C

= D



= B

= Y



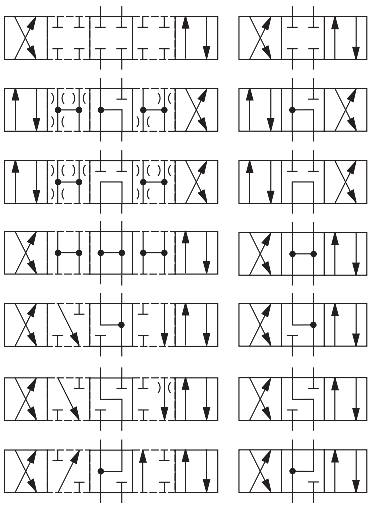
= .A 1)

= .B 1)

[1] **Example:**
- Spool E with spool position “a” → ordering code ..**EA**..
- Spool E with spool position “b” → ordering code ..**EB**..

[2] **Symbol E1**-: P → A/B pre-opening

Be careful because of the pressure intensification with single-rod cylinders!



= E 1)
= E1 2)

= F

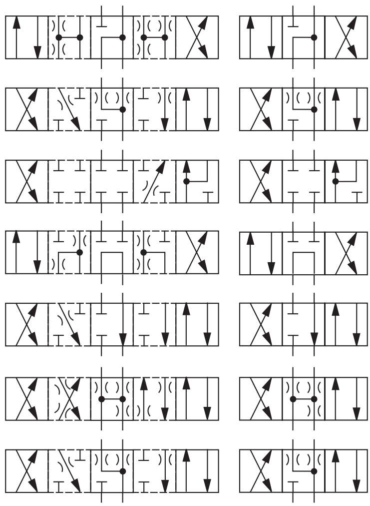
= G

= H

= J

= L

= M



= P

= Q

= R

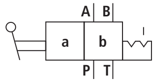
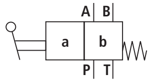
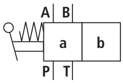
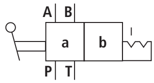
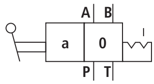
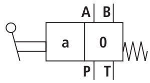
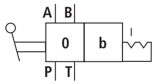
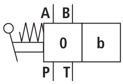
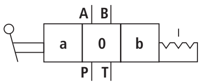
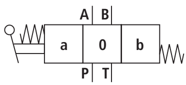
= T

= U

= V

= W

Types of actuation

Ordering code			Type of actuation
Spool symbol	**Actuation side**	**Detent**	**Handle-operated lever** Type WMM 6...XC
A, C, D,		**../F..**	
			
B, Y,			
		../F..	
E, E1, F, G, H, J, L M, P, Q, R, T, U, V, W	"a" 1) **= .A**	**../F..**	
			
	"b" 1) **= .B**	**../F..**	
			
		../F..	
			

1) See spool symbols page 3

Function, section

Valves of type WMM 6...XC are manually actuated directional spool valves.

They control the start, stop and direction of a flow.

The directional valves basically consist of housing (1), an actuating element (2) (handle-operated lever), the control spool (3), and one or two return springs (4).

In the de-energized condition, control spool (3) is held in the central or initial position by the return springs (4).

By means of the actuating elements, the control spool (3) is pushed in the desired spool position.

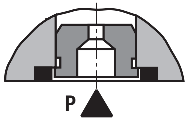
Detent

Directional valves with handle-operated lever are optionally available as 2- or 3-position valves with detent. When using actuating elements with detent, each spool position can be fixed, depending on the valve type.

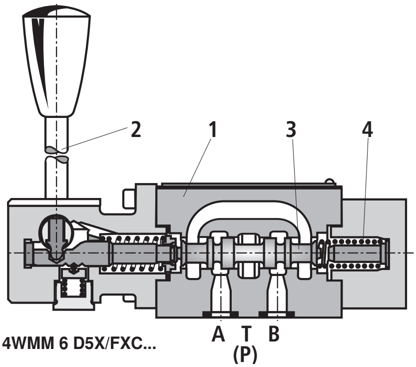
Throttle insert

The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes, that are higher than the performance limit of the valve.

It is inserted in channel P of the directional valve.



Type . WMM 6 ..5X/..B..



Type 4WMM 6 D5X/FXC...

Technical data

general

Weight	kg	ca. 1.4
Installation position		Any
Ambient temperature range	°C	–30 ... +80 (NBR seals) –20 ... +80 (FKM seals)

hydraulic

Maximum operating pressure	– Port A, B, P	bar	315	
	– Port T	bar	100	With symbols A or B, port T must be used as leakage port if the operating pressure exceeds the admissible tank pressure, **2 bar minimum pre-load pressure required.**
Maximum flow		l/min	60	
Flow cross-section	– Spool symbol Q		6 % of nominal cross-section	
	– Spool symbol W		3 % of nominal cross-section	
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 [1]; quickly bio-degradable hydraulic fluids according to VDMA 24568 (also see RE 90221); HETG (rape seed oil [1]; HEPG (polyglycols) [2]; HEES (synthetic ester) [2]; HFC according to ISO 12922 [3]; other hydraulic fluids upon request	
Hydraulic fluid temperature range		°C	–30 ... +80 (NBR seals) –20 ... +80 (FKM seals)	
Viscosity range		mm^2/s	2.8 ... 500	
Maximum permitted degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)			Class 20/18/15 [4]	

Explosion protection information

Area of application according to directive 94/9/EC		IM2; II2G; II2D; II3G; II3D
Ignition protection type Valve		c (EN 13463-5:2004-03)
Maximum surface temperature [5] Temperature class [5]	°C	100 T4
Special conditions for a safe use		
Ambient temperature range	°C	–20 ... +80

[1] Suitable for NBR **and** FKM seals

[2] Suitable **only** for FKM seals

[3] Suitable **only** for NBR seals

[4] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents malfunction and at the same time increases the service life of the components. For the selection of filters, see data sheets RE 50070, RE 50076, and RE 50081.

[5] The specified max. temperature or temperature class refers to the max. permitted fluid and ambient temperature. A max. pressure drop across the valve results in a surface temperature 20 K above the fluid temperature, i.e. application in T6 is possible if the fluid and ambient temperature is max. 60°C.

Note:
The ignition temperature of the hydraulic fluid used must be 50 K higher than the surface temperature of the valve.

Actuating force/torque

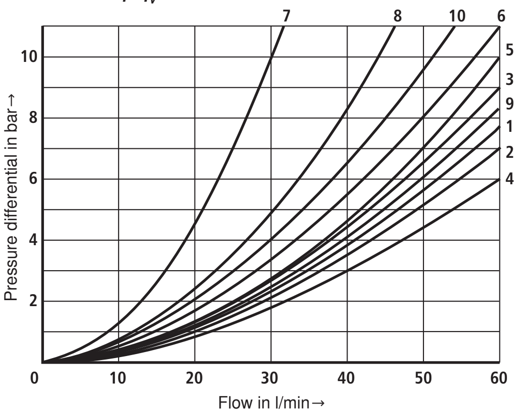
			Type WMM 6...XC
Maximum actuating torque		Ncm	–
Actuating force	– without tank pressure, with/without detent	N	20
	– with tank pressure 150 bar	N	30

Calculation formula for actuating force at the roller plunger ($\boldsymbol{F}_{\mathrm{R}}$) with tank pressure:

$\boldsymbol{F}_{\mathrm{R}} = \boldsymbol{F}_{\text{w/o t pressure}} + \boldsymbol{p}_{\mathrm{T}}$ x 1.4 N/bar

Characteristic curves (measured with HLP46, $\vartheta_{\mathbf{oil}} = 40\,°C \pm 5\,°C$)

Δp-q_V characteristic curves



More characteristic curves:

7 Spool symbol “R” in spool position “b” (A → B)

8 Spool symbols “G” and “T” in central position (P → T)

Spool symbols	Flow direction			
	P–A	P–B	A–T	B–T
A	3	3	–	–
B	3	3	–	–
C	1	1	3	1
D	5	5	3	3
E	3	3	1	1
F	1	3	1	1
G	6	6	9	9
H	2	4	2	2
J	1	1	2	1
L	3	3	4	9
M	2	4	3	3
P	3	1	1	1
Q	1	1	2	1
R	5	5	4	–
T	10	10	9	9
U	3	3	9	4
V	1	2	1	1
W	1	1	2	2
Y	5	5	3	3

3

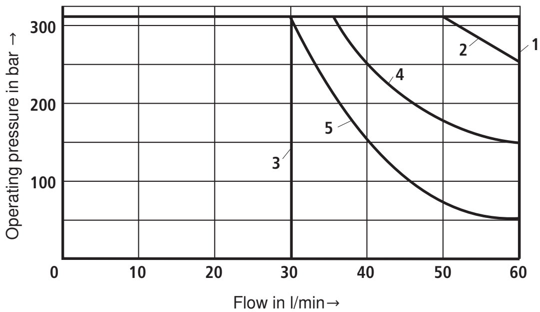
Performance limits (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

The specified switching power limits are valid for operation with two directions of flow (e.g. from P to A and simultaneous return flow from B to T).

Due to the flow forces acting within the valves, the permissible switching power limits may be considerably lower with only one direction of flow (e.g. from P to A while port B is blocked)!

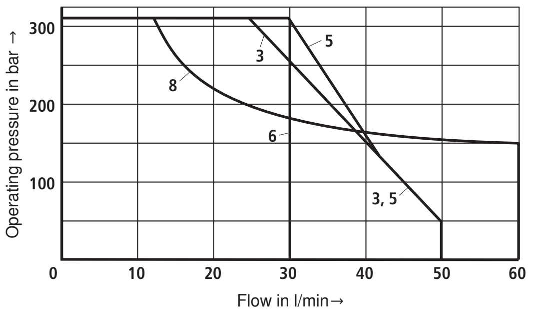
In such cases, please consult us.

Type WMM 6...XC - Spring return



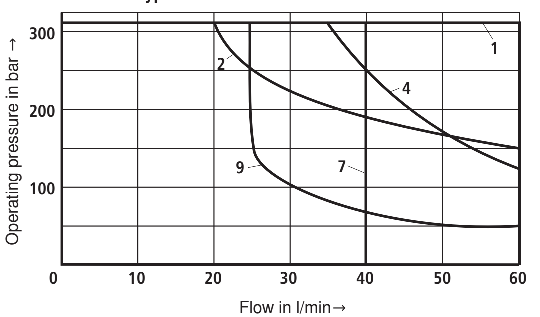
Characteristic curve	Spool symbol
1	E, E1, M, J, L, Q, U, W, C, D, Y, G, H, R
2	A, B
3	V
4	F, P
5	T

Type WMM 6...XC - with detent



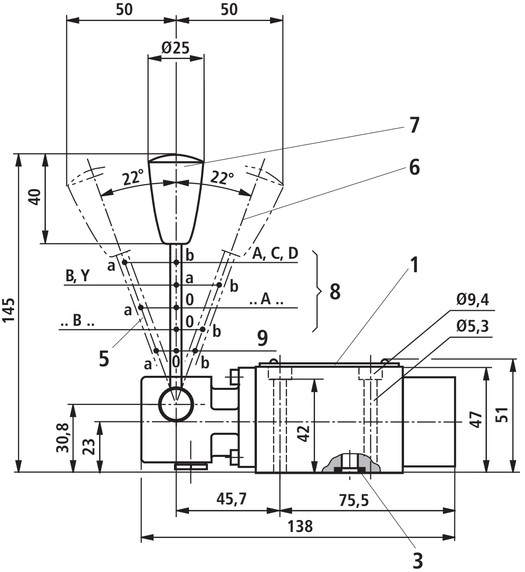
Characteristic curve	Spool symbol
3	A, B
5	F
6	V
8	R

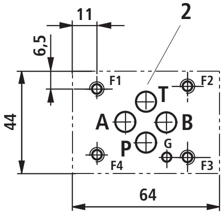
Type WMM 6...XC - with detent

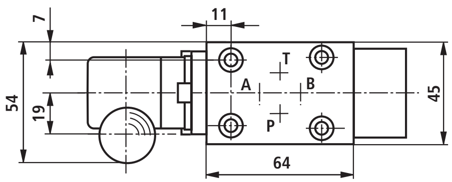


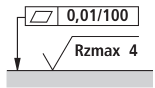
Characteristic curve	Spool symbol
1	E1, M, H, C, D, Y
2	E, J, Q, L, U, W
4	G, T
7	P
9	T

Unit dimensions (dimensions in mm)









Required surface quality of the valve mounting face

- **1** Nameplate
- **2** Porting pattern according to DIN 24340 form A (**without** locating hole), or ISO 4401-03-02-0-05 (**with** locating hole)
- **3** Identical seal rings for ports A, B, P, and T
- **5** Spool position “a”
- **6** Spool position “b”
- **7** Spool position “0”, “a”, and “b” (a and b with 2-position valves)
- **8** 2-position valve
- **9** 3-position valve

Valve mounting screws
For reasons of stability, only the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09–0.14 according to VDA 235-101)
Material no. R913000064 (must be ordered separately)

Notes

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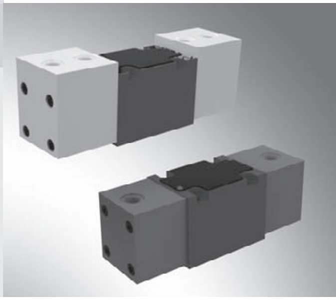
documentation@boschrexroth.de
www.boschrexroth.de

4/3, 4/2 and 3/2 directional valve with fluidic actuation

RE 22282-XC-B2/07.09

Type WP 6...XC, WH 6...XC



Size 6
Component series 6X (WP), 5X (WH)
Maximum operating pressure 315 bar
Maximum flow 60 l/min

ATEX devices
For explosive areas

Part II Technical data sheet

Explosion protection information:

Area of application according to explosion protection directive and ignition protection type

- Area of application according to directive 94/9/EC **IM2, II2G, II2D, II3G, II3D**
- Ignition protection type of the valve: c (EN 13463-5:2004-03)

What you should know about these operating instructions

These operating instructions apply to Rexroth valves in explosion-proof design and consist of the following three parts:

Part I	General information RE 07010-X-B1	**RE 22282-XC-B0**
Part II	Technical data sheet RE 22282-XC-B2	
Part III	Product-specific instructions RE 22282-XC-B3	

Further information regarding the correct handling of hydraulic products of Rexroth is contained in our publication *“General product information on hydraulic products” RE 07008.*

Table of contents

Features

- Direct operated directional spool valve for the intended use in explosive atmospheres
- Actuating elements:
  - Pneumatic (WP)
  - Hydraulic (WH)
- Porting pattern according to DIN 24340 form A (without locating hole)
- Porting pattern according to ISO 4401-03-02-0-05 (with locating hole)

Ordering code and scope of delivery

	W			6		/		XC/		

3 main connections **= 3**
4 main connections **= 4**

Directional valve **= W**

Type of actuation
Pneumatic **= P**
Hydraulic **= H**

Connections radial **= No code**

Size 6 **= 6**

Spool symbols e.g. C, E, EA, EB, etc.
Possible designs see page 3

Type WP
Component series 60 to 69 **= 6X**
(60 to 69: unchanged installation and connection dimensions)
Type WH
Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

with spring return **= No code**
without spring return **= O**
without spring return, with detent **= OF**

without manual override **= No code**
with manual override **= N** [1]

XC = Valve in explosion-proof design, for details see explosion protection information page 6

No code = without throttle insert
B08 [2] **=** Throttle Ø 0.8 mm
B10 [2] **=** Throttle Ø 1.0 mm
B12 [2] **=** Throttle Ø 1.2 mm

Seal material
No code = NBR seals
V = FKM seals
Note:
Observe compatibility of seals with hydraulic fluid used!

No code = without locating hole
/60 [3] **=** with locating hole
/62 = **with** grooved pin

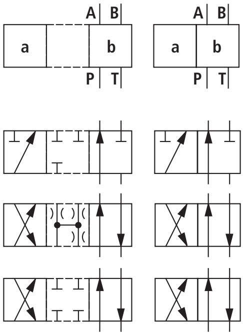
[1] Only with pneumatic actuation "P"
[2] Application in case of flow > performance limit of the valve, effective in channel P.
[3] Grooved pin ISO 8741-3x8-St-A2C, Material no. **R900005076** (separate order)

	Spool positions		Spool positions	
	2 pos.	3 pos.	Type WP	Type WH
No code	•	•	•	•
O	•		•	•
OF	•		•	•

• = Available

Included in the scope of delivery:
Valve operating instructions with declaration of conformity in part III

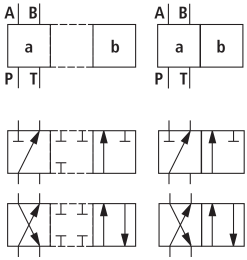
Spool symbols



= A

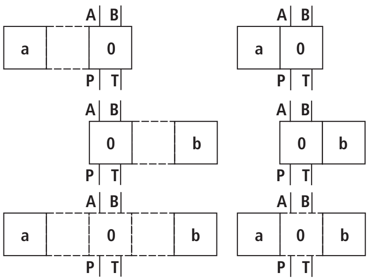
= C

= D



= B

= Y



= .A 1)

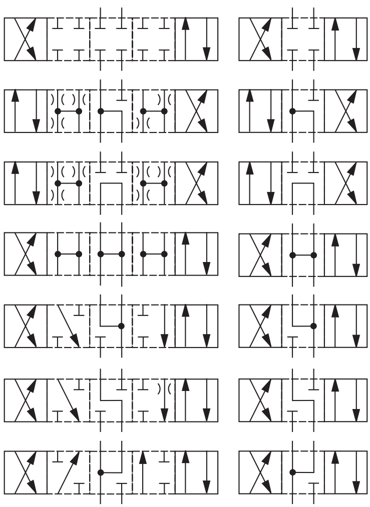
= .B 1)

1) **Example:**

- Spool E with spool position “a” → ordering code ..**EA**..
- Spool E with spool position “b” → ordering code ..**EB**..

2) Symbol E1-: P → A/B pre-opening

Be careful because of the pressure intensification with single-rod cylinders!



= E 1)
= E1 2)

= F

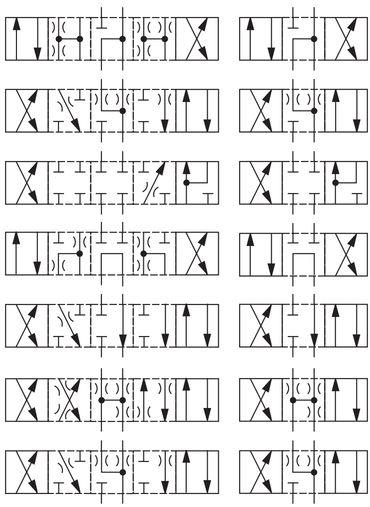
= G

= H

= J

= L

= M



= P

= Q

= R

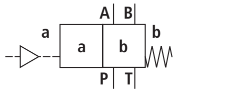
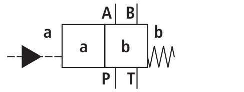
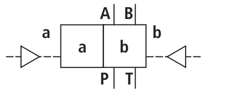
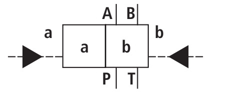
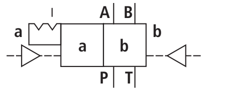
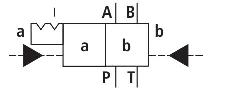
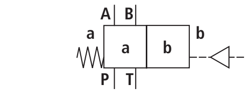
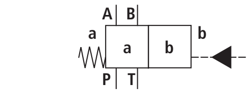
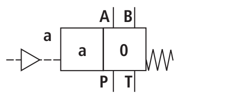
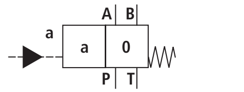
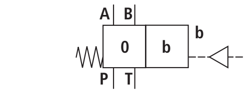
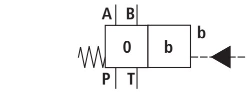
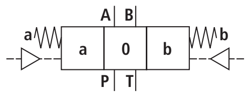
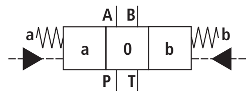
= T

= U

= V

= W

Types of actuation

Ordering code			Type of actuation	
Spool symbol	**Actuation side**	**Spool return**	**P** (pneumatic)	**H** (hydraulic)
				
A, C, D		**../O..**		
		../OF..		
B, Y				
E, E1, F G, H J, L M, P Q, R T, U V, W	**"a" [1] = .A**			
	"b" [1] = .B			
				

[1] See spool symbols page 3.

Function, section

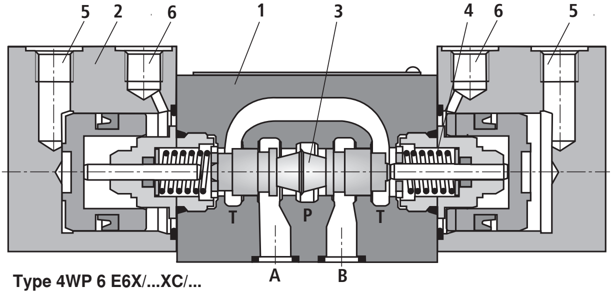
General

Valves of type WP 6...XC and WH 6...XC are fluidically actuated directional spool valves. They control the start, stop and direction of a flow.

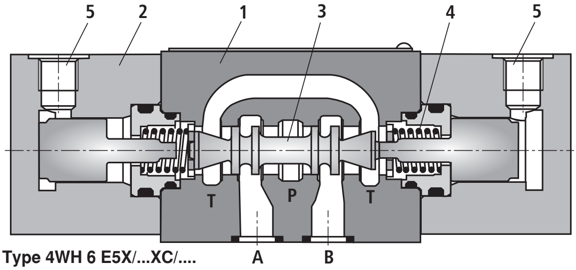
The directional valves basically consist of housing (1), one or two actuating elements (2) (hydraulic, pneumatic actuating cylinder), the control spool (3), and one or two return springs (4). The control connections are arranged radially (type 4WP) (5). The bleeding connections (6) must be established and led to a place outside the explosive area.

In the de-energized condition, control spool (3) is held in the central or initial position by the return springs (4) (except for impulse spool).

By means of the actuating elements, the control spool (3) is pushed in the desired spool position.



Type 4WP 6 E6X/...XC/...

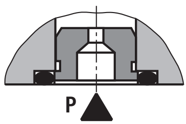


Type 4WH 6 E5X/...XC/....

Throttle insert

The use of a throttle insert is required when due to prevailing operating conditions, flows can occur during the switching processes that are higher than the performance limit of the valve.

It is inserted in channel P of the directional valve.

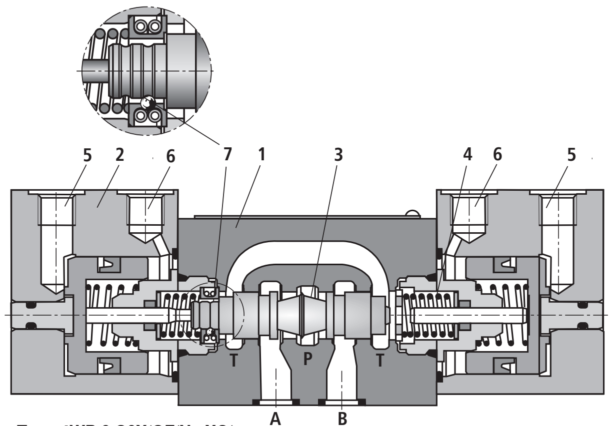


Without spring return, with detent, version ..OF/..

Directional valves with hydraulic or pneumatic actuation are also available as 2-spool position valve with detent (7). When using actuating elements with detent, each spool position can be fixed.

Without spring return, version ..O/..

When using actuating elements without spring return and without detent, there is no defined spool position in the de-energized condition.



Type 4WP 6 C6X/OF/N...XC/...

Technical data

general

Valve type			WP	WH
Weight	– Valve with one actuating cylinder	kg	approx. 1.8	approx. 2.0
	– Valve with two actuating cylinders	kg	approx. 2.0	approx. 2.2
Installation position			Any 1)	
Ambient temperature range		°C	–30 ... +80 (NBR seals) –20 ... +80 (FKM seals)	

hydraulic

Maximum operating pressure	– Port A, B, P	bar	315	
	– Port T	bar	160 With symbols A or B, port T must be used as leakage port if the operating pressure exceeds the admissible tank pressure. **2 bar minimum pre-load pressure required.**	
Maximum flow		l/min	60	
Flow cross-section (Spool position 0)	– with spool symbol Q		6 % of nominal cross-section	
	– with spool symbol W		3 % of nominal cross-section	
Minimum control pressure 8)		bar	4 (see characteristic curve page 7)	6 to 10 > tank pressure 2)
Maximum control pressure 8)		bar	10	200
Control volume		cm^3	4.24	1.23
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 3); quickly bio-degradable hydraulic fluids according to VDMA 24568 (see also RE 90221); HETG (rape seed oil) 3); HEPG (polyglycols) 4); HEES (synthetic esters) 4); HFC according to ISO 12922 5); other hydraulic fluids upon request	
Hydraulic fluid temperature range		°C	–30 ... +80 (NBR seals) –20 ... +80 (FKM seals)	
Viscosity range		mm^2/s	2.8 to 500	
Maximum permitted degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)			Class 20/18/15 6)	
Maximum switching frequency		1/h	7,200	

Explosion protection information

Area of application according to directive 94/9/EC		IM2; II2G; II2D; II3G; II3D
Ignition protection type Valve		c (EN 13463-5:2004-03)
Maximum surface temperature 7) Temperature class 7)	°C	100 T4
Special conditions for a safe use		
Ambient temperature range	°C	–20 ... +80

1) With version **../O..** (A, C, and D): horizontal

2) Performance limits depending on the minimum control pressure, see page 9

3) Suitable for NBR **and** FKM seals

4) Suitable **only** for FKM seals

5) Suitable **only** for NBR seals

6) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of filters, see data sheets RE 50070, RE 50076, RE 50081.

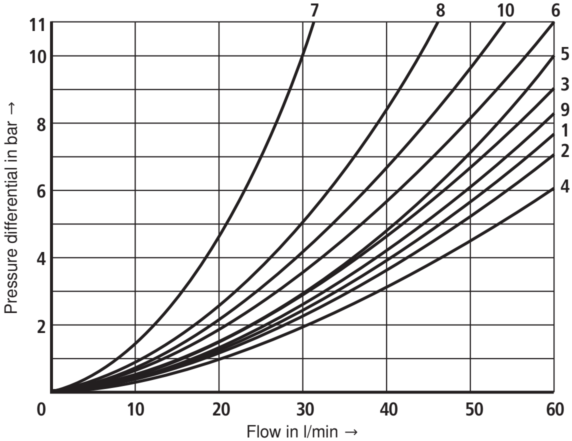
7) The specified max. temperature or temperature class refers to the max. permitted fluid and ambient temperature. A max. pressure drop across the valve results in a surface temperature 20 K above the fluid temperature, i.e. application in T6 is possible if the fluid and ambient temperature is max. 60 °C.

Note:
The ignition temperature of the hydraulic fluid used must be 50 K higher than the surface temperature of the valve.

8) With type WP: Control air must be free from oil to the largest possible extent or the oil content in the control air must be clearly below the explosion limit.

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δp-q_V characteristic curves



Spool symbols	Flow direction			
	P–A	P–B	A–T	B–T
A	3	3	–	–
B	3	3	–	–
C	1	1	3	1
D	5	5	3	3
E	3	3	1	1
F	1	3	1	1
G	6	6	9	9
H	2	4	2	2
J	1	1	2	1
L	3	3	4	9
M	2	4	3	3
P	3	1	1	1
Q	1	1	2	1
R	5	5	4	–
T	10	10	9	9
U	3	3	9	4
V	1	2	1	1
W	1	1	2	2
Y	5	5	3	3

More characteristic curves:

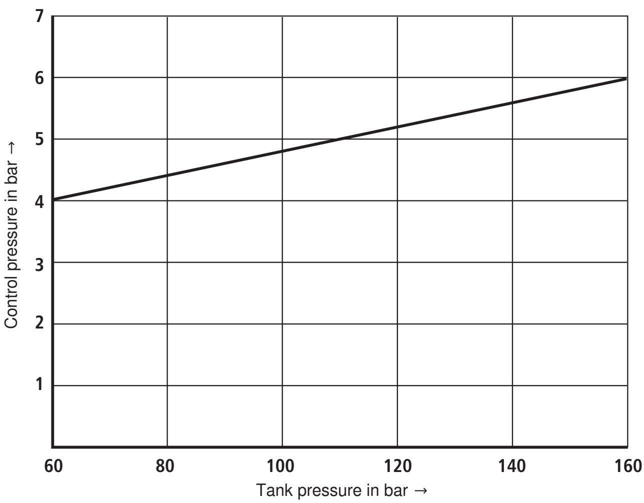
7 Spool symbol “R” in spool position “b” (B → A)

8 Spool symbols “G” and “T” in central position (P → T)

9 Spool symbol “H” in central position P → T)

3

Minimum control pressure depending on the tank pressure



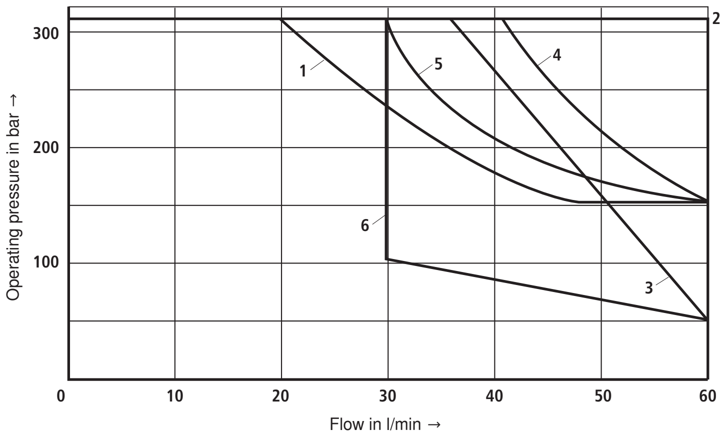
With a higher tank pressure, the minimum control pressure must be increased according to this diagram.

Performance limits: Type WP 6...XC (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Due to the adhesive effect, the switching function of the valves depends on the filtration. For achieving the specified, admissible flow values, full flow filtration with 25 μm is recommended. The flow forces acting within the values also influence the flow performance.

With 4-directional valves, the specified flow data thus applies for the normal use with 2 flow directions (e.g. from P to A and simultaneous return flow from B to T).

If there is only one direction of flow, the admissible flow may be considerably lower in critical cases (e.g. when using a 4-directional valve as 3-directional valve by blocking port A or B).



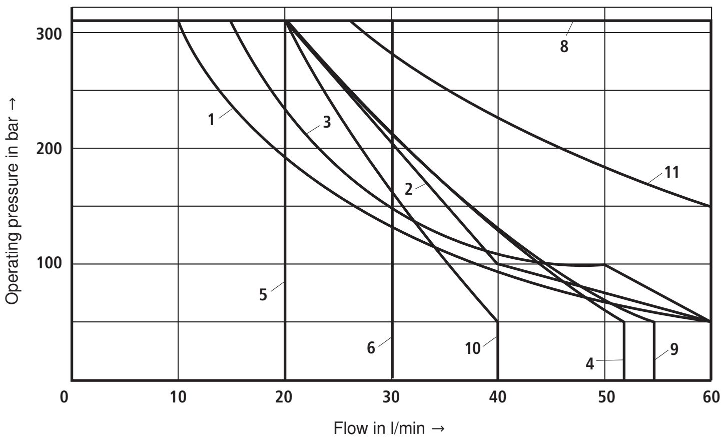
Characteristic curve	Spool symbol
1	A, B
2	A/O, C, C/O, D, D/O, E, E1-, G, H, J, L, M, Q, U, W, and Y
3	F, P
4	R
5	T
6	V

Performance limits: Type WH 6...XC (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Due to the adhesive effect, the switching function of the valves depends on the filtration. For achieving the specified, admissible flow values, full flow filtration with 25 µm is recommended. The flow forces acting within the values also influence the flow performance.

With 4-directional valves, the specified flow data thus applies for the normal use with 2 flow directions (e.g. from P to A and simultaneous return flow from B to T).

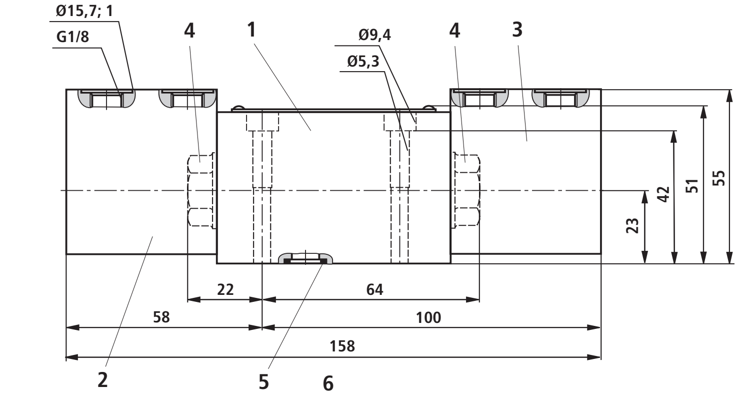
If there is only one direction of flow, the admissible flow may be considerably lower in critical cases (e.g. when using a 4-directional valve as 3-directional valve by blocking port A or B).

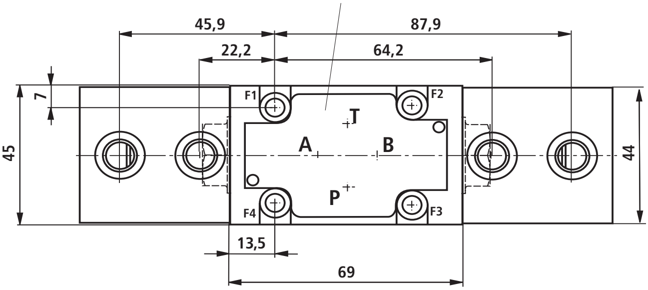


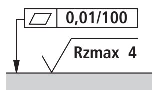
Control pressure 6 bar > tank pressure		
Spring return	**Characteristic curve**	**Spool symbol**
"No code" (with spring return)	1	A, B
	2	C, D, Y
	3	E, J, L, U, M, Q, V, W, E1-
	4	F, P
	5	T
	6	G, H
	7	R
../O..	8	A, C, D
../OF..		

Control pressure 10 bar > tank pressure		
Spring return	**Characteristic curve**	**Spool symbol**
"No code" (with spring return)	1	A, B
	8	C, D, Y, E, G, H, J, L, U, M, Q, V, W, E1-
	9	F, P
	10	R
	11	T
../O..	8	A, C, D
../OF..		

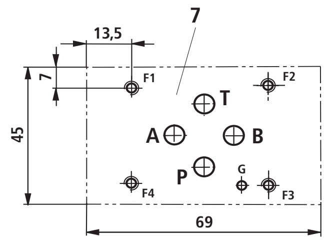
Unit dimensions: Type WP 6...XC (dimensions in mm)







Required surface quality of the valve mounting face



1 Valve with 2 spool positions and 2 actuating cylinders

  Valve with 3 spool positions and 2 actuating cylinders

2 Actuating cylinder “a”

3 Actuating cylinder “b”

4 Plug screw for valve with one actuating cylinder (2 spool positions)

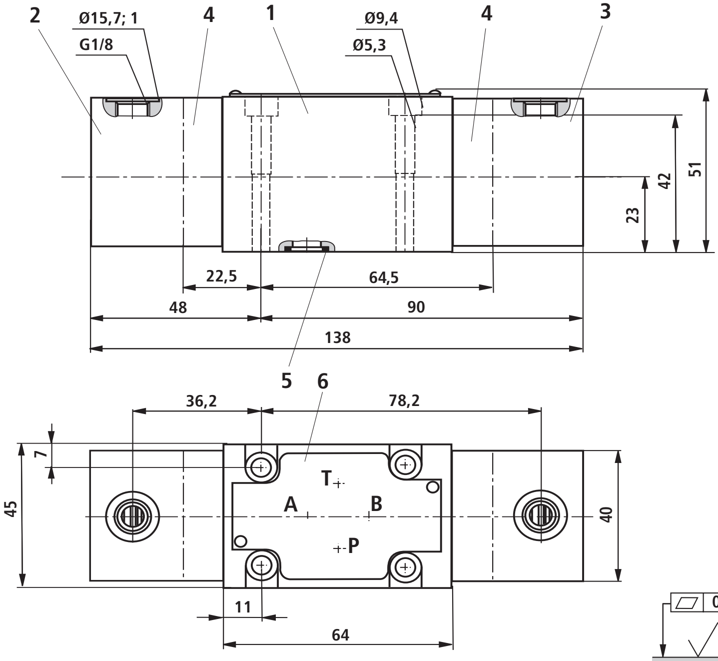
5 Identical seal rings for ports A, B, P, T

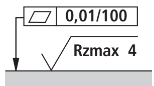
6 Nameplate

7 Porting pattern according to DIN 24340 form A (**without** locating hole), or ISO 4401-03-02-0-05 (**with** locating hole)

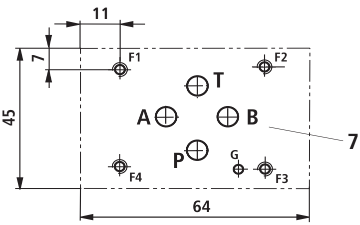
Valve mounting screws
For reasons of stability, only the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09–0.14 according to VDA 235-101)
Material no. R913000064
(must be ordered separately)

Unit dimensions: Type WH 6...XC (dimensions in mm)





Required surface quality of the valve mounting face



1 Valve with 2 spool positions and 2 actuating cylinders
Valve with 3 spool positions and 2 actuating cylinders
2 Actuating cylinder “a”
3 Actuating cylinder “b”
4 Cover for valve with one actuating cylinder (2 spool positions)
5 Identical seal rings for ports A, B, P, T
6 Nameplate
7 Porting pattern according to DIN 24340 form A (**without** locating hole), or ISO 4401-03-02-0-05 (**with** locating hole)

Valve mounting screws
For reasons of stability, only the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09–0.14 according to VDA 235-101)
Material no. R913000064
(must be ordered separately)

3

Notes

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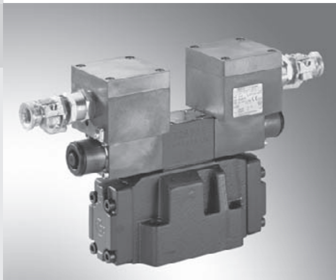
documentation@boschrexroth.de
www.boschrexroth.de

4/2 and 4/3 directional valves, internally pilot operated, externally pilot operated

RE 24751-XD-B2/08.12
Replaces: 01.10

Type H-4WEH…XD...



HAD7266

Sizes 10, 16, 25, 32
Component series 4X, 6X, 7X
Maximum operating pressure 350 bar
Maximum flow 1100 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

– Area of application in accordance with the Explosion Protection Directive 94/9/EC: **I M2, II 2G**
– Type of protection of the valve solenoids:
  Ex d I Mb, Ex d IIC T4 Gb
  EN 60079-0:2009 / EN 60079-1:2007

Special features of seawater-resistant valves

– The external metal parts are galvanized or treated with an anti-corrosion agent.
– The conditional seawater resistance is defined by the "SO329" ordering code.

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 24751-XD-B0**
Part II	Data sheet 24751-XD-B2	
Part III	Product-specific instructions 24751-XD-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

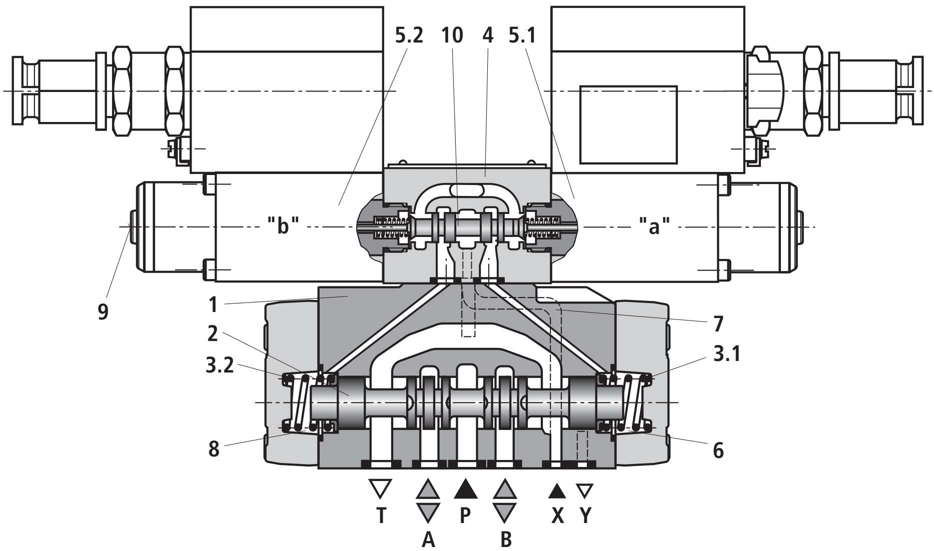
Table of contents

Features

- Valve to control the start, stop and direction of a flow, for intended use in explosive areas
- Electro-hydraulic actuation (WEH)
- For subplate mounting,
  porting pattern according to DIN 24340-A and ISO 4401,
  subplates available in FE/ZN version (see pages 20 to 23)
- Spring centering, spring end position or hydraulic end position
- Wet-pin DC solenoids
- Manual override
- Electrical connection as individual connection with cable gland (see page 13)
- Switching time adjustment, optional
- Preload valve in channel P of the main valve, optional

Function, section

Type H-4WEH 16…XD...



Directional valve type H-4WEH…

The valve type H-4WEH is a directional spool valve with electro-hydraulic actuation. It controls the start, stop and direction of a flow.

The directional valves basically consist of the main valve with housing (1), the main control spool (2), one or two return springs (3.1) and (3.2), as well as the pilot control valve (4) with one or two solenoids "a" (5.1) and/or "b" (5.2).

The main control spool (2) in the main valve is held in the zero or initial position by the springs or by means of pressurization. In the initial position, the two spring chambers (6) and (8) are connected with the tank in a depressurized form via the pilot control valve (4). The pilot control valve is supplied with pilot oil via the control line (7). Supply can be effected internally or externally (externally via port X).

Upon actuation of the pilot control valve, e.g. solenoid "a", the pilot control spool (10) is moved to the left and thus, the spring chamber (8) is pressurized with pilot pressure. The spring chamber (6) remains depressurized.

The pilot pressure acts on the left side of the main control spool (2) and moves it against the spring (3.1). This connects ports P with B and A with T in the main valve.

When the solenoid is switched off, the pilot control spool returns into the initial position (except for impulse spool). The spring chamber (8) is unloaded to the tank.

The pilot oil from the spring chamber is displaced into channel Y via the pilot control valve.

The pilot oil supply and return can be effected internally or externally.

The manual override (9) allows control spool (10) to be moved without solenoid energization.

Ordering code and scope of delivery

H	–	4	WEH				/		6B			XD	

Up to 350 bar	**= H**
4-way version	**= 4**
Directional valve, electro-hydraulically actuated	**= WEH**
Size	
Size 10	**= 10**
Size 16	**= 16**
Size 25	**= 25**
Size 32	**= 32**
Control spool return main valve	
By means of springs	**= no code**
Hydraulically [1]	**= H**
Control spool symbols, see page 6	
Component series 40 to 49 – size 10 (40 to 49: Unchanged installation and connection dimensions)	**= 4X**
Component series 60 to 69 – size 25 (4W.H 25.) and size 32 (60 to 69: Unchanged installation and connection dimensions)	**= 6X**
Component series 70 to 79 – size 16 (70 to 79: Unchanged installation and connection dimensions)	**= 7X**
Control spool return in the pilot control valve with 2 spool positions and 2 solenoids **only** possible with control spool C, D, K, Z and hydraulic control spool return in the main valve	
Without spring return	**= O**
Without spring return with detent	**= OF**
Pilot control valve with wet-pin solenoids, high-power valve (data sheet 23178-XD-B2)	**= 6B**
Direct voltage 24 V	**= G24**
Direct voltage 110 V	**= G110**
With manual override (standard)	**= N**
Explosion protection "Pressure-resistant enclosure" For details see information on the explosion protection, page 11	**= XD**
Pilot oil supply external, pilot oil return external [2]	**= no code**
Pilot oil supply internal, pilot oil return external [3]	**= E**
Pilot oil supply internal, pilot oil return internal [3]	**= ET**
Pilot oil supply external, pilot oil return internal [2]	**= T**

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in part III

Explanation of the foot notes, see page 5

Ordering code and scope of delivery

	Z2					

Surface protection

SO329 =	Conditionally seawater-resistant, galvanized
no code =	Standard

no code =	NBR seals
V =	FKM seals
	(other seals upon request)

Important
Observe compatibility of seals with hydraulic fluid used!

no code =	**Without** pressure reducing valve
D3 =	**With** pressure reducing valve [4]

Preload valve (not for size 10)

no code =	**without** preload valve
P4,5 =	**With** preload valve ($p_{ö}$ = 4.5 bar)

Throttle insert

no code =	Without throttle insert
B08 =	Throttle Ø 0.8 mm
B10 =	Throttle Ø 1.0 mm
B12 =	Throttle Ø 1.2 mm
B15 =	Throttle Ø 1.5 mm

Electrical connection

Z2 =	Solenoid with terminal box and cable gland, for details see chapter Electrical connection

no code =	**Without** switching time adjustment
S =	Switching time adjustment as supply control
S2 =	Switching time adjustment as discharge control

3

[1] 2 spool positions (hydraulic end position): Only control spool C, D, K, Z, Y

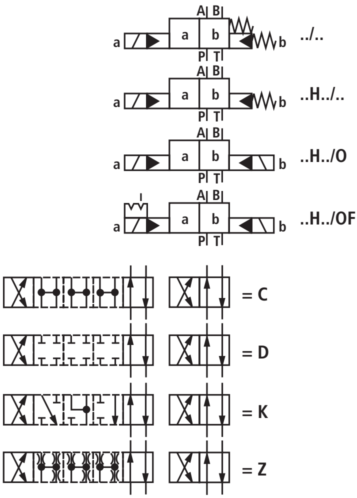
[2] Pilot oil supply X or pilot oil return Y external:
- Observe the maximum pilot pressure according to page 10!

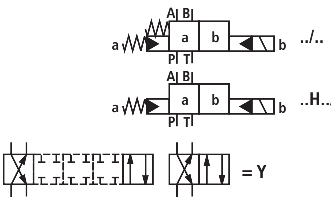
[3] Pilot oil supply internal (version "ET" and "E"):
- Observe the minimum pilot pressure according to page 10!
- In order to prevent inadmissibly high pressure peaks, a throttle insert "B10" has to be provided in the P port of the pilot control valve (see page 9).
- You must moreover provide the pressure reducing valve "D3".

[4] Only in connection with throttle insert "B10"

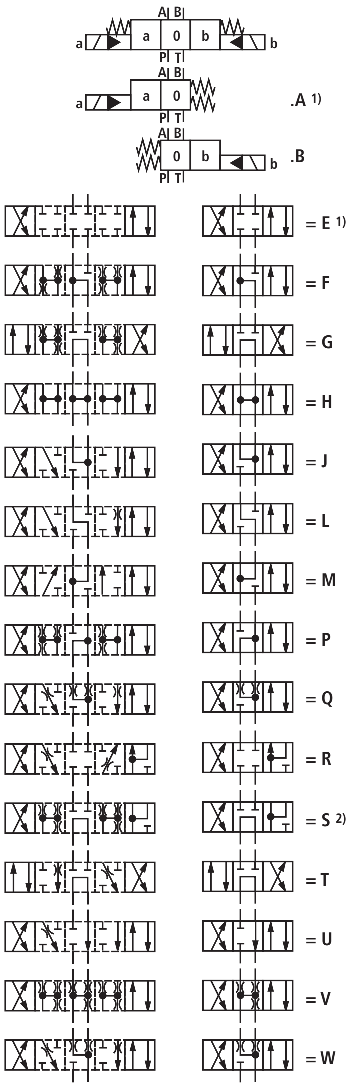
Control spool symbols

2 spool positions





3 spool positions

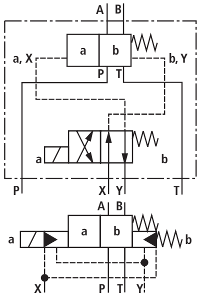
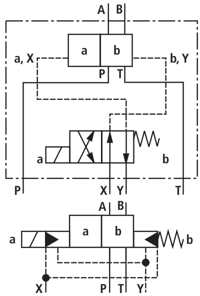
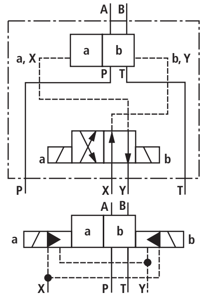
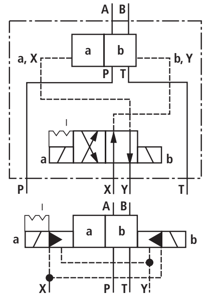
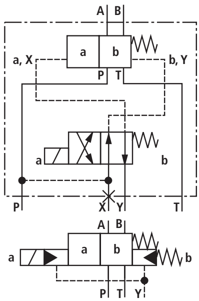
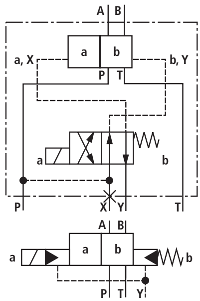
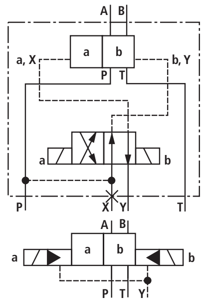
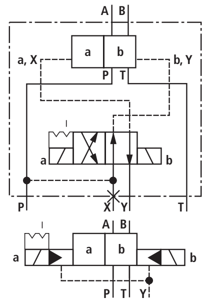


1) Example: Control spool E with spool position "a"
Order example:
H-4WEH 16 **EA**7X/6EG24N9XDETSZ2B10..V..

2) Control spool S only for size 16

Other control spool variants upon request

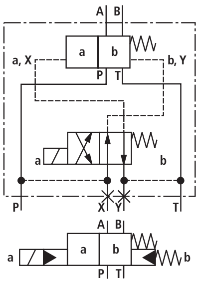
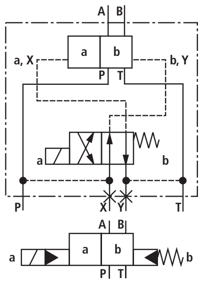
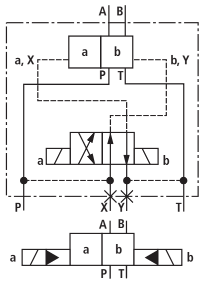
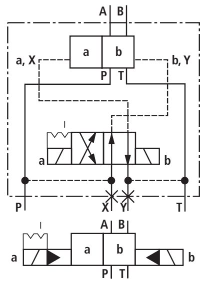
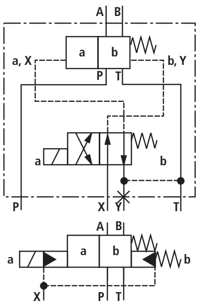
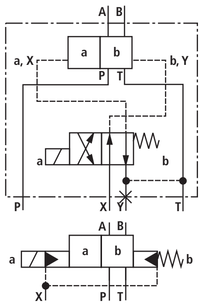
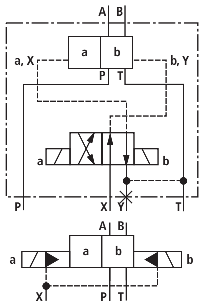
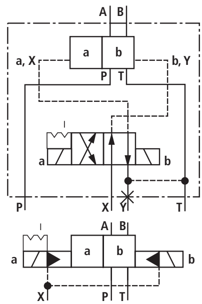
Control spool symbols for valves with 2 spool positions

Valves with spring end position		Valves with hydraulic end position		
	Type H-4WEH.../...	Type H-4WEH..H.../...	Type H-4WEH..H.../O...	Type H-4WEH..H.../OF...
X = external **Y** = external				
	Type H-4WEH.../...E...	Type H-4WEH..H.../...E...	Type H-4WEH..H.../O...E...	Type H-4WEH..H.../OF...E...
X = internal **Y** = external				

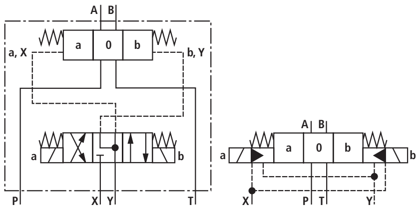
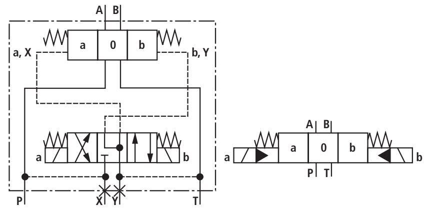
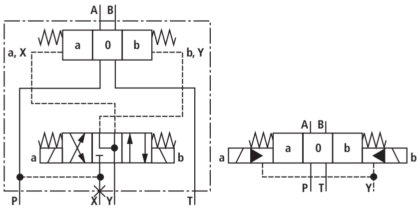
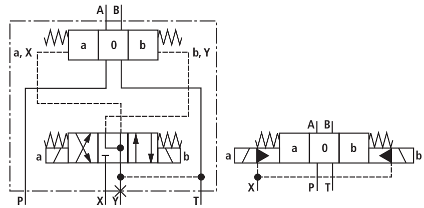
Continuation, see next page

Control spool symbols for valves with 2 spool positions

Continuation from previous page

	Valves with spring end position	Valves with hydraulic end position		
X = internal **Y** = internal	**Type H-4WEH.../...ET...** 	**Type H-4WEH..H.../...ET...** 	**Type H-4WEH..H.../O...ET...** 	**Type H-4WEH..H.../OF...ET...** 
X = external **Y** = internal	**Type H-4WEH.../...T...** 	**Type H-4WEH..H.../...T...** 	**Type H-4WEH..H.../O...T...** 	**Type H-4WEH..H.../OF...T...** 

Control spool symbols for valves with 3 spool positions

Valves with spring-centered zero position			
X = external Y = external	Type H-4WEH.../... 	X = internal Y = internal	Type H-4WEH.../...ET... 
X = internal Y = external	Type H-4WEH.../...E... 	X = external Y = internal	Type H-4WEH.../...T... 

Pilot oil supply

Type H-4WEH…

The pilot oil supply is effected **externally** via the X channel from a separate circuit.

The pilot oil return is effected **externally** via the Y channel into the tank.

Type H-4WEH…E…

The pilot oil supply is effected **internally** from the P channel of the main valve.

The pilot oil return is effected **externally** via the Y channel into the tank. In the subplate, port X is closed.

Type H-4WEH…ET…

The pilot oil supply is effected **internally** from the P channel of the main valve.

The pilot oil return is effected **internally** via the T channel into the tank. In the subplate, ports X and Y are closed.

Type H-4WEH…T…

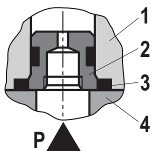
The pilot oil supply is effected **externally** via the X channel from a separate circuit.

The pilot oil return is effected **internally** via the T channel into the tank. In the subplate, port Y is closed.

Throttle insert

Use of the throttle insert (2) is necessary if the pilot oil supply in the P channel of the pilot control valve (1) is to be limited.

The throttle insert (2) is inserted in channel P of the pilot control valve (1).



1 Pilot control valve
2 Throttle insert
3 Seal ring
4 Main valve

3

Technical data

general

Installation position		Any; horizontal with valves with hydraulic control spool return "H" and control spool C, D, K, Z or Y				
Ambient temperature range	°C	–20 … +80				
Storage temperature range	°C	+15 ... +30				
Sizes	Size	**10**	**16**	**25**	**32**	
Weight – Valve with one solenoid	kg	11	13.5	22	39	
Weight – Valve with two solenoids, spring-centered	kg	14	16.5	25	42	
Weight – Switching time adjustment	kg	0.8				
Weight – Pressure reducing valve	kg	0.4				
Surface protection – Valve body – Pilot control valve		Galvanically coated				
Surface protection – Valve body – Main valve		Standard: Painting, layer thickness max. 100 μm SO329: Galvanically coated, Zn and passivated				
Surface protection – Solenoid		Galvanically coated				

hydraulic

Sizes	Size	**10**	**16**	**25**	**32**
Maximum operating pressure					
Ports P, A, B	bar	350			
Port T – with pilot oil return Y external	bar	250			
Port T – with pilot oil return Y internal	bar	210			
Port Y – with pilot oil return external	bar	210			
Flow of the main valve	l/min	up to 160	up to 300	up to 650	up to 1100
Maximum pilot pressure	bar	250 (with a higher pilot pressure, use of a pressure reducing valve is required)			
Minimum pilot pressure – with pilot oil supply X external or internal (control spool D, K, E, J, L, M, Q, R, U, W)					
3-spool position valve, spring-centered	bar	10	14	13	8.5
2-spool position valve, spring end position	bar	10	14	13	10
2-spool position valve, hydraulic end position	bar	7	14	8	5
– with pilot oil supply X internal (control spool C, F, H, P, T, V, Z, S [1])	bar	6.5 [2]	4.5 [3]	4.5 [3]	4.5 [3]
Pilot volume for switching process					
3-spool position valve, spring-centered	cm^3	2.04	5.72	14.2	29.4
2-spool position valve	cm^3	4.08	11.45	28.4	58.8
Pilot volume for shortest switching time	l/min	approx. 35	approx. 35	approx. 35	approx. 45
Hydraulic fluid		Mineral oil (HL, HLP) according to DIN 51524 [4], fast bio-degradable hydraulic fluids according to VDMA 24568 (see also data sheet 90221), HETG (rape seed oil) [4], HEPG (polyglycols) [5], HEES (synthetic esters) [5], flame-resistant hydraulic fluid HFC according to ISO 12922 [6], other hydraulic fluids on request ignition temperature > 180 °C			

Continuation and foot notes, see page 11

Technical data

hydraulic (continued)

Hydraulic fluid temperature range	°C	–20 ... +80 (NBR seals)
		–15 ... +80 (FKM seals)
Viscosity range	mm^2/s	2.8 … 500
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)		Class 20/18/15 [7)]

electric

Voltage type		Direct voltage
Available voltages	V	24, 110
Voltage tolerance (nominal voltage)	%	±10
Admissible residual ripple	%	< 5
Duty cycle / operating mode according to VDE 0580		S1 (continuous operation)
Switching time according to ISO 6403		See page 12
Switching frequency	1/h	up to 15000
Nominal power at ambient temperature 20 °C	W	13
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C	W	15.8
Protection class according to EN 60529		IP 65 with correctly installed connection line

Information on the explosion protection

Area of application as per directive 94/9/EC		I M2, II 2G
Type of protection Valve		c (EN 13463-5:2011)
Maximum surface temperature [8)]	°C	130
Temperature class		T4
Type of protection Valve solenoid according to EN 60079-0:2009 / EN 60079-1:2007		Ex d I Mb Ex d IIC T4 Gb
Type examination certificate Solenoid		BVS 03 ATEX E 300 X
"IEC Certificate of Conformity" Solenoid		IECEx BVS 11.0091 X
Special conditions for safe use		– In case of bank assembly, only one solenoid of all valves may be energized at a time. – In case of valves with two solenoids, maximally one of the solenoids may be energized at a time.
Ambient temperature range	°C	–20 … +80

1) Control spool S only for size 16

2) For control spools C, F, G, H, P, T, V, Z, an internal pilot oil supply without preload valve is only possible if the flow from P → T in the central position (for 3-spool position valve) or while crossing the central position (for 2-spool position valve) is so large that the pressure differential of P → T reaches a value of at least 6.5 bar.

3) For control spools C, F, G, H, P, T, V, Z, S [1)] – by means of preload valve (not size 10) or correspondingly high flow.

4) Suitable for NBR **and** FKM seals

5) Suitable **only** for FKM seals

6) If HFC hydraulic fluid is used, the following parameters have to be complied with:
Pressure at P, A, B max. 160 bar, at T max. 3 bar (with E, ET and T) and/or at X max. 160 bar and Y max. 3 bar
Ambient temperature 0 ... 36 °C
Hydraulic fluid temperature max. 55 °C
Duty cycle 60 %
Only NBR seals are admissible.
For more information, please ask our sales staff.

7) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

8) Surface temperature > 50 °C, provide contact protection

3

Technical data

Switching times (= Contacting at the pilot control valve until start of opening of the control edge in the main valve and change in the control spool stroke by 95 %)

Pilot pressure		bar	70	250	Spring
			ON		OFF
Size 10	without throttle insert	ms	50 ... 70	50 ... 70	30 ... 40
	with throttle insert	ms	70 ... 100	60 ... 80	30 ... 40
Size 16	without throttle insert	ms	60 ... 90	50 ... 70	60 ... 90
	with throttle insert	ms	120 ... 140	90 ... 110	60 ... 90
Size 25	without throttle insert	ms	80 ... 110	60 ... 80	110 ... 140
	with throttle insert	ms	210 ... 260	130 ... 160	110 ... 140
Size 32	without throttle insert	ms	90 ... 140	80 ... 110	150 ... 170
	with throttle insert	ms	430 ... 570	240 ... 360	150 ... 170

Important:

- The switching times are measured according to ISO 6403 with HLP46, ϑ_{oil} = 40 °C ± 5 °C. With different oil temperatures, deviations are possible.
- The switching times increase by approx. 30 ms if the pressure reducing valve "D3" is used.
- The switching times have been determined under ideal conditions and may differ in the system, depending on the application conditions.

Free flow cross-sections in zero position with control spools Q, V and W

Control spool **Q**	A – T, B – T	mm²	13	32	78	83	78
Control spool **V**	A – T, B – T	mm²	13	32	73	83	73
	P – A, P – B	mm²	13	32	84	83	84
Control spool **W**	A – T, B – T	mm²	2.4	6	10	14	20

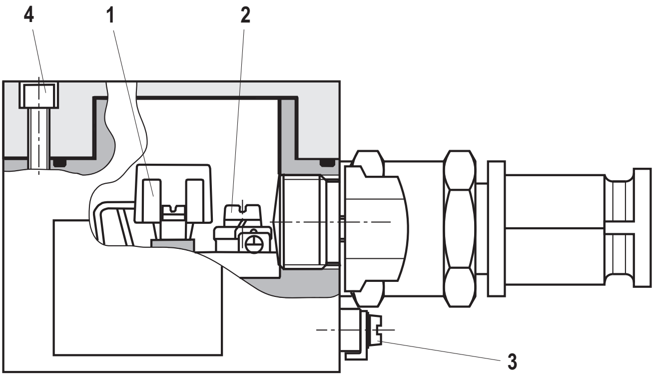
Electrical connection

The type-examination tested valve solenoid of the valve is equipped with one terminal box and a type-tested cable entry.

The connection is polarity-independent.

Important

When establishing the electrical connection, the protective earthing conductor (PE ⏚) has to be connected properly.



Properties of the connection terminals and mounting elements

Item	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire max. 2.5 mm^2 Finely stranded max. 2.5 mm^2
2	Connection for protective earthing conductor	Single-wire 0.75 … 2.5 mm^2 Finely stranded 0.75 … 1.5 mm^2
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm^2 Finely stranded min. 4 mm^2
4	Screws for cover	–

Cable gland

Line diameter	mm	9…12
Sealing		Outer sheath sealing

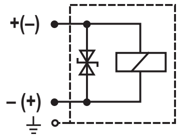
Connection line

Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–20 … > +110

Electrical connection (continued)

Circuit diagram

Direct voltage, polarity-independent



Over-current fuse and switch-off voltage peak

Important

A fuse appropriate for the solenoid's rated current (max. 3 x I_{rated} according to DIN 41571 and/or IEC 60127) or a protective motor switch with short-circuit and thermal instantaneous tripping must be connected to each valve solenoid as short-circuit protection. The cut-off capacity of this fuse must match or exceed the short-circuit current of the supply source.

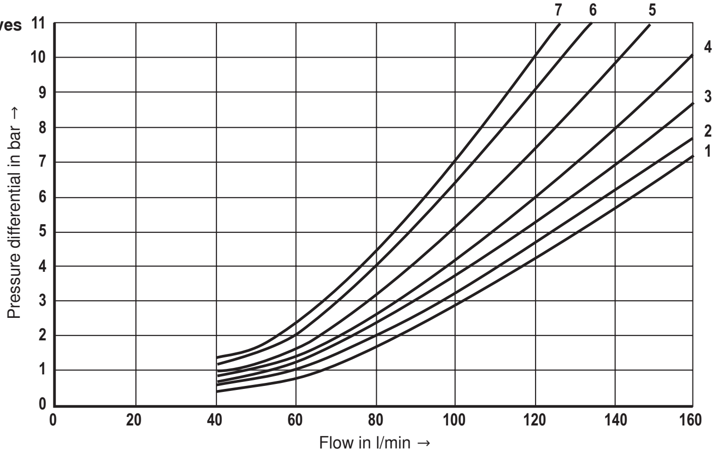
This fuse or motor protection switch may only be fitted outside the explosive area or must be of an explosion-proof design.

When inductivities are switched off, voltage peaks result which may cause failures in the connected control electronics. For this reason, the valve solenoids comprise a suppression circuit which dampens this voltage peak to the voltage value shown in the table.

Voltage data in the valve type code	Nominal voltage Valve solenoid	Rated current Valve solenoid	Recommended pre-fuse characteristics medium time-lag according to DIN 41571	Maximum voltage value upon switch-off	Suppression circuit
G24	24 V DC	0.542 A DC	630 mA	–90 V	Suppressor diode bi-directional
G110	110 V DC	0.118 A DC	125 mA	–390 V	

Characteristic curves: Type H-4WEH 10… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δp - q_V **characteristic curves**



Characteristic curve selection

Control spool	Spool position				Control spool	Zero position		
	P – A	P – B	A – T	B – T		A – T	B – T	P – T
E, Y, D	2	2	4	5				
F	1	4	1	4	**F**	3	–	6
G, T	4	2	2	6	**G, T**	–	–	7
H, C	4	4	1	4	**H**	1	3	5
J, K	1	2	1	3				
L	2	3	1	4	**L**	3	–	–
M	4	4	3	4				
P	4	1	3	4	**P**	–	7	5
Q, V, W, Z	2	2	3	5				
R	2	2	3	–				
U	3	3	3	4	**U**	–	4	–

Performance limits: Type H-4WEH 10**…** (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

2- and 3-spool position valves
Maximum flow q_V in l/min

Control spool	Operating pressure p_{max} in bar		
	200	**250**	**315**
E, J, L, M, Q, R, U, V, W, C, D, K, Z, Y	160	160	160
H	160	150	120
G, T	160	160	140
F, P	160	140	120

Important

The specified switching power limits are valid for operation with two directions of flow (e. g. P → A and simultaneous return flow B → T) in the ratio 1:1.

Due to the flow forces acting within the valves, the admissible switching power limit may be considerably lower with only one direction of flow (e. g. P → A while port B is blocked)!

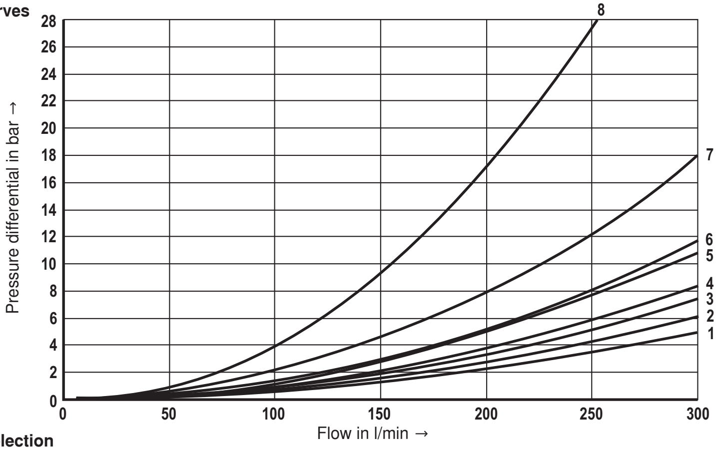
(In such cases, please consult us!)

The switching power limit was established while the solenoids were at operating temperature, at 10 % undervoltage and without tank pre-loading.

3

Characteristic curves: Type H-4WEH 16… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δp - q_V characteristic curves



Characteristic curve selection

Control spool	Spool position P – A	P – B	A – T	B – T	P – T
E, Y, D	1	1	3	4	–
F	1	1	5	4	–
G, T	4	1	5	5	7
H, C, Q, V, Z	1	1	5	6	–
J, K, L	1	1	5	6	–

Control spool	Spool position P – A	P – B	A – T	B – T	P – T
M, W	1	1	3	4	–
R	1	1	3	–	–
U	2	2	3	5	–
S	3	3	3	–	8

Performance limits: Type H-4WEH 16… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

2-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar 70	140	210	280	350
X external, spring end position in the main valve (with $p_{St\ min}$ = 12 bar)					
C, D, K, Y, Z	300	300	300	300	300
X external, spring end position in the main valve [1]					
C	300	300	300	300	300
D, Y	300	270	260	250	230
K	300	250	240	230	210
Z	300	260	190	180	160
X external, hydraulic end position in the main valve					
HC, HD, HK, HZ, HY	300	300	300	300	300

Important
See also "**Important**" page 15

3-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar 70	140	210	280	350
X external, spring centering in the main valve					
E, H, J, L, M, Q, U, W, R	300	300	300	300	300
F, P	300	250	180	170	150
G, T	300	300	240	210	190
S	300	300	300	250	220
V	300	250	210	200	180

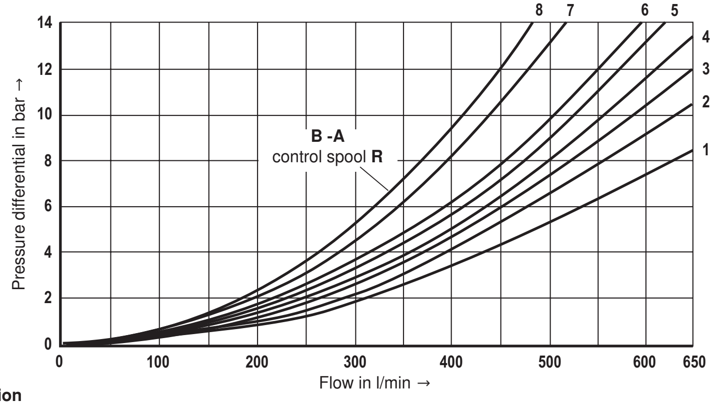
Important

[1] If the specified flow values are exceeded, the function of the return spring is no longer guaranteed if the pilot pressure fails!

- With pilot oil supply **X internal,** you must always use a preload valve due to the negative overlap of the control spools F, G, H, P, T, S, C and HC.
- With control spools V, Z and HZ, the preload valve is **not** required for flows > 180 l/min.

Characteristic curves: Type H-4WEH 25… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δp - q_V characteristic curves



7 Control spool **G**
Central position **P – T**

8 Control spool **T**
Central position **P – T**

Characteristic curve selection

Control spool	P – A	P – B	A – T	B – T
E	1	1	1	3
F	1	4	3	3
G	3	1	2	4
H	4	4	3	4
J, Q	2	2	3	5
L	2	2	3	3
M	4	4	1	4
P	4	1	1	5
R	2	1	1	–
U	4	1	1	6
V	2	4	3	6
W	1	1	1	3
T	3	1	2	4

Performance limits: Type H-4WEH 25… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

2-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar				
	70	**140**	**210**	**280**	**350**
X external, spring end position in the main valve (with $p_{St\ min}$ = 13 bar)					
C, D, K, Y, Z	700	700	700	700	650
X external, spring end position in the main valve [1]					
C	700	700	700	700	650
D, Y	700	650	400	350	300
K	700	650	420	370	320
Z	700	700	650	480	400
X external, hydraulic end position in the main valve					
HC, HD, HK, HZ, HY	700	700	700	700	700
HC../O.. HD../O.. HK../O.. HZ../O..	700	700	700	700	700
HC../OF.. HD../OF.. HK../OF.. HZ../OF..	700	700	700	700	700

3-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar				
	70	**140**	**210**	**280**	**350**
X external, spring centering in the main valve					
E, L, M, Q, U, W,	700	700	700	700	650
G, T	400	400	400	400	400
F	650	550	430	330	300
H	700	650	550	400	360
J	700	700	650	600	520
P	650	550	430	330	300
V	650	550	400	350	310
R	700	700	700	650	580

Important

[1] If the specified flow values are exceeded, the function of the return spring is no longer guaranteed if the pilot pressure fails!

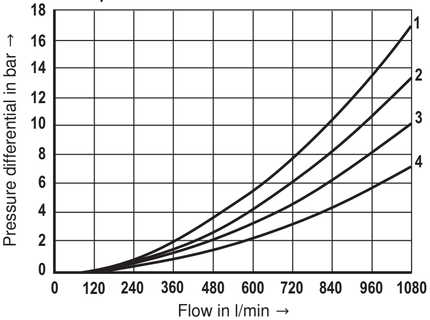
- With pilot oil supply **X internal,** a preload valve has to be used for flows < 180 l/min due to the negative overlap of the control spools Z, HZ and V.
- With pilot oil supply **X internal,** you must always use a preload valve due to the negative overlap of the control spools C, HC, F, G, H, P and T.

Important

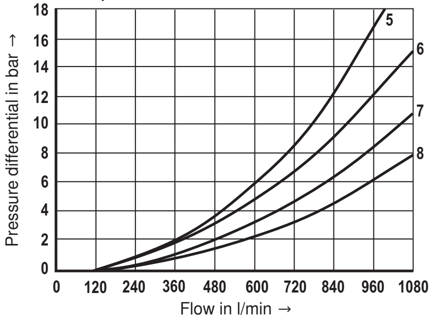
See also "**Important**" page 15

Characteristic curves: Type H-4WEH 32… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

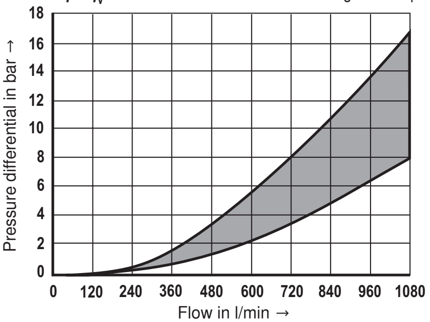
Δ*p* - *q*$_V$ characteristic curves – Control spools **E, R** and **W**



Δ*p* - *q*$_V$ characteristic curves – Control spools **G** and **T**



Δ*p* - *q*$_V$ characteristic curves – All remaining control spools



Control spool	Spool position				
	P – A	P – B	A – T	B – T	B – A
E	4	4	3	2	–
R	4	4	3	–	1
W	4	4	3	2	–

Control spool	Spool position				
	P – A	P – B	A – T	B – T	P – T
G	7	8	7	5	6
T	7	8	7	5	6

Performance limits: Type H-4WEH 32… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

2-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar				
	70	**140**	**210**	**280**	**350**
X external, spring end position in the main valve (with $p_{St\ min}$ = 10 bar)					
C, D, K, Y, Z	1100	1040	860	750	680
X external, spring end position in the main valve [1)]					
C	1100	1040	860	800	700
D, Y	1100	1040	540	480	420
K	1100	1040	860	500	450
Z	1100	1040	860	700	650
X external, hydraulic end position in the main valve					
HC, HD, HK, HZ, HY	1100	1040	860	750	680

Important

See also "**Important**" page 15

3-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar				
	70	**140**	**210**	**280**	**350**
X external, spring centering in the main valve					
E, J, L, M, Q, U, W, R	1100	1040	860	750	680
G, T, H, F, P	900	900	800	650	450
V	1100	1000	680	500	450

Important

[1)] If the specified flow values are exceeded, the function of the return spring is no longer guaranteed if the pilot pressure fails!

- With pilot oil supply **X internal**, a preload valve has to be used for flows < 180 l/min due to the negative overlap of the control spools Z, HZ and V.
- With pilot oil supply **X internal,** you must always use a preload valve due to the negative overlap of the control spools C, HC, F, G, H, P and T.

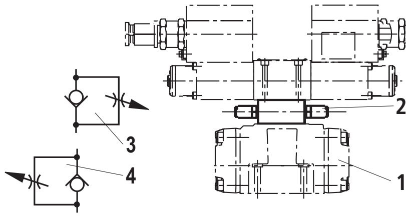
Switching time adjustment, pressure reducing valve, preload valve

Switching time adjustment "S/S2"

The switching time of the main valve (1) is influenced by using a twin throttle check valve (2), type Z2FS 6.

Symbol (3) shows the switching time adjustment "S" (supply control), symbol (4) shows the switching time adjustment "S2" (discharge control)

Type H-4WEH 10 ..4X/…S or S2

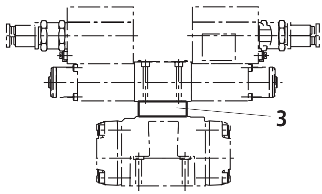


Pressure reducing valve "D3"

With the design internal pilot oil supply (ET or E) or external pilot oil supply and a pilot pressure of more than 250 bar, the valve must be ordered with a pressure reducing valve (3), type ZDR6PO, **and** a throttle insert "B10".

Ordering code: "B10..D3"

Type H-4WEH 10 ..4X/…/..D3



Preload valve "P4,5" (not for size 10)

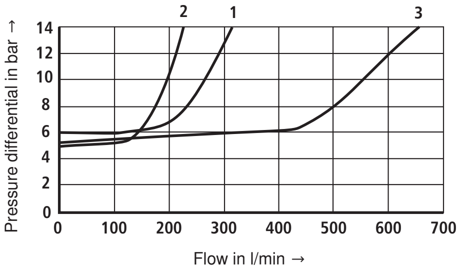
In case of valves with depressurized circulation and internal pilot oil supply, a preload valve is necessary in the P channel of the main valve in order to build up the minimum pilot pressure.

Ordering code: "P4,5"

The pressure differential of the preload valve is to be added to the pressure differential of the main valve (see characteristic curves) to result in one total value.

The cracking pressure amounts to approx. 4.5 bar.

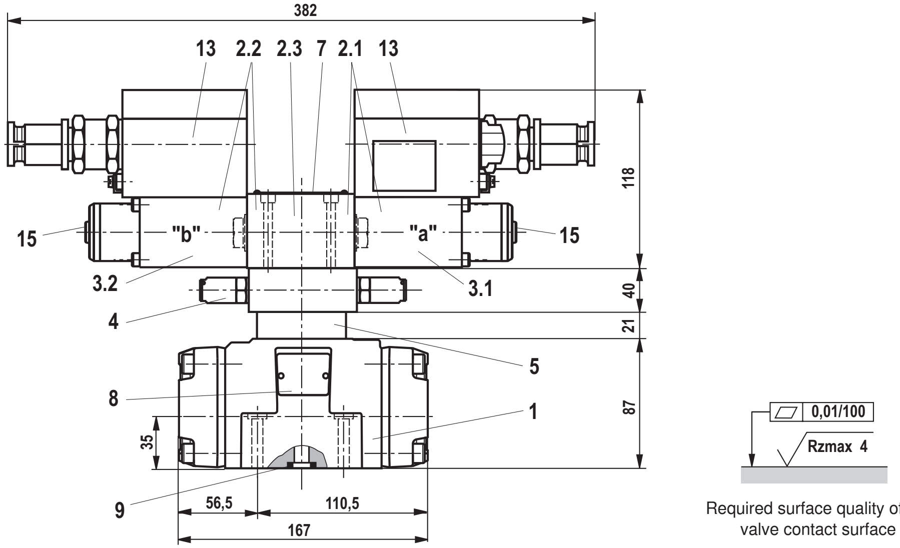
Δp–q_V characteristic curve
(measured with HLP46, ϑ_{Oil} = 40 °C ± 5 °C)



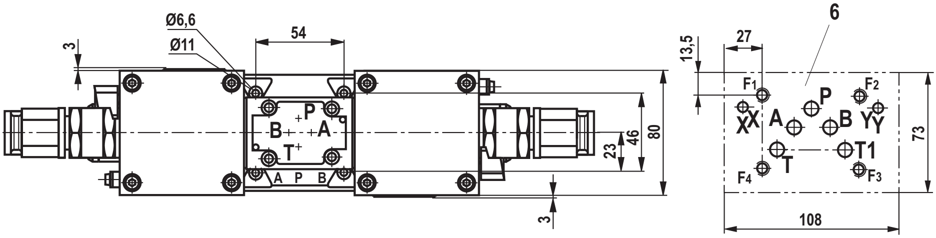
1 = Size 16 2 = Size 25 3 = Size 32

3

Device dimensions: Type H-4WEH 10… (dimensions in mm)



Required surface quality of the valve contact surface



Subplates
- **without** ports X, Y G 534/01 FE/ZN (G3/4)
- **with** ports X, Y G 535/01 FE/ZN (G3/4)
  G 536/01 FE/ZN (G1)

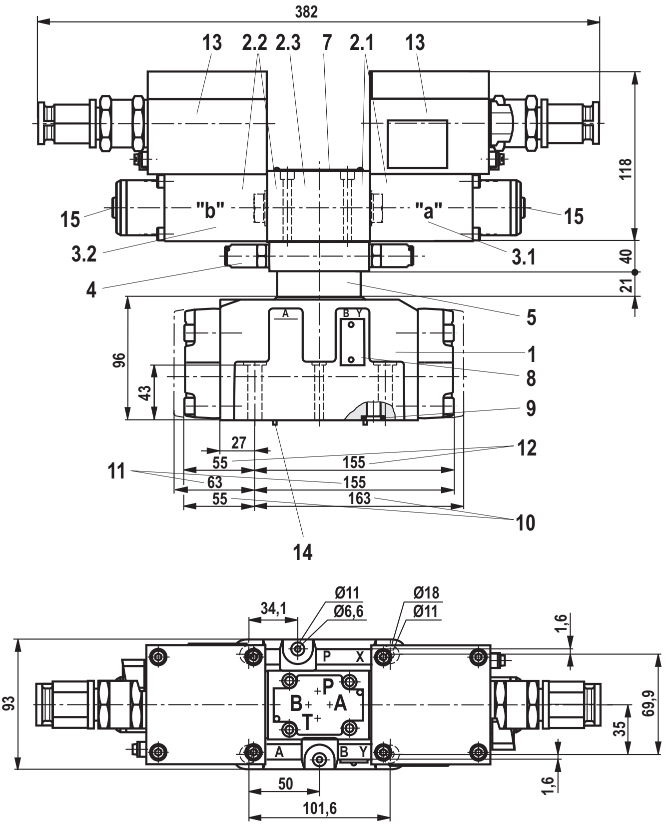
with dimensions as in the data sheet 45054 (must be ordered separately)

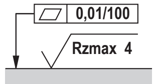
Item explanations and information on the subplates, see page 24

Valve mounting screws

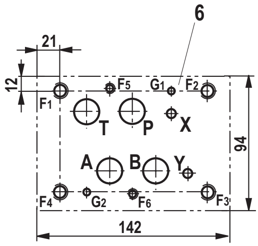
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x45-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

Device dimensions: Type H-4WEH 16… (dimensions in mm)





Required surface quality of the valve contact surface



3

Subplates

G 172/01 FE/ZN (G3/4)
G 172/02 FE/ZN (M27 x 2)
G 174/01 FE/ZN (G1)
G 174/02 FE/ZN (M33 x 2)
G 174/08 FE/ZN (flange)

with dimensions as in the data sheet 45056 (must be ordered separately)

Item explanations and information on the subplates, see page 24

Valve mounting screws

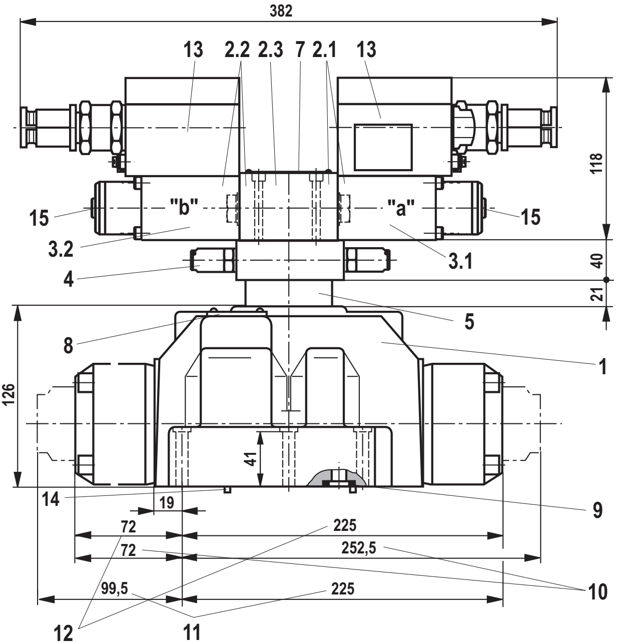
For reasons of stability, exclusively use the following valve mounting screws:

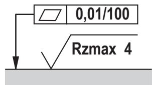
4 hexagon socket head cap screws
ISO 4762-M10x60-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)

2 hexagon socket head cap screws
ISO 4762-M6x60-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)

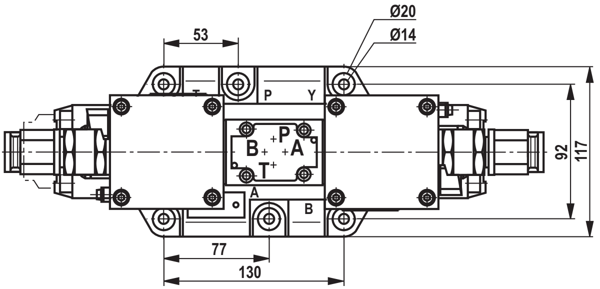
(must be ordered separately)

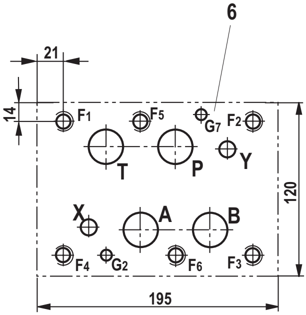
Device dimensions: Type H-4WEH 25… (dimensions in mm)





Required surface quality of the valve contact surface





Subplates

G 151/01 FE/ZN (G1)
G 154/01 FE/ZN (G1 1/4)
G 154/08 FE/ZN (flange)
G 156/01 FE/ZN (G1 1/2)

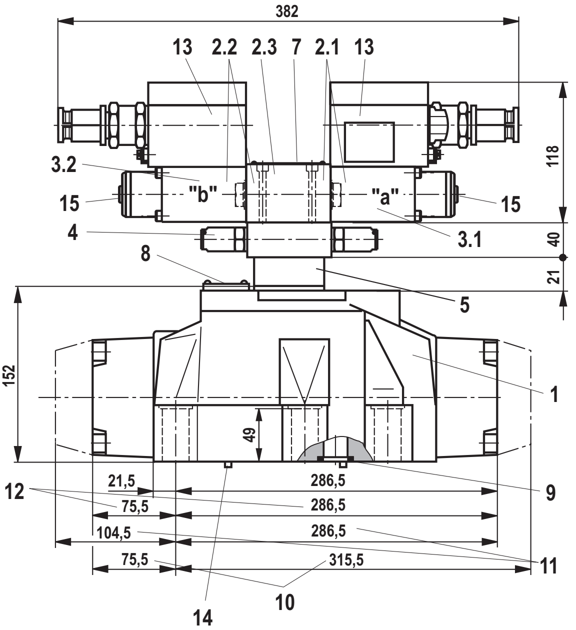
with dimensions as in the data sheet 45058 (must be ordered separately)

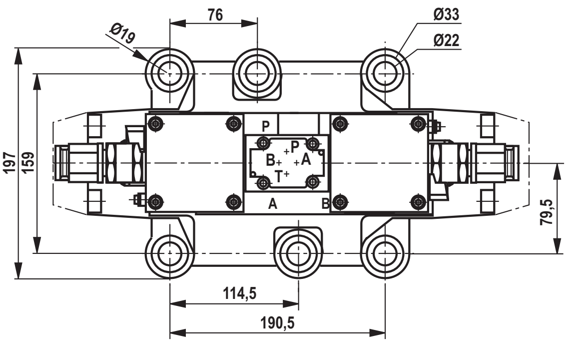
Item explanations and information on the subplates, see page 24

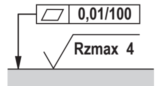
Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
6 hexagon socket head cap screws
ISO 4762-M12x60-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

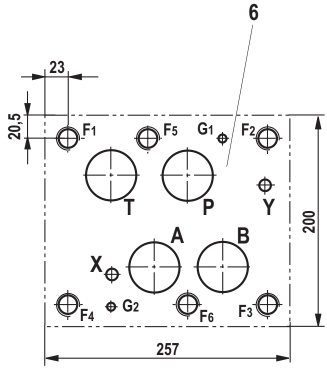
Device dimensions: Type H-4WEH 32… (dimensions in mm)







Required surface quality of the valve contact surface



Subplates

G 157/01 FE/ZN (G1 1/2)
G 157/02 FE/ZN (M48 x 2)
G 158/10 FE/ZN (flange)

with dimensions as in the data sheet 45060
(must be ordered separately)

Item explanations and information on the subplates, see page 24

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
6 hexagon socket head cap screws
ISO 4762-M20x80-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

Device dimensions: Item explanations and notice

Item explanations regarding the device dimensions on pages 20 to 23

1 Main valve

2 Pilot control valve type 4WE 6…XE according to technical data sheet 23178-XE-B2

2.1
- Pilot control valve type 4WE 6 D… (1 solenoid "a")
  For main valves with Control spools C, D, K, Z
  Control spool HC, HD, HK, HZ
- Pilot control valve type 4WE 6 JA... (1 solenoid "a")
  For main valves with control spools EA, FA, etc., spring return

2.2
- Pilot control valve type 4WE 6 Y... (1 solenoid "b")
  For main valves with Control spool Y
  Control spool HY
- Pilot control valve type 4WE 6 JB... (1 solenoid "b")
  For main valves with control spools EB, FB, etc., spring return

2.3
- Pilot control valve type 4WE 6J… (2 solenoids)
  For main valves with 3 spool positions, spring-centered

3.1 Valve solenoid "a"

3.2 Valve solenoid "b"

4 Switching time adjustment, optional

5 Pressure reducing valve, optional

6 Processed valve contact surface
Porting pattern according to:
DIN 24340-A10 and
ISO 4401-05-05-0-05 for size 10
DIN 24340-A16 and
ISO 4401-07-07-0-05 for size 16
DIN 24340-A25 and
ISO 4401-08-08-0-05 for size 25
DIN 24340-A32 and
ISO 4401-10-09-0-05 for size 32

7 Name plate for the pilot control valve

8 Name plate for the complete valve

9 R-rings/O-rings

10 2-spool position valves with spring end position in the main valve (C, D, K, Z)

11 2-spool position valves with spring end position in the main valve (Y)

12 3-spool position valves, spring-centered
2-spool position valves with hydraulic end position in the main valve

13 Terminal box

14 Locking pin

15 Manual override "N"

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

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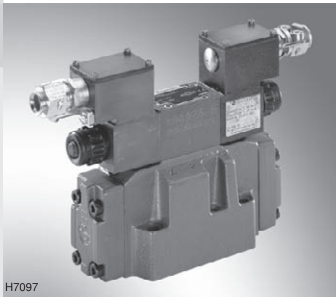
documentation@boschrexroth.de
www.boschrexroth.de

4/2 and 4/3 directional valves, internally pilot operated, externally pilot operated

RE 24751-XE-B2/09.13
Replaces: 01.10

Type H-4WEH…XE...

Sizes 10, 16, 25, 32
Component series 4X, 6X, 7X
Maximum operating pressure 350 bar
Maximum flow 1100 l/min



Actual product may differ

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
- Type of protection of the valve solenoid: Ex e mb IIC T4 Gb according to EN 60079-7:2007 / EN 60079-18:2009

Special features of seawater-resistant valves

- The external metal parts are galvanized or treated with an anti-corrosion agent.
- The conditional seawater-resistance is defined by "SO329" in the ordering code.

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 24751-XE-B0**
Part II	Data sheet 24751-XE-B2	
Part III	Product-specific instructions 24751-XE-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

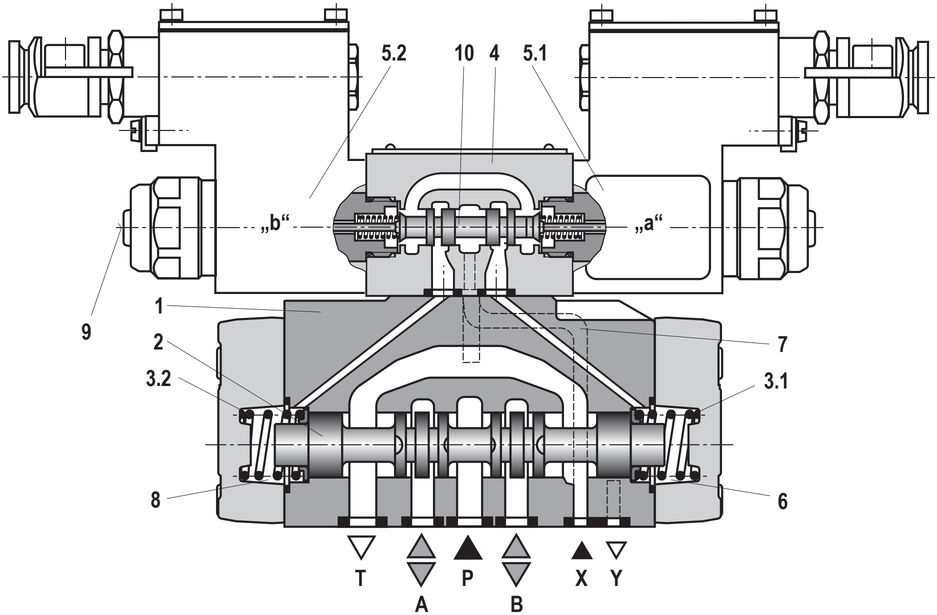
Table of contents

Features

– Valve to control the start, stop and direction of a flow, for proper use in explosive areas
– Electro-hydraulic actuation (WEH)
– For subplate mounting, porting pattern according to DIN 24340-A and ISO 4401, subplates available in FE/ZN version (see pages 20 to 23)
– Spring centering, spring end position or hydraulic end position
– Wet-pin DC or AC solenoids
– Solenoid coil can be rotated by 90°
– Manual override, optional
– Electrical connection as individual connection with cable gland
– Switching time adjustment, optional
– Preload valve in channel P of the main valve, optional

Function, section

Type H-4WEH 16…XE...



Directional valves type H-4WEH…

The valve type H-4WEH is a directional spool valve with electro-hydraulic actuation. It controls the start, stop and direction of a flow.

The directional valves basically consist of the main valve with housing (1), the main control spool (2), one or two return springs (3.1) and (3.2), as well as the pilot control valve (4) with one or two solenoids "a" (5.1) and/or "b" (5.2).

The main control spool (2) in the main valve is held in the zero or initial position by the springs or by means of pressurization. In the initial position, the two spring chambers (6) and (8) are connected with the tank in a depressurized form via the pilot control valve (4). The pilot control valve is supplied with pilot oil via the control line (7). Supply can be effected internally or externally (externally via port X).

Upon actuation of the pilot control valve, e.g. solenoid "a", the pilot control spool (10) is moved to the left and thus, the spring chamber (8) is pressurized with pilot pressure. The spring chamber (6) remains depressurized.

The pilot pressure acts on the left side of the main control spool (2) and moves it against the spring (3.1). This connects ports P with B and A with T in the main valve.

When the solenoid is switched off, the pilot control spool returns into the initial position (except for impulse spool). The spring chamber (8) is unloaded to the tank.

The pilot oil from the spring chamber is displaced into channel Y via the pilot control valve.

The pilot oil supply and return can be effected internally or externally.

The manual override (9) allows control spool (10) to be moved without solenoid energization.

Ordering code and scope of delivery

H – 4	WEH				/		6E			XE	

Up to 350 bar	**= H**
4-way version	**= 4**
Directional valve, electro-hydraulically actuated	**= WEH**
Size	
Size 10	**= 10**
Size 16	**= 16**
Size 25	**= 25**
Size 32	**= 32**
Control spool return main valve	
By means of springs	**= no code**
Hydraulically [1]	**= H**
For control spool symbols, see page 6	
Component series 40 to 49 – size 10 (40 to 49: Unchanged installation and connection dimensions)	**= 4X**
Component series 60 to 69 – size 25 (4W.H 25.) and size 32 (60 to 69: Unchanged installation and connection dimensions)	**= 6X**
Component series 70 to 79 – size 16 (70 to 79: Unchanged installation and connection dimensions)	**= 7X**
Control spool return in the pilot control valve with 2 spool positions and 2 solenoids **only** possible with control spool C, D, K, Z and hydraulic control spool return in the main valve:	
Without spring return	**= O**
Without spring return with detent	**= OF**
Pilot control valve with wet-pin solenoids High-power valve (RE 23178-XE-B2)	**= 6E**
Direct voltage 24 V	**= G24**
AC voltage 230, V 50/60 Hz	**= W230R**
For further ordering codes for other voltages, see page 14	
Without manual override	**= no code**
With manual override (standard)	**= N**
Explosion protection "increased safety" For details see information on the explosion protection, page 11	**= XE**
Pilot oil supply external, pilot oil return external [2]	**= no code**
Pilot oil supply internal, pilot oil return external [3]	**= E**
Pilot oil supply internal, pilot oil return internal [3]	**= ET**
Pilot oil supply external, pilot oil return internal [2]	**= T**

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in Part III

Explanation of the footnotes, see page 5

Ordering code and scope of delivery

	Z2					

Surface protection
- **SO329 =** Conditionally seawater-resistant
- **no code =** Standard

- **no code =** NBR seals
- **V =** FKM seals

(other seals upon request)

Important:
Observe compatibility of seals with hydraulic fluid used.

- **no code =** **Without** pressure reducing valve
- **D3 =** **With** pressure reducing valve [4]

Preload valve (not for size 10)
- **no code =** **Without** preload valve
- **P4,5 =** **With** preload valve ($p_ö$ = 4.5 bar)

Throttle insert
- **no code =** Without throttle insert
- **B08 =** Throttle Ø 0.8 mm
- **B10 =** Throttle Ø 1.0 mm
- **B12 =** Throttle Ø 1.2 mm
- **B15 =** Throttle Ø 1.5 mm

Electrical connection
- **Z2 =** Solenoid with terminal box and cable gland, for details see chapter Electrical connection

- **no code =** **Without** switching time adjustment
- **S =** Switching time adjustment as supply control
- **S2 =** Switching time adjustment as discharge control

[1] 2 spool positions (hydraulic end position): Only control spool C, D, K, Z, Y

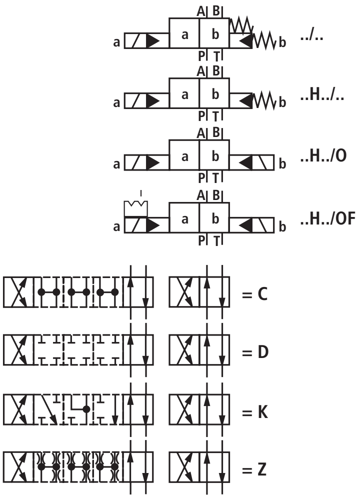
[2] Pilot oil supply X or pilot oil return Y external:
- Observe the maximum pilot pressure according to page 10.

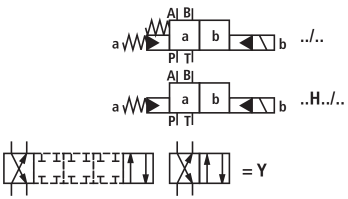
[3] Pilot oil supply internal (version "ET" and "E"):
- Observe the minimum pilot pressure according to page 10.
- In order to prevent inadmissibly high pressure peaks, a throttle insert "B10" has to be provided in port P of the pilot control valve (see page 9).
- You must moreover provide the pressure reducing valve "D3".

[4] Only in connection with throttle insert "B10"

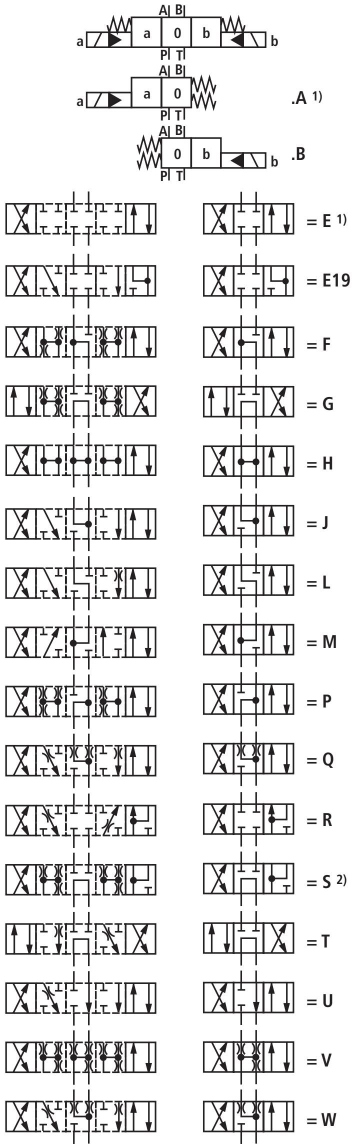
Control spool symbols

2 spool positions





3 spool positions

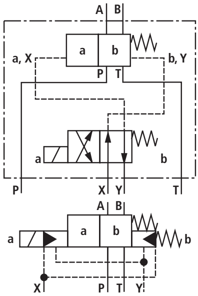
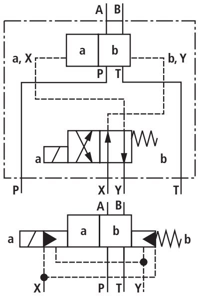
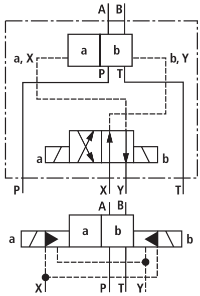
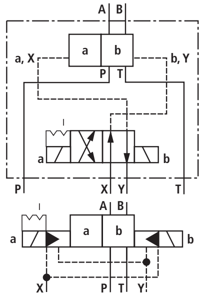
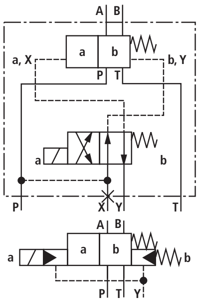
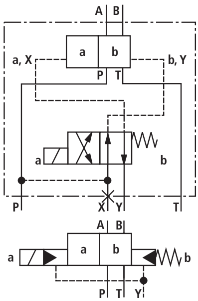
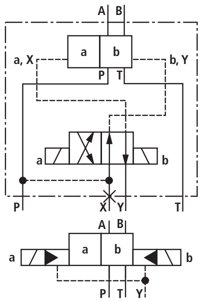
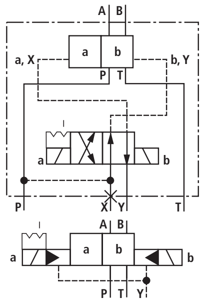


[1] Example: Control spool E with spool position "a"
Order example:
H-4WEH 16 **EA**7X/6EG24N9XEETSZ2B10..V..

[2] Control spool S only for size 16

Other control spool variants upon request

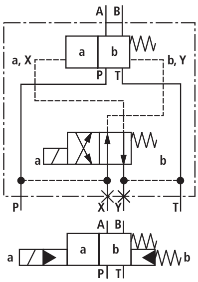
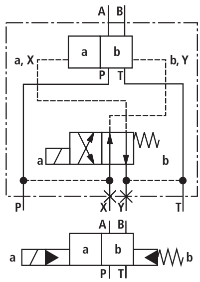
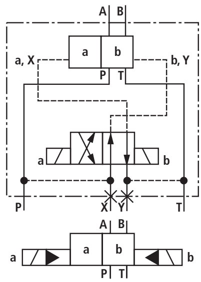
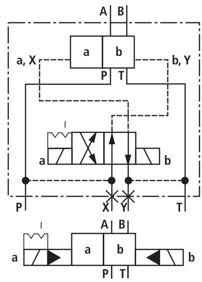
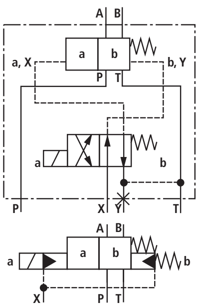
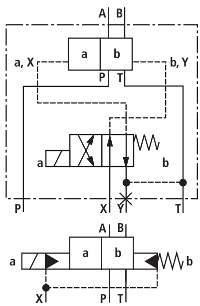
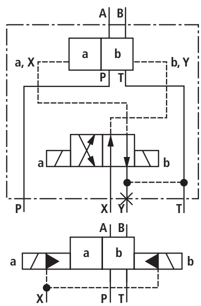
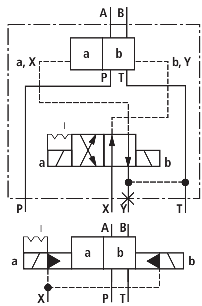
Control spool symbols for valves with 2 spool positions

	Valves with spring end position	Valves with hydraulic end position		
	Type H-4WEH.../...	Type H-4WEH..H.../...	Type H-4WEH..H.../O...	Type H-4WEH..H.../OF...
X = external **Y** = external				
	Type H-4WEH.../...E...	Type H-4WEH..H.../...E...	Type H-4WEH..H.../O...E...	Type H-4WEH..H.../OF...E...
X = internal **Y** = external				

Continued on the next page

Control spool symbols for valves with 2 spool positions

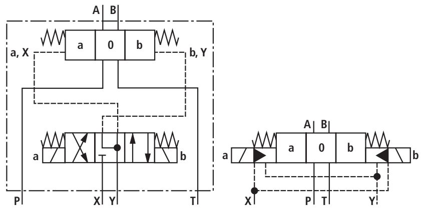
Continuation from previous page

	Valves with spring end position	Valves with hydraulic end position		
	Type H-4WEH.../...ET...	**Type H-4WEH..H.../...ET...**	**Type H-4WEH..H.../O...ET...**	**Type H-4WEH..H.../OF...ET...**
X = internal **Y** = internal				
	Type H-4WEH.../...T...	**Type H-4WEH..H.../...T...**	**Type H-4WEH..H.../O...T...**	**Type H-4WEH..H.../OF...T...**
X = external **Y** = internal				

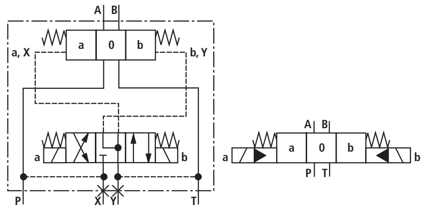
Control spool symbols for valves with 3 spool positions

Valves with spring-centered zero position

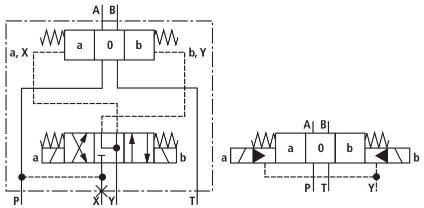
X = external Y = external — **Type H-4WEH.../...**



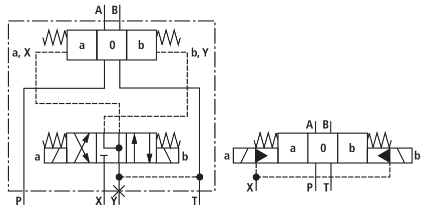
X = internal Y = internal — **Type H-4WEH.../...ET...**



X = internal Y = external — **Type H-4WEH.../...E...**



X = external Y = internal — **Type H-4WEH.../...T...**



Pilot oil supply

Type H-4WEH…

The pilot oil supply is effected **externally** via the X channel from a separate circuit.

The pilot oil return is effected **externally** via the Y channel into the tank.

Type H-4WEH…E…

The pilot oil supply is effected **internally** from the P channel of the main valve.

The pilot oil return is effected **externally** via the Y channel into the tank. In the subplate, port X is closed.

Type H-4WEH…ET…

The pilot oil supply is effected **internally** from the P channel of the main valve.

The pilot oil return is effected **internally** via the T channel into the tank. In the subplate, ports X and Y are closed.

Type H-4WEH…T…

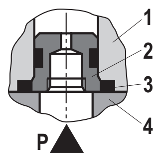
The pilot oil supply is effected **externally** via the X channel from a separate circuit.

The pilot oil return is effected **internally** via the T channel into the tank. In the subplate, port Y is closed.

Throttle insert

Use of the throttle insert (2) is necessary if the pilot oil supply in the P channel of the pilot control valve (1) is to be limited.

The throttle insert (2) is inserted in channel P of the pilot control valve (1).



1 Pilot control valve
2 Throttle insert
3 Seal ring
4 Main valve

3

Technical data

general

Installation position				Any; horizontal with valves with hydraulic control spool return "H" and control spool C, D, K, Z or Y			
Ambient temperature range			°C	–20 … +70 [1]			
Storage temperature range			°C	–20 ... +50			
Sizes			Size	**10**	**16**	**25**	**32**
Weight	Valve with one solenoid		kg	8.5	11	19	36.5
	Valve with two solenoids, spring-centered		kg	10.2	12.5	20.5	39
	Switching time adjustment		kg	0.8			
	Pressure reducing valve		kg	0.4			
Surface protection	Valve body	Pilot control valve		Galvanized coating			
		Main valve		Standard: Painting, layer thickness max. 100 μm SO329: Galvanically coated, Zn and passivated			
	Solenoid			Galvanized coating			

hydraulic

Sizes			Size	**10**	**16**	**25**	**32**
Maximum operating pressure							
	Ports P, A, B		bar	350			
	Port T	With pilot oil return Y external	bar	250			
		With pilot oil return Y internal	bar	210			
	Port Y	With pilot oil return external	bar	210			
Flow of the main valve			l/min	Up to 160	Up to 300	Up to 650	Up to 1100
Maximum pilot pressure			bar	250 (with a higher pilot pressure, use of a pressure reducing valve is required)			
Minimum pilot pressure – With pilot oil supply X external or internal (control spool D, K, E, E19, J, L, M, Q, R, U, W)							
	3-spool position valve, spring-centered		bar	10	14	13	8.5
	2-spool position valve, spring end position		bar	10	14	13	10
	2-spool position valve, hydraulic end position		bar	7	14	8	5
– With internal pilot oil supply (control spool C, F, H, P, T, V, Z, S [2])			bar	6.5 [3]	4.5 [4]	4.5 [4]	4.5 [4]
Pilot volume for switching process							
	3-spool position valve, spring-centered		cm^3	2.04	5.72	14.2	29.4
	2-spool position valve		cm^3	4.08	11.45	28.4	58.8
Pilot volume for shortest switching time			l/min	Approx. 35	Approx. 35	Approx. 35	Approx. 45
Hydraulic fluid				Mineral oil (HL, HLP) according to DIN 51524 [5], fast bio-degradable hydraulic fluids according to VDMA 24568 (see also RE 90221), HETG (rape seed oil) [5], HEPG (polyglycols) [6], HEES (synthetic esters) [6], flame-resistant hydraulic fluid HFC according to ISO 12922 [7], other hydraulic fluids on request Ignition temperature > 180 °C			
Hydraulic fluid temperature range			°C	–20 ... +80 (NBR seals)			
				–15 ... +80 (FKM seals)			
Viscosity range			mm^2/s	2.8 … 500			
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)				Class 20/18/15 [8]			

Footnotes, see page 11

Technical data

electric

Voltage type		Direct voltage	Alternating voltage
Available voltages	V	24, 48, 96, 110	110, 230
Voltage tolerance (nominal voltage)	%	±10	
Admissible residual ripple	%	< 5	–
Duty cycle/operating mode according to VDE 0580		S1 (continuous operation)	
Switching time according to ISO 6403		see page 12	
Switching frequency	1/h	Up to 15000	Up to 7200
Nominal power at ambient temperature 20 °C	W	17	
Maximum power with 1.1 x nominal voltage and ambient temperature 20 °C	W	20.6	
Protection class according to EN 60529		IP 66 [9)]	

Important:
Solenoids for AC voltage are DC solenoids with integrated rectifier

Information on the explosion protection

Area of application in accordance with the Explosion Protection Directive 94/9/EC		II 2G
Type of protection Valve		c (EN 13463-5:2011)
Maximum surface temperature [10)]	°C	135
Temperature class		T4
Type of protection Valve solenoid according to EN 60079-7:2007 / EN 60079-18:2009		Ex e mb IIC T4 Gb
Type examination certificate Solenoid		KEMA 02ATEX2240 X
"IECEx Certificate of Conformity" Solenoid		IECEx DEK 12.0068X
Ambient temperature range	°C	–20 … +70 [1)]

Special conditions for safe use	– In case of valves with two solenoids, maximally one of the solenoids may be energized at a time. – Simultaneously energizing several valves in bank assembly is possible if the ambient temperature does not exceed 60 °C. – In case of bank assembly, if only one of the solenoids is energized at a time, and during individual operation, the maximum ambient temperature may not exceed 70 °C. – The maximum temperature of the valve casing surface is 120 °C. This has to be considered when selecting the connection cable and contact of the connection cable with the casing surface is to be prevented.

1) Observe the "Special conditions for safe use" on page 11.

2) Control spool S only for size 16

3) For control spools C, F, G, H, P, T, V, Z, an internal pilot oil supply without preload valve is only possible if the flow from P → T in the central position (for 3-spool position valve) or while crossing the central position (for 2-spool position valve) is so large that the pressure differential of P → T reaches a value of at least 6.5 bar.

4) For control spools C, F, G, H, P, T, V, Z, S [1)] – by means of preload valve (not size 10) or correspondingly high flow.

4) Suitable for NBR **and** FKM seals

5) Suitable **only** for FKM seals

7) Only in connection with NBR seals, max. admissible pressure 210 bar, Δp < 15 bar, hydraulic fluid temperature max. 60 °C
More information is available from our sales staff.

8) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components.
For the selection of the filters see www.boschrexroth.com/filter.

9) With correctly installed electrical connection

10) Surface temperature > 50 °C, provide contact protection

Technical data

Switching times (= contacting at the pilot control valve until start of opening of the control edge in the main valve and change in the control spool stroke by 95 %)

Pilot pressure		bar	70	250	Spring
			ON		OFF
Size 10	without throttle insert	ms	50 ... 70	50 ... 70	30 ... 40
	with throttle insert	ms	70 ... 100	60 ... 80	30 ... 40
Size 16	without throttle insert	ms	60 ... 90	50 ... 70	60 ... 90
	with throttle insert	ms	120 ... 140	90 ... 110	60 ... 90
Size 25	without throttle insert	ms	80 ... 110	60 ... 80	110 ... 140
	with throttle insert	ms	210 ... 260	130 ... 160	110 ... 140
Size 32	without throttle insert	ms	90 ... 140	80 ... 110	150 ... 170
	with throttle insert	ms	430 ... 570	240 ... 360	150 ... 170

Important:

- The switching times are measured according to ISO 6403 with HLP46, ϑ_{oil}= 40 °C ± 5 °C.
  With different oil temperatures, deviations are possible.
- The switching times increase by approx. 30 ms if the pressure reducing valve "D3" is used.
- The switching times have been determined under ideal conditions and may differ in the system, depending on the application conditions.

Free flow cross-sections in zero position with control spools Q, V and W

Control spool **Q**	A – T, B – T	mm^2	13	32	78	83	78
Control spool **V**	A – T, B – T	mm^2	13	32	73	83	73
	P – A, P – B	mm^2	13	32	84	83	84
Control spool **W**	A – T, B – T	mm^2	2.4	6	10	14	20

Electrical connection

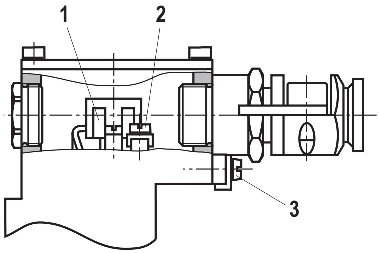
The type-examination tested valve solenoid of the valve is equipped with a terminal box and a type-tested cable gland.

The connection is polarity-independent.

Solenoids to be connected to AC voltage are equipped with an integrated rectifier.

Important

When establishing the electrical connection, the protective earthing conductor (PE ⏚) has to be connected properly.



Properties of the connection terminals

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 … 2.5 mm^2 Finely stranded 0.75 … 1.5 mm^2
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm^2 Finely stranded max. 1.5 mm^2
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm^2 Finely stranded 4 mm^2

3

Cable gland

Type approval		II 2G Ex e IIC Gb
Threaded connection		M20 x 1.5
Protection class according to EN 60529		IP66 [1)]
Line diameter	mm	9 … 11
Sealing		Outer sheath sealing

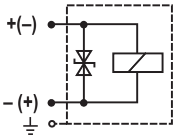
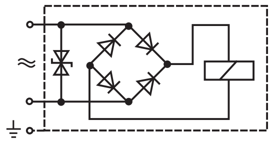
Connection line

Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–30 … > +110

[1)] If installed properly

Electrical connection

Circuit diagrams

Direct voltage, polarity-independent	Alternating voltage
	

Over-current fuse and switch-off voltage peaks

Important

Corresponding to the rated current, a fuse according to DIN 41571 and EN / IEC 60127 has to be connected ahead of every valve solenoid (max. 3 x I_{rated}).

The shut-off threshold of the fuse has to match the prospective short-circuit current of the supply source.

The prospective short-circuit current of the supply source may amount to a maximum of 1500 A.

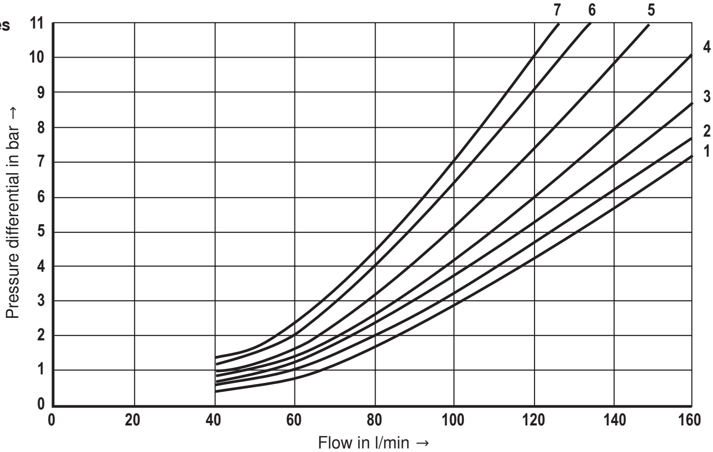
This fuse may only be installed outside the explosive area or must be of an explosion-proof design.

When inductivities are switched off, voltage peaks are the result which may cause faults in the connected control electronics. For this reason, the valve solenoids comprise an interference protection circuit which dampens this voltage peak to the voltage value shown in the table.

Voltage data in the valve type code	Nominal voltage valve solenoid	Rated current valve solenoid	Rated current external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Rated voltage of external miniature fuse: Medium time-lag (M) according to DIN 41571 and EN/IEC 60127	Maximum voltage value upon switch-off	Interference protection circuit
G24	24 V DC	0.708 A DC	800 mA	250 V	–90 V	Suppressor diode bi-directional
G48	48 V DC	0.354 A DC	400 mA	250 V	–200 V	
G96	96 V DC	0.177 A DC	200 mA	250 V	–370 V	
G110	110 V DC	0.155 A DC	200 mA	250 V	–390 V	
W110R	110 V AC	0.163 A AC	200 mA	250 V	–3 V	Bridge rectifier and suppressor diode
W230R	230 V AC	0.078 A AC	80 mA	250 V	–3 V	

Characteristic curves: Type H-4WEH 10… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δp - q_V characteristic curves



Characteristic curve selection

Control spool	Spool position				Control spool	Zero position		
	P – A	P – B	A – T	B – T		A – T	B – T	P – T
E, Y, D	2	2	4	5				
F	1	4	1	4	**F**	3	–	6
G, T	4	2	2	6	**G, T**	–	–	7
H, C	4	4	1	4	**H**	1	3	5
J, K	1	2	1	3				
L	2	3	1	4	**L**	3	–	–
M	4	4	3	4				
P	4	1	3	4	**P**	–	7	5
Q, V, W, Z	2	2	3	5				
R	2	2	3	–				
U	3	3	3	4	**U**	–	4	–

3

Performance limits: Type H-4WEH 10… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

2- and 3-spool position valves
Maximum flow q_V in l/min

Control spool	Operating pressure p_{max} in bar		
	200	**250**	**315**
E, J, L, M, Q, R, U, V, W, C, D, K, Z, Y	160	160	160
H	160	150	120
G, T	160	160	140
F, P	160	140	120

Important

The specified switching power limits are valid for operation with two directions of flow (e.g. from P → A and simultaneous return flow from B → T) in the ratio 1:1.

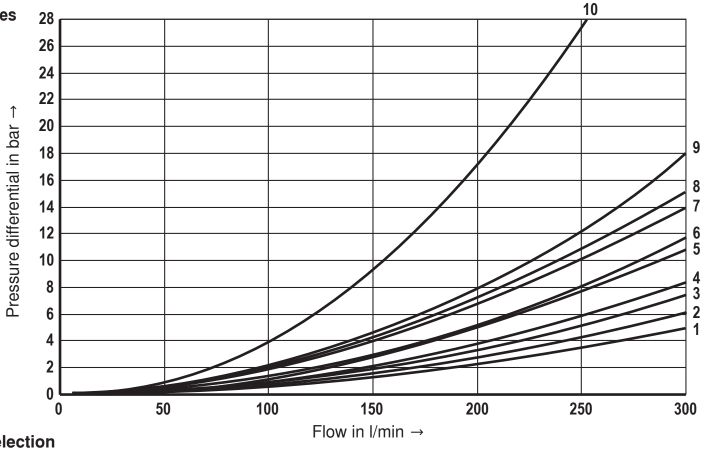
Due to the flow forces acting within the valves, the admissible switching power limit may be considerably lower with only one direction of flow (e.g. from P → A while port B is blocked or if there are simultaneous flows in different directions).

(In such cases, please consult us.)

The switching power limit was established while the solenoids were at operating temperature, at 10 % undervoltage and without tank preloading.

Characteristic curves: Type H-4WEH 16… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δp - q_V **characteristic curves**



Characteristic curve selection

Control spool	Spool position				
	P – A	P – B	A – T	B – T	P – T
E, Y, D	1	1	3	4	–
E19	–	6	8	7	–
F	1	1	5	4	–
G, T	4	1	5	5	9
H, C, Q, V, Z	1	1	5	6	–
J, K, L	1	1	5	6	–

Control spool	Spool position				
	P – A	P – B	A – T	B – T	P – T
M, W	1	1	3	4	–
R	1	1	3	–	–
U	2	2	3	5	–
S	3	3	3	–	10

Performance limits: Type H-4WEH 16… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

2-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar				
	70	140	210	280	350
X external, spring end position in the main valve (with $p_{St\ min}$ = 12 bar)					
C, D, K, Y, Z	300	300	300	300	300
X external, spring end position in the main valve [1)]					
C	300	300	300	300	300
D, Y	300	270	260	250	230
K	300	250	240	230	210
Z	300	260	190	180	160
X external, hydraulic end position in the main valve					
HC, HD, HK, HZ, HY	300	300	300	300	300

3-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar				
	70	140	210	280	350
X external, spring centering in the main valve					
E, E19, H, J, L, M, Q, U, W, R	300	300	300	300	300
F, P	300	250	180	170	150
G, T	300	300	240	210	190
S	300	300	300	250	220
V	300	250	210	200	180

Important

1) If the specified flow values are exceeded, the function of the return spring is no longer guaranteed if the pilot pressure fails.

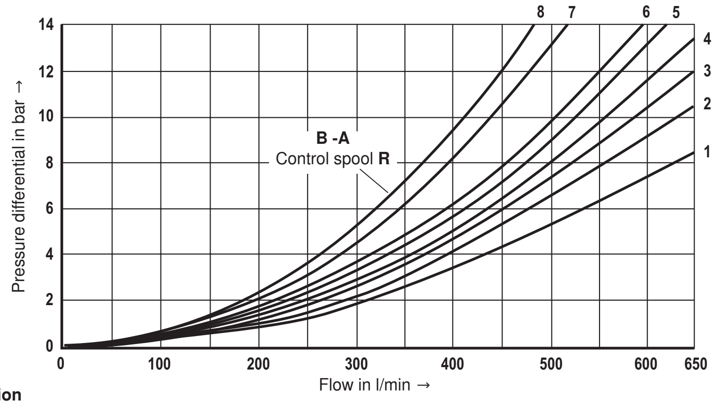
- With pilot oil supply **X internal,** you must always use a preload valve due to the negative overlap of the control spools F, G, H, P, T, S, C and HC.
- With control spools V, Z and HZ, the preload valve is **not** required for flows > 180 l/min.

Important

See also "**Important**" page 15

Characteristic curves: Type H-4WEH 25… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δp - q_V characteristic curves



7 Control spool **G** central position **P – T**

8 Control spool **T** central position **P – T**

Characteristic curve selection

Control spool	Spool position P – A	P – B	A – T	B – T
E	1	1	1	3
F	1	4	3	3
G	3	1	2	4
H	4	4	3	4
J, Q	2	2	3	5

Control spool	Spool position P – A	P – B	A – T	B – T
L	2	2	3	3
M	4	4	1	4
P	4	1	1	5
R	2	1	1	–

Control spool	Spool position P – A	P – B	A – T	B – T
U	4	1	1	6
V	2	4	3	6
W	1	1	1	3
T	3	1	2	4

Performance limits: Type H-4WEH 25**…** (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

2-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar: 70	140	210	280	350
X external, spring end position in the main valve (with $p_{St\ min}$ = 13 bar)					
C, D, K, Y, Z	700	700	700	700	650
X external, spring end position in the main valve [1]					
C	700	700	700	700	650
D, Y	700	650	400	350	300
K	700	650	420	370	320
Z	700	700	650	480	400
X external, hydraulic end position in the main valve					
HC, HD, HK, HZ, HY	700	700	700	700	700
HC../O.. HD../O.. HK../O.. HZ../O..	700	700	700	700	700
HC../OF.. HD../OF.. HK../OF.. HZ../OF..	700	700	700	700	700

Important

See also "**Important**" page 15

3-spool position valve
Maximum flows q_V in l/min

Control spool	Operating pressure p_{max} in bar: 70	140	210	280	350
X external, spring centering in the main valve					
E, L, M, Q, U, W,	700	700	700	700	650
G, T	400	400	400	400	400
F	650	550	430	330	300
H	700	650	550	400	360
J	700	700	650	600	520
P	650	550	430	330	300
V	650	550	400	350	310
R	700	700	700	650	580

Important

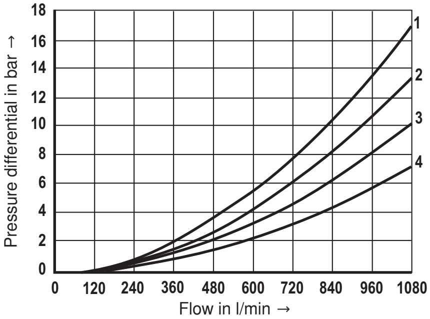
[1] If the specified flow values are exceeded, the function of the return spring is no longer guaranteed if the pilot pressure fails.

- With pilot oil supply **X internal,** a preload valve has to be used for flows < 180 l/min due to the negative overlap of the control spools Z, HZ and V.
- With pilot oil supply **X internal,** you must always use a preload valve due to the negative overlap of the control spools C, HC, F, G, H, P and T.

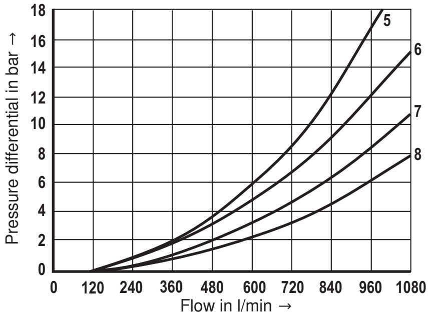
3

Characteristic curves: Type H-4WEH 32… (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

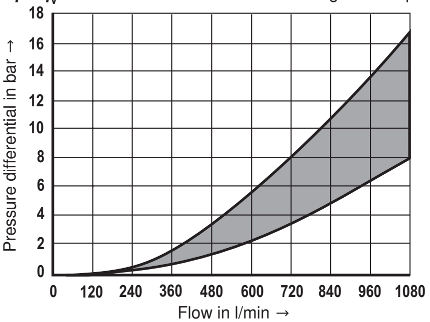
Δ***p*** **-** q_V **characteristic curves** – control spools **E, R** and **W**



Δ***p*** **-** q_V **characteristic curves** – control spools **G** and **T**



Δ***p*** **-** q_V **characteristic curves** – all remaining control spools



Control spool	**Spool position**				
	P – A	**P – B**	**A – T**	**B – T**	**B – A**
E	4	4	3	2	–
R	4	4	3	–	1
W	4	4	3	2	–

Control spool	**Spool position**				
	P – A	**P – B**	**A – T**	**B – T**	**P – T**
G	7	8	7	5	6
T	7	8	7	5	6

Performance limits: Type H-4WEH 32**…** (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

2-spool position valve
Maximum flows q_V in l/min

Control spool	**Operating pressure p_{max} in bar**				
	70	**140**	**210**	**280**	**350**
X external, spring end position in the main valve (with $p_{St\ min}$ = 10 bar)					
C, D, K, Y, Z	1100	1040	860	750	680
X external, spring end position in the main valve [1)]					
C	1100	1040	860	800	700
D, Y	1100	1040	540	480	420
K	1100	1040	860	500	450
Z	1100	1040	860	700	650
X external, hydraulic end position in the main valve					
HC, HD, HK, HZ, HY	1100	1040	860	750	680

Important
See also "**Important**" page 15

3-spool position valve
Maximum flows q_V in l/min

Control spool	**Operating pressure p_{max} in bar**				
	70	**140**	**210**	**280**	**350**
X external, spring centering in the main valve					
E, J, L, M, Q, U, W, R	1100	1040	860	750	680
G, T, H, F, P	900	900	800	650	450
V	1100	1000	680	500	450

Important

[1)] If the specified flow values are exceeded, the function of the return spring is no longer guaranteed if the pilot pressure fails.

- With pilot oil supply **X internal**, a preload valve has to be used for flows < 180 l/min due to the negative overlap of the control spools Z, HZ and V.
- With pilot oil supply **X internal,** you must always use a preload valve due to the negative overlap of the control spools C, HC, F, G, H, P and T.

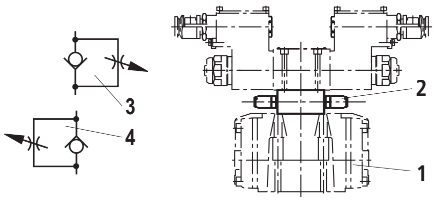
Switching time adjustment, pressure reducing valve, preload valve

Switching time adjustment "S/S2"

The switching time of the main valve (1) is influenced by using a twin throttle check valve (2), type Z2FS 6.

Symbol (3) shows the switching time adjustment "S" (supply control), symbol (4) shows the switching time adjustment "S2" (discharge control)

Type H-4WEH 10 ..4X/…S or S2

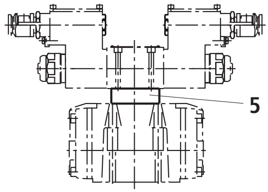


Pressure reducing valve "D3"

With the design internal pilot oil supply (ET or E) or external pilot oil supply and a pilot pressure of more than 250 bar, the valve must be ordered with a pressure reducing valve (5), type ZDR6PO, **and** a throttle insert "B10".

Ordering code: "B10..D3"

Type H-4WEH 10 ..4X/…/..D3



Preload valve "P4,5" (not for size 10)

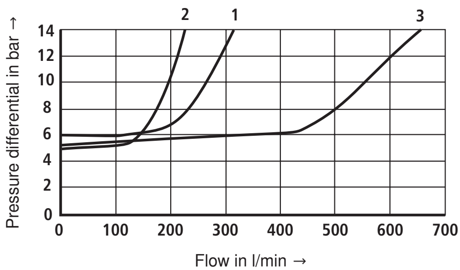
In case of valves with depressurized circulation and internal pilot oil supply, a preload valve is required in the P channel of the main valve in order to build up the minimum pilot pressure.

Ordering code: "P4,5"

The pressure differential of the preload valve is to be added to the pressure differential of the main valve (see characteristic curves) to result in one total value.

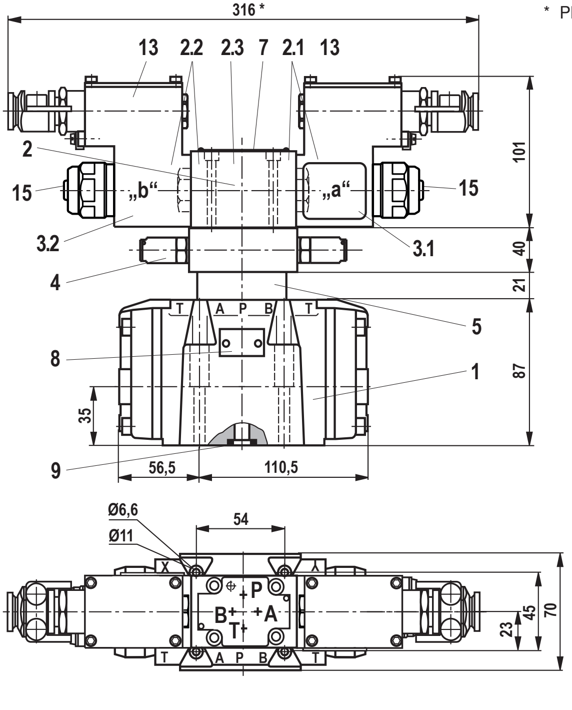
The cracking pressure amounts to approx. 4.5 bar.

Δp–q_V characteristic curve
(measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

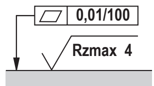


1 = size 16 2 = size 25 3 = size 32

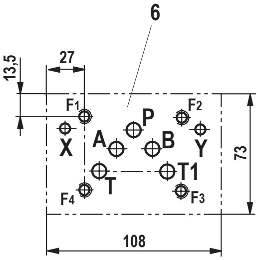
Dimensions: Type H-4WEH 10… (dimensions in mm)



* Plus 2 x 80 mm for detaching the solenoid coils



Required surface quality of the valve contact surface



Subplates

- **without** ports X, Y G 534/01 FE/ZN (G3/4)
- **with** ports X, Y G 535/01 FE/ZN (G3/4)
  G 536/01 FE/ZN (G1)

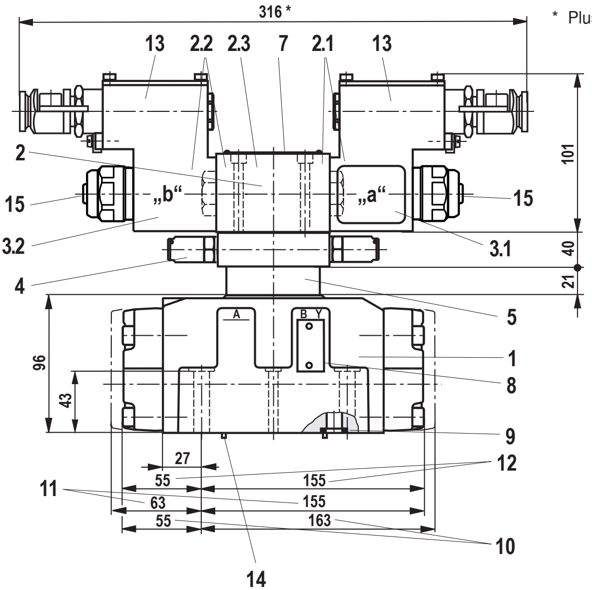
with dimensions as in the data sheet 45054
(must be ordered separately)

Item explanations and information on the subplates, see page 24

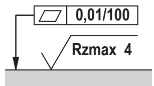
Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x45-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

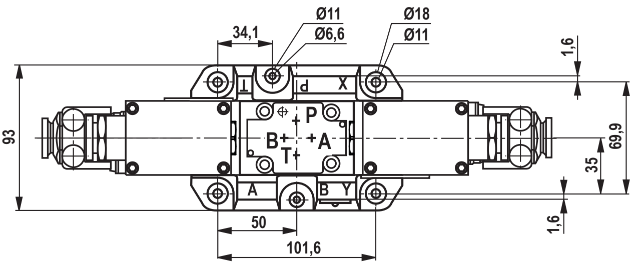
Dimensions: Type H-4WEH 16… (dimensions in mm)

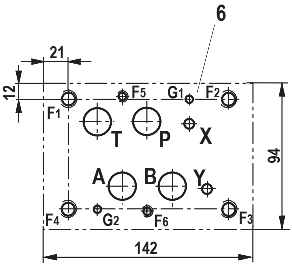


* Plus 2 x 80 mm for detaching the solenoid coils



Required surface quality of the valve contact surface





Subplates

G 172/01 FE/ZN (G3/4)
G 172/02 FE/ZN (M27 x 2)
G 174/01 FE/ZN (G1)
G 174/02 FE/ZN (M33 x 2)
G 174/08 FE/ZN (flange)

with dimensions as in the data sheet 45056 (must be ordered separately)

Item explanations and information on the subplates, see page 24

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:

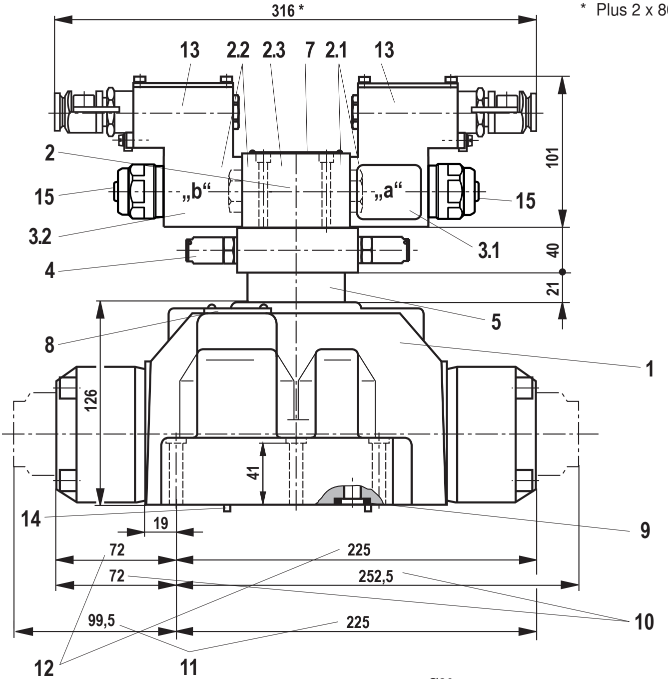
4 hexagon socket head cap screws
ISO 4762-M10x60-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)

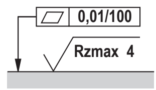
2 hexagon socket head cap screws
ISO 4762-M6x60-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)

(must be ordered separately)

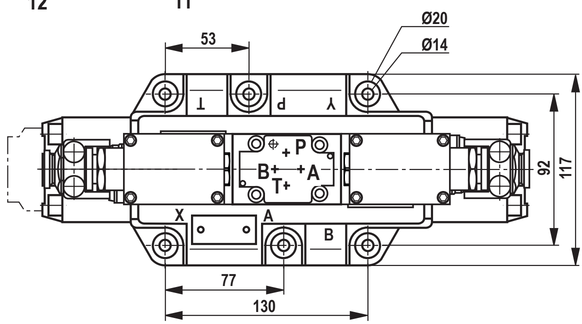
Dimensions: Type H-4WEH 25… (dimensions in mm)

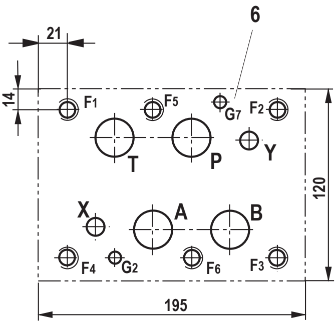
* Plus 2 x 80 mm for detaching the solenoid coils





Required surface quality of the valve contact surface





Subplates

G 151/01 FE/ZN (G1)
G 154/01 FE/ZN (G1 1/4)
G 154/08 FE/ZN (flange)
G 156/01 FE/ZN (G1 1/2)

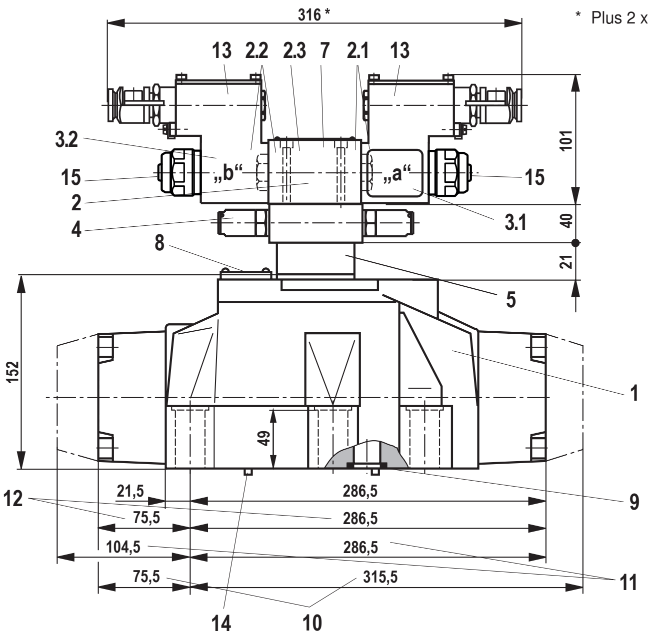
with dimensions as in the data sheet 45058
(must be ordered separately)

Item explanations and information on the subplates, see page 24

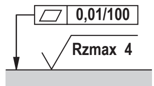
Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
6 hexagon socket head cap screws
ISO 4762-M12x60-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

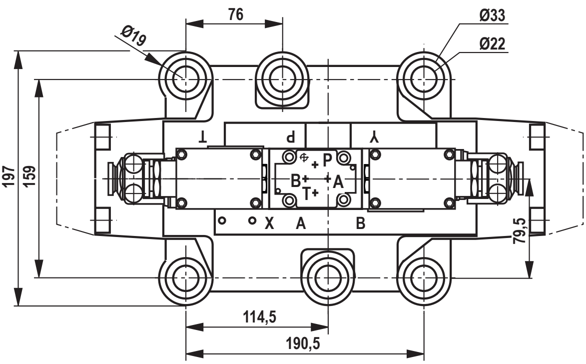
Dimensions: Type H-4WEH 32… (dimensions in mm)

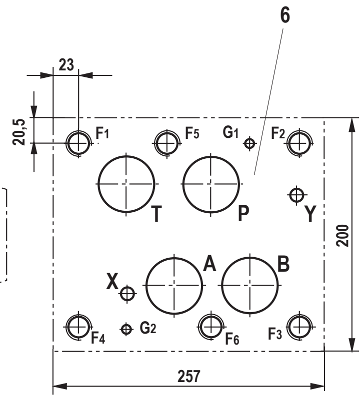


* Plus 2 x 80 mm for detaching the solenoid coils



Required surface quality of the valve contact surface





Subplates

G 157/01 FE/ZN (G1 1/2)
G 157/02 FE/ZN (M48 x 2)
G 158/10 FE/ZN (flange)

with dimensions as in the data sheet 45060
(must be ordered separately)

Item explanations and information on the subplates, see page 24

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
6 hexagon socket head cap screws
ISO 4762-M20x80-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

Dimensions: Item explanations and notice

Item explanations regarding the unit dimensions on pages 20 to 23

1 Main valve

2 Pilot control valve type 4WE 6…XE according to data sheet 23178-XE-B2

2.1
- Pilot control valve type 4WE 6 D… (1 solenoid "a") for main valves with Control spools C, D, K, Z; Control spool HC, HD, HK, HZ
- Pilot control valve type 4WE 6 JA... (1 solenoid "a") for main valves with control spools EA, FA, etc., spring return

2.2
- Pilot control valve type 4WE 6 Y... (1 solenoid "b") for main valves with Control spool Y; Control spool HY
- Pilot control valve type 4WE 6 JB... (1 solenoid "b") for main valves with control spools EB, FB, etc., spring return

2.3
- Pilot control valve type 4WE 6J… (2 solenoids) for main valves with 3 spool positions, spring-centered

3.1 Valve solenoid "a"

3.2 Valve solenoid "b"

4 Switching time adjustment, optional

5 Pressure reducing valve, optional

6 Machined valve contact surface

Porting pattern according to:
DIN 24340-A10 and
ISO 4401-05-05-0-05 for size 10

DIN 24340-A16 and
ISO 4401-07-07-0-05 for size 16

DIN 24340-A25 and
ISO 4401-08-08-0-05 for size 25

DIN 24340-A32 and
ISO 4401-10-09-0-05 for size 32

7 Name plate for the pilot control valve

8 Name plate for the complete valve

9 R-rings/O-rings

10 2-spool position valves with spring end position in the main valve (C, D, K, Z)

11 2-spool position valves with spring end position in the main valve (Y)

12 3-spool position valves, spring-centered
2-spool position valves with hydraulic end position in the main valve

13 Terminal box

14 Locking pin

15 Manual override, optional

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

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Pressure-reducing valves, directly operated

RE 26564-XC-B2/06.09
Replaces: 12.05

Types DR 6 DP...XC and ZDR 6 D...XC

H7389

Nominal size 6
Unit series 5X (DR 6...) and 4X (ZDR 6...)
Maximum operating pressure, primary 315 bar (DR 6... and ZDR 6...)
Maximum flow rates 60 l/min (DR 6...) and 50 l/min (ZDR 6...)

ATEX units
For potentially explosive atmospheres

Part II Technical Data Sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive and type of protection

– Range of application as per Directive 94/9/EG **IM2, II2G**
– Type of protection of valve: c (EN 13463-5:2004-03)

What you need to know about these Operating Instructions

These Operating Instructions apply to the explosion-proof version of Rexroth valves, and consist of the following three parts:

Part I	General Information RE 07010-X-B1	**RE 26564-XC-B0**
Part II	Technical Data Sheet RE 26564-XC-B2	
Part III	Product-specific Instructions RE 26564-XC-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication “General Product Information on Hydraulic Products”, RE 07008.

Overview of Contents

Features

– For subplate mounting type Typ DR6DP...XC
- Position of ports to DIN 24340-A6 (standard) and ISO 4401-03-02-0-05
- 5 pressure stages
- Setting element in the form of a rotary knob
- Optional non-return valve, see ordering data

– As modular valve type Typ ZDR6DP...XC
- Position of ports to DIN 24340-A6, **without** locating bore (standard) and ISO 4401-03-02-0-05 **with** locating bore (order code .../**60**)
- 4 pressure stages
- Setting element in the form of a rotary knob
- Optional non-return valve, see ordering data

Ordering data and scope of delivery

DR 6 DP	1	– 5X /		Y		XC	V

Directly operated pressure-reducing valve, nominal size 6, as subplate-mounted valve

Setting element

Rotary knob = **1**

Unit series 50 to 59 = **5X**
(50 to 59: installation and connection dimensions unchanged)

Maximum secondary pressure

25 bar	= **25**
75 bar	= **75**
150 bar	= **150**
210 bar	= **210**
315 bar [1]	= **315**

Y = Internal control oil supply
External leakage oil return

No code = With non-return valve
M = Without non-return valve

XC = Valve in explosion-proof design, see information on explosion protection, page 6, for details

V = FKM seals
Note:
Take compatibility of seals and pressure fluid into account!

[1] **Without** non-return valve

Included in scope of delivery:

Valve operating instructions with Declaration of Conformity in Part III

ZDR 6 D		1	– 4X /		Y		XC		

Directly operated pressure-reducing valve, nominal size 6, as modular valve

Pressure reduction

in channel A2	= **A**
in channel B2 [1] [2]	= **B**
in channel P1 [1] [2]	= **P**

Setting element

Rotary knob = **1**

Unit series 40 to 49 = **4X**
(40 to 49: installation and connection dimensions unchanged)

Maximum secondary pressure

25 bar	= **25**
75 bar	= **75**
150 bar	= **150**
210 bar	= **210**

Y = Internal control oil supply
External leakage oil return

No code = With non-return valve (only possible with pressure reduction in channel A2)
M = Without non-return valve

XC = Valve in explosion-proof design, see information on explosion protection, page 6, for details

No code = NBR-seals
V = FKM-seals
Note:
Take compatibility of seals and pressure fluid into account!

No code = Without locating bore
/60 = With locating bore

[1] **Without** non-return valve

[2] See functional description of „DP“ and „DB“ versions on page 5

Included in scope of delivery:

Valve operating instructions with Declaration of Conformity in Part III

Function, sectional diagram, DR 6 DP...XC

The DR 6 DP…XC type valve is a directly operated pressure-reducing valve in subplate-mounted design. It is a 3-way version, i.e. it limits the pressure of the secondary circuit.

It is used to reduce system pressure.

The secondary pressure is set by means of the setting element (4).

In the initial position, the valve is open. Pressure fluid can flow from channel P to channel A unimpeded. The pilot line (6) also makes the pressure in channel A available to the piston surface area opposite the compression spring (3). If the pressure in channel A exceeds the value set at the compression spring (3), the control piston (2) moves into the control position and keeps the set pressure in channel A at a constant level.

The control signal and control oil arrive internally from channel A via the pilot line (6).

If the pressure in channel A continues to increase due to external forces being exerted on the load, the control piston (2) is pushed even harder against the compression spring (3).

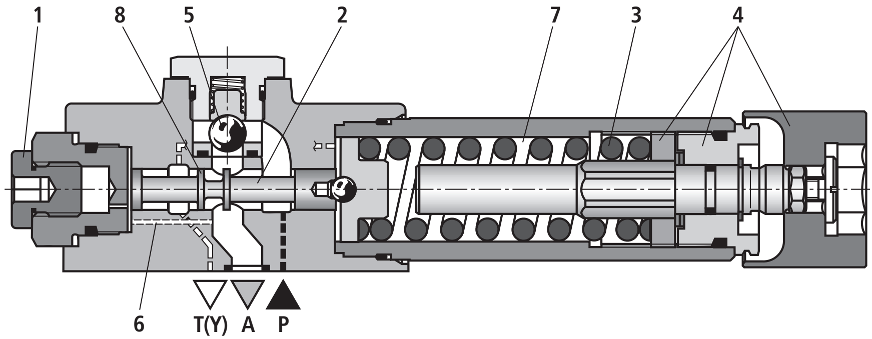
This causes channel A to be connected to the tank via the metering edge (8) on the control piston (2). In this way, the amount of pressure fluid that flows to the tank ensures that the pressure cannot rise any further.

The leakage oil from the spring chamber (7) is always returned externally via channel T (Y).

An optional non-return valve (5) may be installed to ensure a free return flow from channel A to channel P.

A gage connection (1) enables the secondary pressure to be monitored (see page 9 for connection dimensions).

Type DR 6 DP1-5X/...XCYV

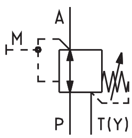


Symbols, DR 6 DP...XC

"YM" version

Internal control oil supply
External leakage oil return

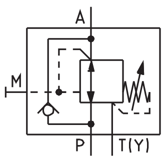
Without non-return valve



"Y" version

Internal control oil supply
External leakage oil return

With non-return valve



Function, sectional diagram, ZDR 6 D...XC

The ZDR 6 D…XC type valve is a directly operated pressure-reducing valve in modular design. It is a 3-way version, i.e. it limits the pressure of the secondary circuit.

It is used to reduce system pressure. The pressure-reducing valve basically consists of a housing (1), a control piston (2), a compression spring (3), a setting element (4) and an optional non-return valve.
The secondary pressure is set by means of the setting element (4).

"DA" version
In the initial position, the valve is open. Pressure fluid can flow from channel A1 to channel A2 unimpeded. The pilot line (5) also makes the pressure in channel A2 available to the piston surface area opposite the compression spring (3). If the pressure in channel A2 exceeds the value set at the compression spring (3), the control piston (2) moves into the control position and keeps the set pressure in channel A2 at a constant level. The control signal and control oil arrive internally from channel A2 via the pilot line (5).
If the pressure in channel A2 continues to increase due to external forces being exerted on the load, the control piston (2) is pushed even harder against the compression spring (3). This causes channel A2 to be connected to the tank via the metering edge (9) on the control piston (2). In this way, the amount of pressure fluid that flows to the tank ensures that the pressure cannot rise any further. The leakage oil from the spring chamber (7) is always returned externally to channel T(Y) via the bore (6). A gage connection (8) enables the secondary pressure to be monitored (see page 10 for connection dimensions).
A non-return valve to ensure a free flow from channel A2 to A1 can only be inserted in the "DA" version

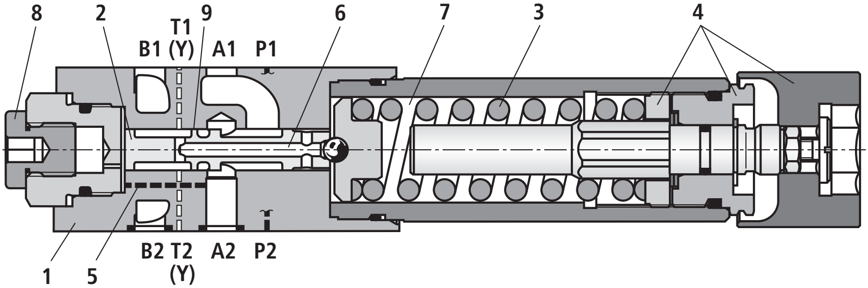
"DP" and "DB" versions
In the DP version, the pressure is reduced in channel P1. The control signal and control oil come internally from channel P1.

In the DB version, the pressure in channel P1 is reduced, but the control oil is derived internally from channel B.

Note:
In the DB version, care must be taken to ensure that the pressure in channel B does not exceed the set pressure when the directional control valve is in the P to A switching position. Otherwise, the pressure will be reduced in channel A.

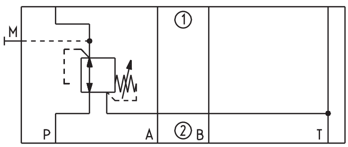
3

Type ZDR 6 DA1-4X/...XCYM

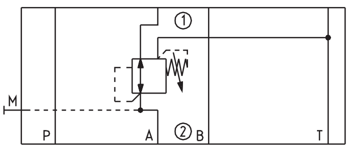


Symbols, ZDR 6 D...XC

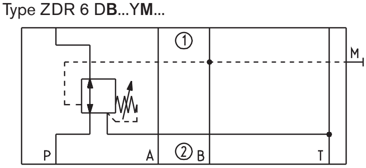
Type ZDR 6 D**P**...**YM**...



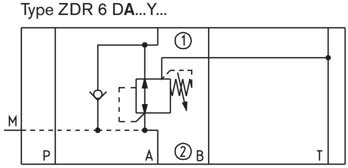
Type ZDR 6 D**A**...**YM**...



Type ZDR 6 D**B**...**YM**...



Type ZDR 6 D**A**...Y...



Technical data

General

Installation position		Optional
Ambient temperature range	°C	–20 … +80 (FKM-seals) –30 … +80 (NBR-seals)
Storage temperature range	°C	–20 … +80 (FKM-seals) –30 … +80 (NBR-seals)
Weight	kg	1.2
Surface protection	Standard	Paint, layer thickness max. 100 µm

Hydraulic

Valve type		DR 6 DP...XC	ZDR 6 D...XC
Maximum operating pressure, primary	bar	315	315
Maximum secondary pressure [1]	bar	25 / 75 / 150 / 210 / 315	25 / 75 / 150 / 210
Maximum counter pressure Port T(Y)	bar	50	160
Maximum flow rate	l/min	60	50
Pressure fluid		Mineral oil (HL, HLP) to DIN 51524 other pressure fluids available on request Ignition temperature > 180 °C	
Pressure fluid temperature range	°C	–20 … +80 (FKM-seals) –30 … +80 (NBR-seals)	
Viscosity range	mm^2/s	10 … 800	
Maximum permissible degree of contamination of pressure fluid Purity class to ISO 4406 (c)		Class 20/18/15 [2]	

Information on explosion protection

Range of application as per Directive 94/9/EG		IM2, II2G
Type of protection of valve		c (EN 13463-5:2004-03)
Maximum surface temperature [3]	°C	125
Temperature class		T4

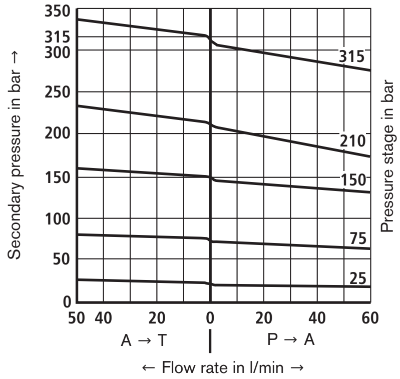
[1] In order to prevent the maximum permitted secondary pressure from being exceeded, it must be checked with a suitable measuring instrument if it is altered.

[2] The purity classes stated for the components must be complied with in hydraulic systems. Effective filtration prevents problems and also extends the service life of components. For a selection of filters, see Technical Data Sheets RE 50070, RE 50076 and RE 50081.

[3] As high surface temperatures may occur, European standards ISO 13732-1 and EN 982 on the prevention of accidental contact must be observed.

Characteristic curves, DR 6 DP...XC (measured with HLP46, $\vartheta_{oil} = 40\ °C \pm 5\ °C$)

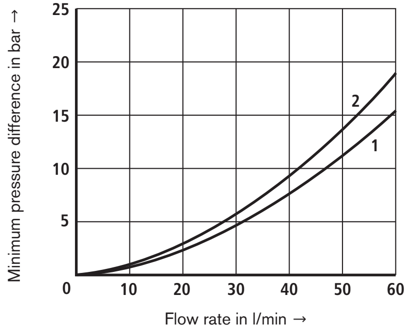
p_A - q_V curves



Note:
When the pressure is set lower, the curve shape still corresponds to the pressure stage

The curves for the pressure relief function apply to an initial pressure of 0 in the overall flow range!

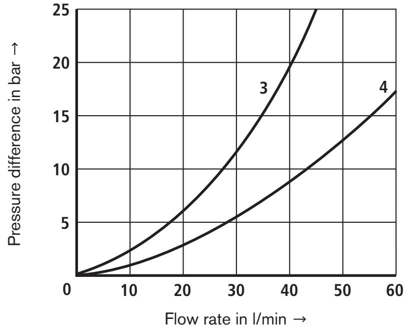
Δp_{min} - q_V curves



1 Minimum pressure difference Δp_{min} with flow P → A

2 Minimum pressure difference Δp_{min} with flow A → T (Y)

Δp - q_V curves



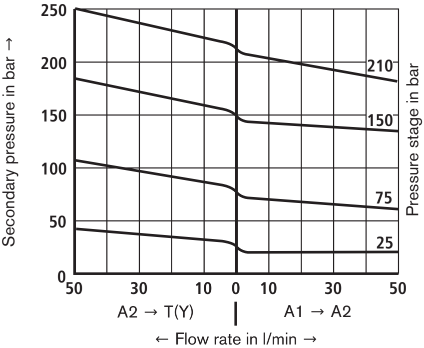
3 Pressure difference Δp with flow via non-return valve only

4 Pressure difference Δp with flow via non-return valve and fully open control cross-section

Characteristic curves, ZDR 6 D...XC (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

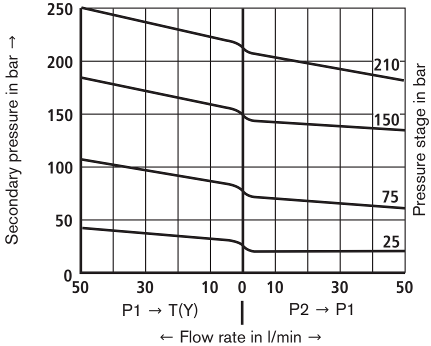
Type ZDR 6 DA...

p_A - q_V curves



Types ZDR 6 DP... and ZDR 6 DB...

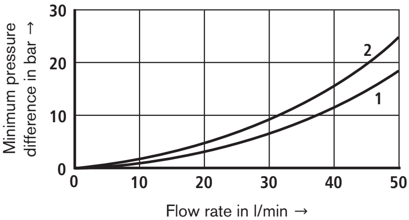
p_A - q_V curves



When the pressure is set lower, the curve shape still corresponds to the pressure stage.

The curves for the pressure relief function apply to an initial pressure of 0 in the overall flow range!

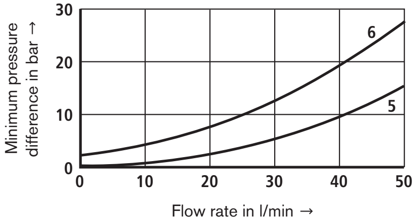
Δp_{min} - q_V curves



1 Minimum pressure difference Δp_{min} with flow A1 → A2

2 Minimum pressure difference Δp_{min} with flow A2 → T (Y) (3rd way)

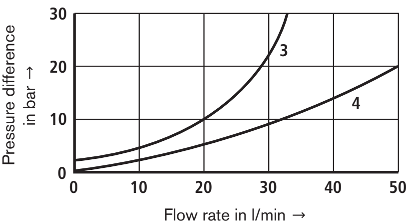
Δp_{min} - q_V curves



5 Minimum pressure difference Δp_{min} with flow P2 → P1

6 Minimum pressure difference Δp_{min} with flow P1 → T (Y) (3rd way)

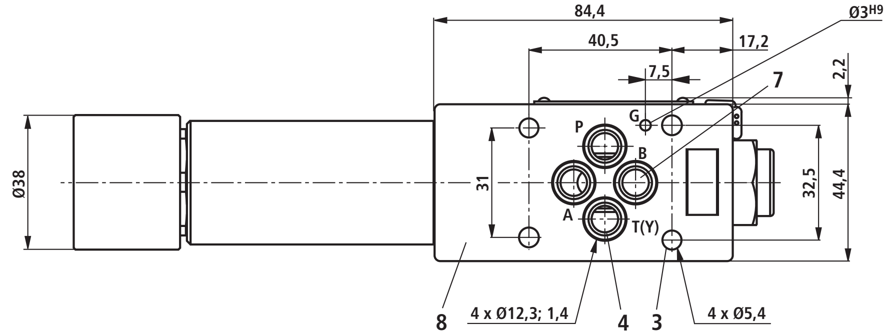
Δp - q_V curves

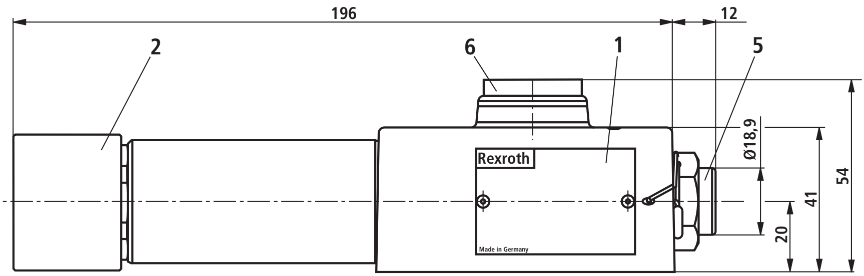


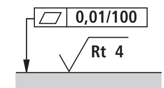
3 Pressure difference Δp with flow A2 → A1 via non-return valve only

4 Pressure difference Δp with flow A2 → A1 via non-return valve and fully open control cross-section

Unit dimensions, DR 6 DP...XC (in mm)







Required surface quality
of mating component

1 Nameplate

2 Setting element „1“, additionally with hexagon socket SW19 for manual override

3 Valve mounting bores

4 Same seals for ports A, B, P and T (Y)

5 Gage connection G1/4, 12 deep, hexagon socket SW6

6 With non-return valve

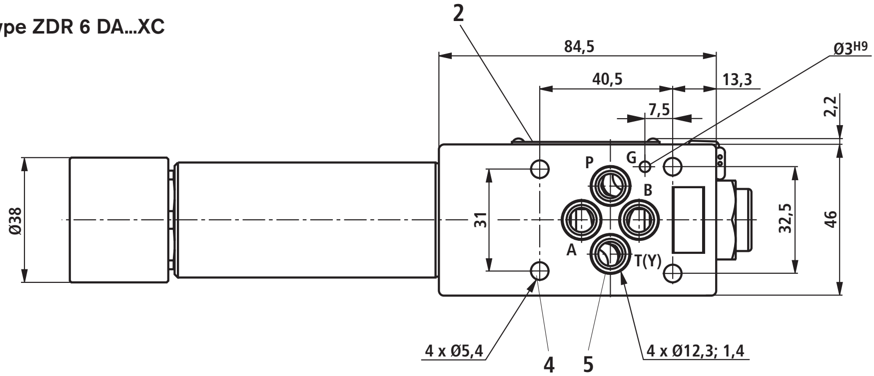
7 Port B without function

8 Position of ports to DIN 24340-A6, **without** locating bore (standard)
Position of ports to ISO 4401-03-02-0-05, **with** locating bore

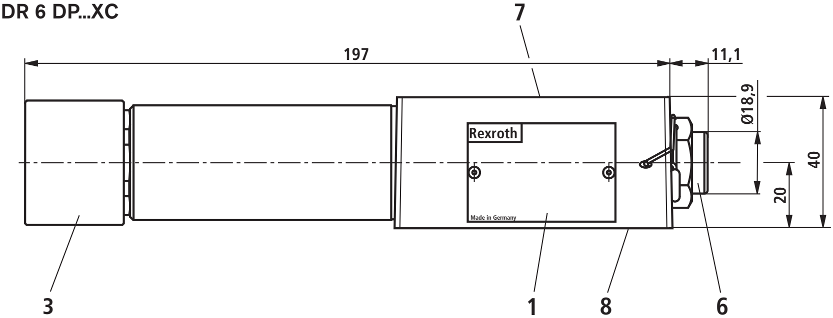
Valve fastening bolts
In order to ensure a secure connection, use only the following valve fastening bolts:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(coefficient of friction 0.09-0.14 to VDA 235-101)
(must be ordered separately, also see RE 26564-XC-B3, section 9.1, Available accessories)

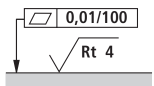
Unit dimensions, ZDR 6 D...XC (in mm)

Type ZDR 6 DA...XC



Type ZDR 6 DB...XC and
Type ZDR 6 DP...XC





Required surface quality of mating component

1. **1** Nameplate, ZDR 6 DB… or ZDR 6 DP...
2. **2** Nameplate, ZDR 6 DA...
3. **3** Setting element “1“, additionally with hexagon socket SW19 for manual override
4. **4** Valve mounting bores
5. **5** Same seals for ports A, B, P, T (Y)
6. **6** Gage connection G1/4, 12 deep, hexagon socket SW6
7. **7** Position of ports to ISO 4401-03-02-0-05, **with** locating bore

   Position of ports to DIN 24340-A6, **without** locating bore (standard)
8. **8** Position of ports to ISO 4401-03-02-0-05, **with** locating bore

Valve fastening bolts
In order to ensure a secure connection, use only the following valve fastening bolts:
4 hexagon socket head cap screws
ISO 4762-M5x...-10.9-flZn-240h-L
(coefficient of friction 0.09-0.14 to VDA 235-101)
(must be ordered separately, also see RE 26564-XC-B3, section 9.1, Available Accessories)

Notes

Notes

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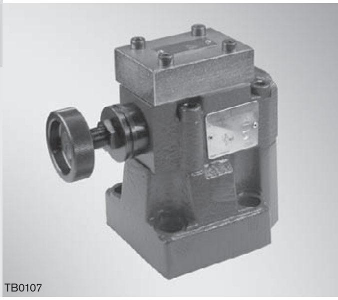
Telefax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

Pressure relief valve, pilot operated

RE 25802-XC-B2/01.07

Type DB...5X/...XC

Nominal sizes (NG) 10, 20, 30
Unit series 5X
Maximum operating pressure 350 bar



TB0107

ATEX units
For potentially explosive atmospheres

Part II Technical Data Sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive and type of protection

– Range of application as per Directive RL 94/9/EG IM2, II2G, II2D
– Type of protection of valve: c (EN 13463-5:2001-01)

What you need to know about these Operating Instructions

These Operating Instructions apply to the explosion-proof version of Rexroth valves, and consist of the following three parts:

Part I General Information RE 07010-X-B1
Part II Technical Data Sheet RE 25802-XC-B2
Part III Product-specific Instructions RE 25802-XC-B3

Mat. No. R901155669

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General Product Information for Hydraulic Products", RE 07008.

Overview of Contents

Features

- For subplate mounting, mounting hole configuration to:
  ISO 6264-AR-06-2-A (NG10),
  ISO 6264-AS-08-2-A (NG20),
  ISO 6264-AT-10-2-A (NG30)
- For threaded connection
- Type of adjustment: rotary knob
- 5 pressure stages
- Subplates (see page 10)

Note:
By adding an additional type 3WE 6… spool-type directional control valve, you can expand the valve in such a way that it can feature solenoid-operated relief (see pages 11 and 12).

Ordering data and scope of delivery

DB			1		5X/			XC	V

Pilot operated pressure relief valve

Nominal size (NG) **= 10, 20, 30**

Type of connection

Valve for subplate mounting **= –**
Valve for threaded connection **= G**

Type of adjustment

Rotary knob **= 1**

With main piston Ø24 mm (NG10, NG20) **= –**
With main piston Ø28 mm (NG30 only) **= N**

Unit series 50 to 59 **= 5X**
(50 to 59: installation and connection dimensions unchanged)

Set pressure up to 50 bar **= 50**
Set pressure up to 100 bar **= 100**
Set pressure up to 200 bar **= 200**
Set pressure up to 315 bar **= 315**
Set pressure up to 350 bar **= 350**

Control oil flow

– = Internal control oil supply and return
X = External control oil supply, internal return
Y = Internal control oil supply, external return
XY = External control oil supply and return

No code = Standard version
U = Valve for minimum opening pressure (only possible up to pressure stage 315 bar)

XC = Valve in explosion-proof design, see information on explosion protection, page 5 for details

V = FKM seals
Note:
Take compatibility of seals and pressure fluid into account!

Included in scope of delivery:

Valve operating instructions

3

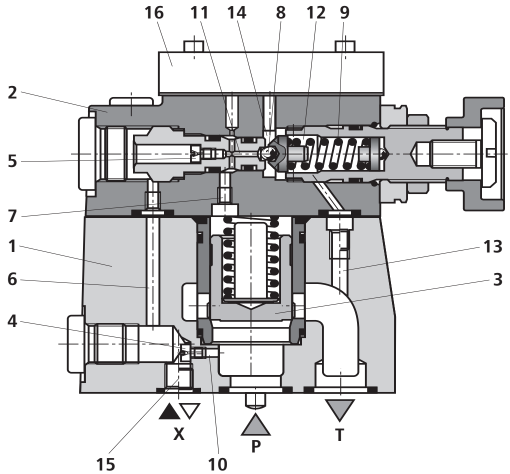
Function, sectional diagram, symbols

DB type valves are pilot operated pressure relief valves and are used to limit the operating pressure. They basically consist of the main valve (1) with main piston cartridge (3), the pilot valve (2) and the sealing plate (16).

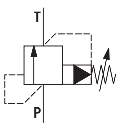
The available pressure in channel P acts on the main piston (3). At the same time, the pressure is applied to the spring-loaded end of the main piston (3) and to the ball (8) in the pilot valve (2) via the control lines (6) and (7), which are equipped with nozzles (4). If the pressure in channel P rises above the value set at the spring (9), the ball (8) opens against the spring (9). The signal that triggers this arrives internally from channel P vial the control lines (10) and (6). The pressure fluid at the spring-loaded end of the main piston (3) now flows through the control line (7), nozzle hole (11) and ball (8) into the spring chamber (12). From here, it is conveyed to the tank internally via control line (13) in the DB…-… type valve, and externally via control line (14) in the DB…Y… type valve. The nozzles (4) and (5) lead to a drop in pressure at the main piston (3), so that the connection from channel P to channel T is now free. The pressure fluid now flows from channel P to channel T, and the set operating pressure is maintained.

The pressure relief valve can be relieved from pressure or switched to a different pressure (second pressure stage) via the port "X" (15).

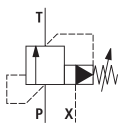
Type DB 10…XC…



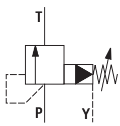
Type DB…**–**…



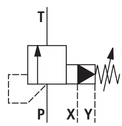
Type DB…**X**…



Type DB…**Y**…



Type DB…**XY**…



Note:

Hydraulic counter pressures in port T with an internal control oil return or in port Y with an external control oil return are added in the ratio of 1:1 to the response pressure of the valve that is set in the pilot control.

Example:

Pressure setting of valve through spring pre-tension (item 12) in the pilot valve/setting unit.
$\boldsymbol{p}_{\text{spring}}$ **= 200 bar**

Hydraulic counter pressure in port T with internal control oil return $\boldsymbol{p}_{\text{hydraulic}}$ **= 50 bar**

=> response pressure = $\boldsymbol{p}_{\text{spring}}$ + $\boldsymbol{p}_{\text{hydraulic}}$ **= 250 bar**

Technical data

General

Nominal size				NG10	NG20	NG30
Installation position				Optional		
Ambient temperature range			°C	–20…+80		
Storage temperature range			°C	–20…+80		
Weight	Subplate mounting	– DB…	kg	2.6	3.5	4.4
	Threaded connection	– DB…G	kg	5.3	5.1	4.8
Surface protection			Standard	Paint, layer thickness max. 100 µm		

Hydraulic

Maximum working pressure	– Ports P, X	bar	350		
	– Port T	bar	315		
Maximum counter pressure	– Port Y (DB)	bar	315		
	– Ports Y, T (with spool-type directional control valve)	bar	See Technical Data Sheets listed in table on page 11		
Maximum set pressure [1]		bar	50; 100; 200; 315; 350		
Minimum set pressure [1]			Dependent on flow rate (see characteristic curves on page 6)		
Maximum flow rate	– Subplate mounting	l/min	250	500	650
	– Threaded connection	l/min	250	500	650
Pressure fluid			Mineral oil (HL, HLP) to DIN 51524, rapidly biodegradable pressure fluids to VDMA 24568 (also see RE 90221), HETG (rapeseed oil); HEPG (polyglycols); HEES (synthetic ester) Ignition temperature > 180 °C		
Pressure fluid temperature range		°C	–20…+80		
Viscosity range		mm^2/s	10…800		
Maximum permissible degree of contamination of pressure fluid Purity class to ISO 4406 (c)			Class 20/18/15 [2]		

3

Information on explosion protection

Range of application as per Directive RL 94/9/EG		IM2, II2G	II2D
Type of protection of valve		c (EN 13463-5:2001-01)	c (EN 13463-5:2001-01)
Maximum surface temperature [3]	°C	–	115
Temperature class		T4	–
Degree of protection		–	IP 65

[1] In order to prevent the maximum permitted response pressure from being exceeded in the system, it must be checked with a suitable measuring instrument during the setting process.

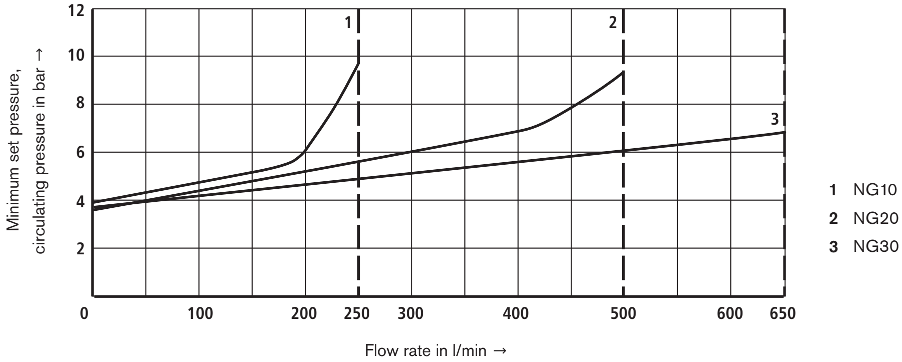
[2] The purity classes stated for the components must be complied with in hydraulic systems. Effective filtration prevents problems and also extends the service life of components. For a selection of filters, see Technical Data Sheets RE 50070, RE 50076 and RE 5008.

[3] As high surface temperatures may occur, European standards EN 563 and EN 982 on the prevention of accidental contact must be observed.

Characteristic curves (measured with HLP46, $\vartheta_{oil} = 40\ °C \pm 5\ °C$)

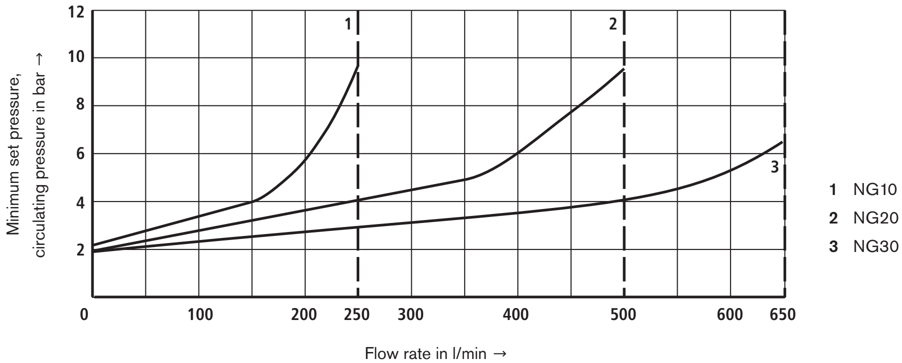
Standard version

Minimum set pressure and circulating pressure as a function of the flow rate 1)



Version „U“

Minimum set pressure and circulating pressure as a function of the flow rate 1)



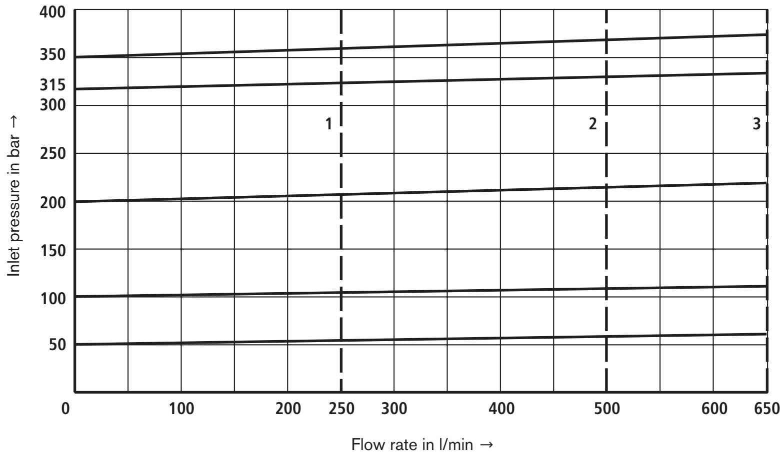
Important!

The characteristic curves were measured with **external, non-pressurized control oil return.**
If the control oil return is internal, the inlet pressure increases by the amount of outlet pressure at port T.

1) The curves apply to outlet pressure $p_T = 0$ over the entire flow range!

Characteristic curves (measured with HLP46, $\vartheta_{oil} = 40\ °C \pm 5\ °C$)

Inlet pressure as a function of the flow rate

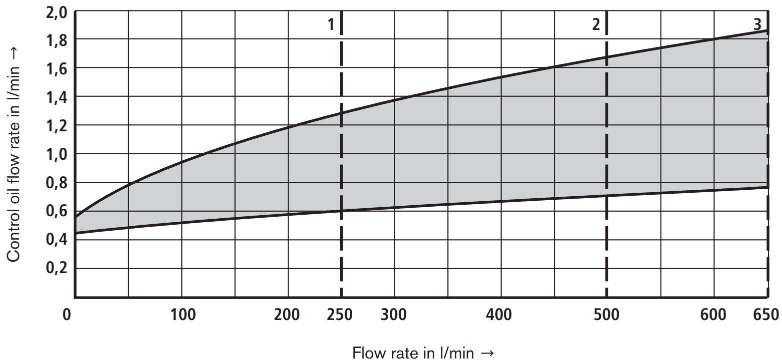


1 NG10
2 NG20
3 NG30

Important:

The characteristic curves were measured with **external, non-pressurized control oil return.**
If the control oil return is internal, the inlet pressure increases by the amount of outlet pressure at port T.

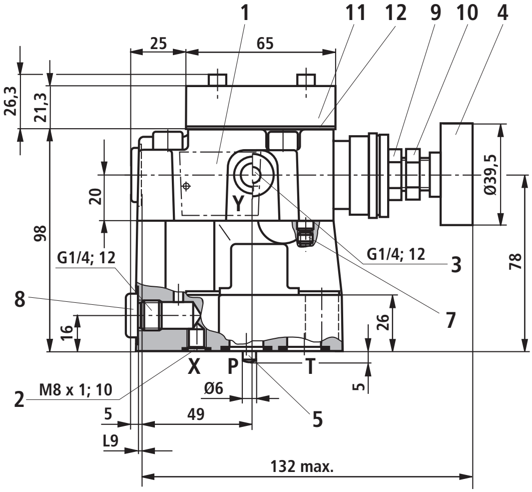
Control oil flow rate



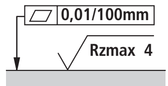
1 NG10
2 NG20
3 NG30

Unit dimensions: Subplate mounting (nominal dimensions in mm)

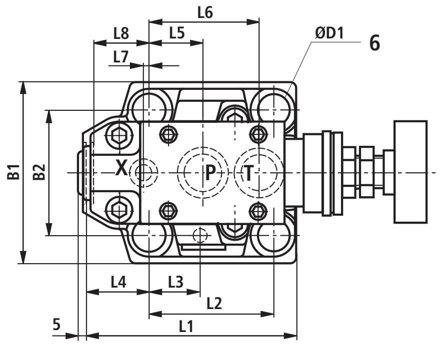
Type DB.–…XC…



See page 10 for legend to item numbers



Required surface quality of mating component

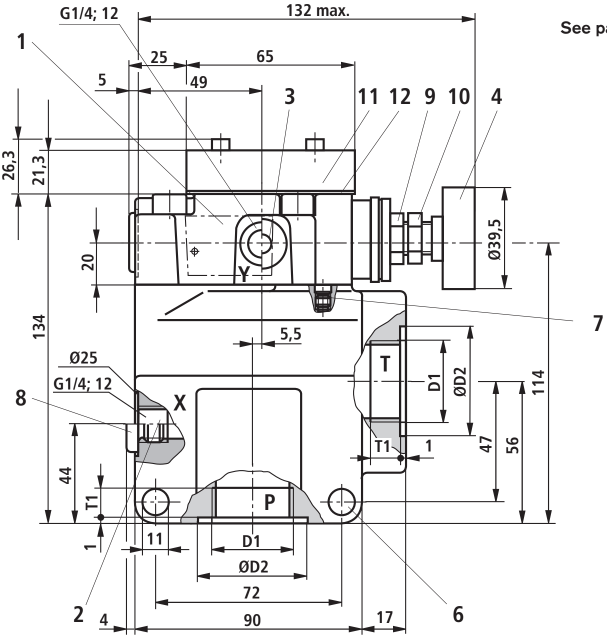


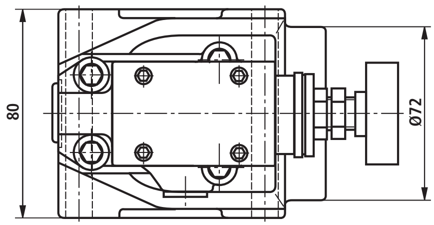
Typ	L1	L2	L3	L4	L5	L6	L7	L8	L9	B1	B2	ØD1
DB 10	91	53.8	22.1	27.5	22.1	47.5	0	25.5	2	78	53.8	14
DB 20	116	66.7	33.4	33.3	11.1	55.6	23.8	22.8	10.5	100	70	18
DB 30	147.5	88.9	44.5	41	12.7	76.2	31.8	20	21	115	82.6	20

Unit dimensions: Threaded connection (nominal dimensions in mm)

Type DB.G…XC…

See page 10 for legend to item numbers





Type	D1	ØD2	T1
DB 10 G	G1/2	34	14
DB 15 G	G3/4	42	16
DB 20 G	G1	47	18
DB 25 G	G1 1/4	58	20
DB 30 G	G1 1/2	65	22

Unit dimensions: Legend to item numbers

1 Nameplate
2 Port X for external control oil supply
3 Port Y for external control oil return
4 Type of adjustment “1”
5 Dowel pin
6 Valve mounting bore
7 Not present with internal control oil return
8 Test port
9 Lock nut (SW17)
10 Lock nut (SW17)
11 Cover plate
12 Sealing plate

Subplates as per Technical Data Sheed RE 45064
(order separately)

Valve type	Type	Mat. no.
DB 10	G 546/01 FE/ZN (G1/2)	**R901156999**
DB 20	G 409/01 FE/ZN (G1)	**R901018328**
DB 30	G 411/01 FE/ZN (G1 1/2)	**R900580254**

Valve fastening bolts for subplate-mounted valves
(order separately)

In order to ensure a secure connection, use only the following valve fastening bolts:

– Type DB 10
4 x ISO 4762-M12x50-10.9-flZn-240h-L
(coefficient of friction μ_{tot} = 0.09-0.14)
Material No. **R913000283**
– Type DB 20
4 x ISO 4762-M16x50-10.9-flZn-240h-L
(coefficient of friction μ_{tot} = 0.09-0.14)
Material No. **R913000378**
– Type DB 30
4 x DIN 912-M18x50-10.9
Material No. **R900002245**

Valve fastening bolts for threaded connection valves on request:
– **2 x M10 x …**
(see unit dimensions on page 9, item 6)

Solenoid-operated relief

With the addition of a type 3WE 6… spool-type directional control valve, the valve can be converted in such a way that it is capable of being electrically switched to non-pressurized circulation (main piston relieved of pressure).

Before adding a 3WE 6… spool-type directional control valve to a DB…5X/…XC pilot operated pressure relief valve, check whether the category and safety class resulting from this combination still satisfy the requirements of the potentially explosive atmosphere in which the valve is to be used.

The spool-type directional control valves for the conversion and the resulting categories and safety classes are set out in the table below.

Important notes:

– The relief function with directional control valve must not be used for safety functions!

– During assembly, please note the operating instructions that are supplied with the spool-type directional control valves.

– Modification or conversion of valves without the use of the operating instructions is not permitted.

– Before assembly, identify all parts by means of their nameplates.

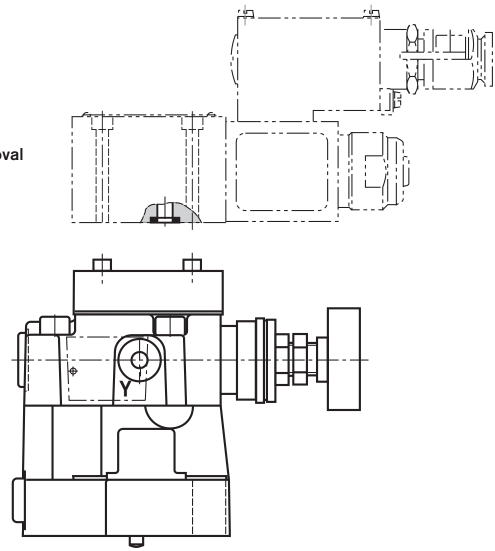
The spool-type directional control valve determines the category to Directive 94/9/EG:

Spool-type directional control valve	Category to 94/9/EG	Technical Data Sheet
3WE 6…5X/…XH	IM2; II2G	RE 23177-XH-B2
3WE 6…6X/…XD	IM2; II2G	RE 23178-XD-B2
3WE 6…6X/…XE	II2G	RE 23178-XE-B2
3WE 6…6X/…XN	II3G; II3D	RE 23178-XN-B2
Example: **DB…5X/…XC** plus **3WE 6…6X/…XN** [1] results in suitability for use in category **II3G; II3D**		

[1] When selecting a valve, please also note the possible switching versions on page 12.

Example:
Addition of a 3WE 6…6X/…XE spool-type directional control valve

The assembly of the directional control valve (removal of sealing plate) is described in RE 25802-XC-B3, section 3.4.



3

Solenoid-operated relief (continued)

Switching versions

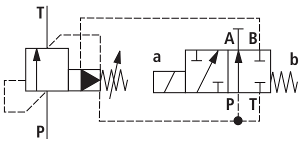
For each type of control oil supply of a DB valve, two switching versions are possible for solenoid-operated relief:

– Closed without current

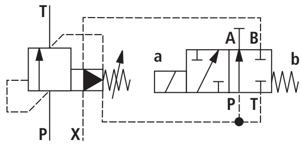
– Open without current

The choice of piston for the 3WE 6… spool-type directional control valve is determined by the required switching version.

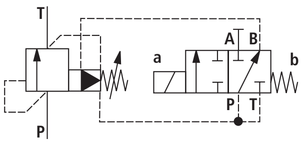
Closed without current
DB…**–**… plus
3WE 6 **A**…



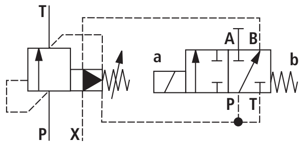
Closed without current
DB…**X**… plus
3WE 6 **A**…



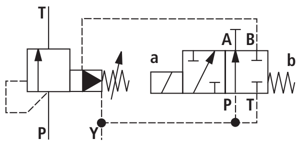
Open without current
DB…**–**… plus
3WE 6 **B**…



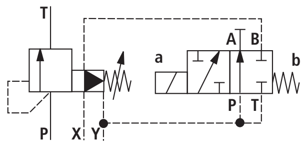
Open without current
DB…**X**… plus
3WE 6 **B**…



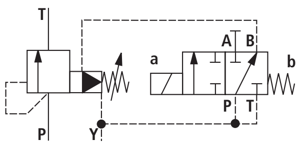
Closed without current
DB…**Y**… plus
3WE 6 **A**…



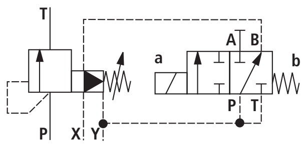
Closed without current
DB…**XY**… plus
3WE 6 **A**…



Open without current
DB…**Y**… plus
3WE 6 **B**…



Open without current
DB…**XY**… plus
3WE 6 **B**…



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Safety valves, directly operated

RE 25010-XC-B2/06.09
Replaces: **09.08**

Type DBDH…1X/…XC…E

Nominal size (NG) 4…30
Unit series 1X

Safety valves
for potentially explosive atmospheres

Part II Technical Data Sheet

Information on safety:

Range of application as type-tested valve in accordance with the Pressure Equipment Directive 97/23/EG

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive and type of protection

– Ranges of application as per Directive 94/9/EG: **IM2, II2G, II2D**
– Type of protection of valve: c (EN 13463-5:2004-03)

What you need to know about these Operating Instructions

These Operating Instructions apply to the explosion-proof version of Rexroth valves, and consist of the following three parts:

Part I	General Information RE 07010-X-B1	**RE 25010-XC-B0**
Part II	Technical Data Sheet RE 25010-XC-B2	
Part III	Product-specific Instructions RE 25010-XC-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication “General Product Information on Hydraulic Products”, RE 07008.

Overview of Contents

Contents	Page

Features

- As ATEX units in accordance with Directive 94/9/EG for ranges of application: **IM2, II2G, II2D**
- As type-tested safety valves in accordance with Pressure Equipment Directive 97/23/EG
- As screw-in valve (cartridge)
- For threaded connection
- For sub plate mounting
- Adjustment with hand wheel

Ordering data and scope of delivery

DBD	H			1X /		XC		E

Pressure relief valve, directly operated

Setting element for pressure adjustment

Hand wheel = H

Nominal size (NG) = 4, = 6, = 10, = 20, = 30

Version

Screw-in valve (cartridge) = K
Threaded connection [1] = G
Sub plate mounting [1] = P

Unit series 10 to 19 = 1X
(10 to 19: installation and connection dimensions unchanged)

Set response pressure (bar) [2] **= 30 bis 630**

XC = Explosion protection „Constructional Safety", see information on explosion protection, page 5, for details

Seal material

V = FKM-seals [3]
No code = NBR-seals [4]

Note:
Take compatibility of seals and pressure fluid into account!

E = Type-tested safety valve as per Pressure Equipment Directive 97/23/EG

[1] Not possible with size NG4
[2] Operating limits, page 5
[3] All pressure stages possible
[4] Pressure stages < 315 bar possible

Included in scope of delivery:

Valve operating instructions with Declaration of Conformity in Part III

Note:

Not all combinations of the above type codes are available.

3

Component identification mark

Type-tested safety valves have a component code, which is composed of elements that are always the same, the meaning of which is described to **example** below:

TÜV . SV . 03 - 390 . 4,5 . F . 30 . 500

- 500: Set response pressure in bar
- 30: Maximum permitted flow rate in l/min without back pressure in the flow line
- F: Valve for pressure fluid
- 4,5: Narrowest flow diameter before the valve seat in mm
- 390: Number of component code assigned by the testing authority
- 03: Last two digits indicating the year in which the validity of the component code was last extended
- SV: Safety valve
- TÜV: Designation of the named authority that conducted type testing

Function, sectional diagram, symbol

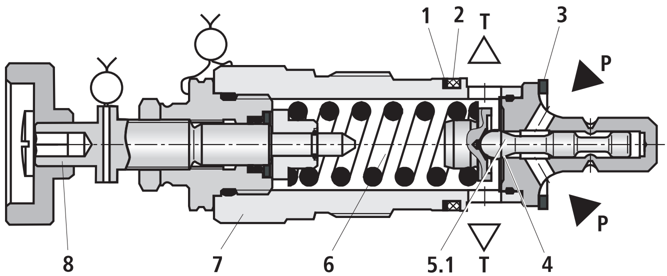
Valves of the type DBDH…1X/…XC…E are type-tested, directly operated pressure relief valves which conform to the Pressure Equipment Directive 97/23/EG. They are employed for reducing system pressure and are intended for use as safety valves.
When the preset response pressure is exceeded in the P duct, the valves react and connect the P and T ducts internally. The valves are available in different versions: as screw-in valve “K” for screwing into blocks, as a valve with threaded connection “G”, or as a valve for subplate mounting “P” (“G” and “P” are not possible with size NG4).
The screw-in valve itself, which is used in all versions, basically consists of the sleeve (7), spring (6), cone (5.1, response pressure up to 400 bar) or ball (5.2, response pressure 405 bar and over), valve seat (4) and setting element (8).
The spring presses the cone (5.1) or the ball (5.2) against the valve seat (4). The response pressure is factory-set to a fixed value using the setting element, then the valve is sealed.

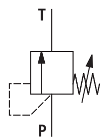
The P duct is connected to the system. The pressure predominating in the system acts on the cone or the ball. If the pressure in the P duct rises above the value set by the pretension of the spring, the cone or the ball lifts up from the valve seat against the spring force, and connects the P and T ducts. The pressure fluid flows out of the P duct into the T duct. Design measures limit the maximum possible lift of the cone.

The valves are available with graduated response pressures (in 5 bar increments). The valve spring can be relieved of tension using the hand wheel, and the response pressure can be reduced from the factory setting without having to remove the seal. To do this, please refer to Part III of the Operating Instructions, RE 25010-XC-B3, section 5.3.

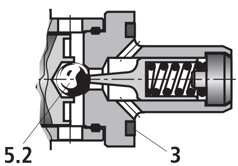
Example illustration with symbol:

Screw-in valve **DBDH 10 K1X/...XC...E**
Response pressure 30 … 400 bar

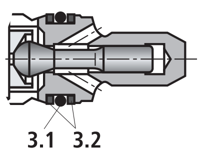




Response pressure 405 … 630 bar (ball poppet valve NG10)



Screw-in valve type Typ **DBDH 4 K1X/...XC...E**
Response pressure 60 … 500 bar



P	P duct
T	T duct
1, 2	O-rings on valve body
3	Axial or radial sealing of single seal
3.1, 3.2	Sealing elements of axial or radial seal of multiple seal
4	Valve seat
5.1	Valve cone
5.2	Valve ball
6	Spring
7	Sleeve
8	Hand wheel setting element

Technical data

General

Installation position		Optional
Ambient temperature range	°C	–20 … +80 (FKM-seals) –30 … +80 (NBR-seals)
Storage temperature range	°C	–20 … +80 (FKM-seals) –30 … +80 (NBR-seals)
Dimensions, weight		See “Unit dimensions” from page 12
Surface protection for versions “G” and “P”		Paint, layer thickness max. 100 µm
Degree of protection to EN 60529:1991+A1:2000		IP 65

Hydraulic
(measured at a viscosity of $\nu = 32$ mm²/s and a pressure fluid temperature of 40° C)

Set response pressure	bar	See last number of component identification mark
Maximum back pressure in flow line	bar	See page 8 ... 11 “Characteristic curves … with back pressure in the flow line”
Maximum flow rate	l/min	See penultimate number of component identification mark and page 6 onwards, “Characteristic curves for maximum permitted flow rate”
Pressure fluid		Mineral oil (HL, HLP) to DIN 51524, other pressure fluids available on request Ignition temperature > 180 °C
Pressure fluid temperature range When used as a safety valve	°C	–15 … +60 [1]
Viscosity range When used as a safety valve	mm²/s	12 … 230 [1]
Maximum permitted degree of contamination of pressure fluid purity class to ISO 4406 (c)		Class 20/18/15

3

Operating limits

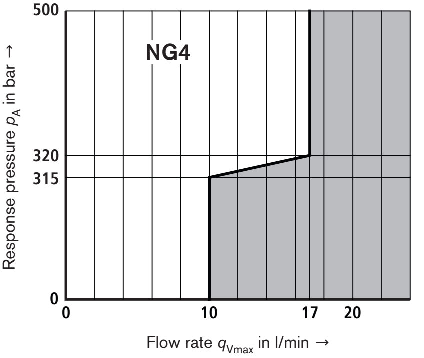
NG	Response pressure p_A in bar	Max. flow rate q_{Vmax} in l/min
4	60 … 315	10
	320 … 500	17
6, 10, 20, 30	See characteristic curves and last number of component identification mark	See characteristic curves and last number of component identification mark

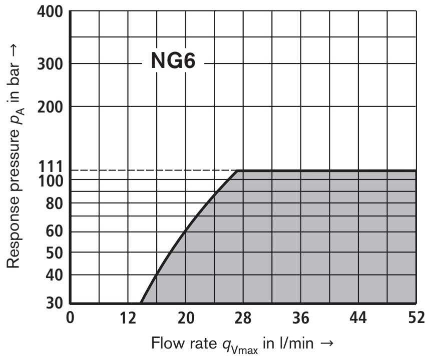
Information on explosion protection

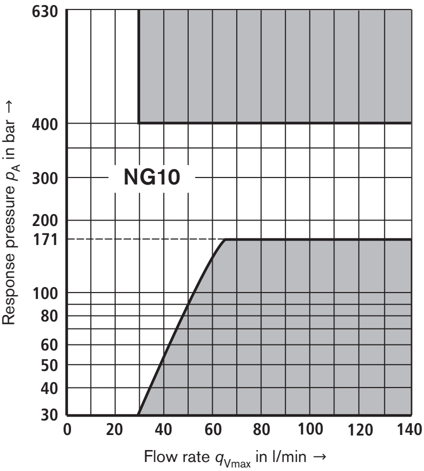
Range of application as per Directive 94/9/EG		IM2, II2G	IM2, II2D
Type of protection of valve		c (EN 13463-5:2004-03)	c (EN 13463-5:2004-03)
Maximum surface temperature Temperature class	°C	125 T4	114 –
Degree of protection		–	IP 65
Special conditions for safe use		The screw-in valve (cartridge) must not be painted!	

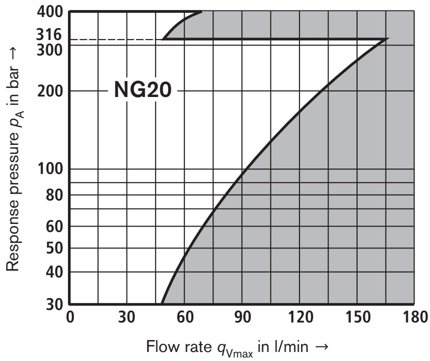
[1] If the valve is not employed as a safety valve in accordance with Pressure Equipment Directive 97/23/EG, the temperature of the pressure fluid must not exceed +80 °C, the viscosity must not exceed 800 mm²/s.

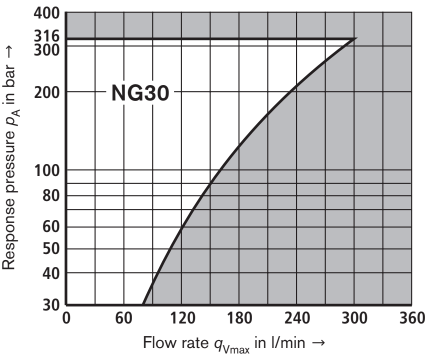
Characteristic curves for maximum permitted flow rate











Note:

Value pairs that are **located in the gray areas** of the characteristic curves **cannot** be achieved with the valve!

The characteristic curves presented here apply solely to a back pressure of 0 bar in the flow line.

Important information for operation in accordance with the Pressure Equipment Directive 97/23/EG

- Before you order a type-tested safety valve, please note that at the desired response pressure *p*, the maximum permitted flow rate q_{Vmax} of the safety valve is greater than the maximum possible flow rate of the system/accumulator which the valve is intended to protect.
  With this in mind, please note the appropriate regulations.
- In accordance with Pressure Equipment Directive 97/23/EG, the system pressure may not increase due to the flow rate by more than 10 % of the set response pressure (see component code). The maximum permitted flow rate q_{Vmax} specified in the component code must not be exceeded. Flow lines from safety valves must exit safely. It must not be possible for fluid to collect in the flow system (see AD2000, code of practice A2).

Essential notes for use!

- The response pressure specified in the component code is factory-set at a flow rate of 2 l/min.
- The maximum permitted flow rate specified in the component code applies to applications without back pressure in the flow line (port T).
- If the seal on the safety valve is removed, the valve no longer conforms to the Pressure Equipment Directive!
- The requirements of the Pressure Equipment Directive and the AD2000 code of practice A2 must be observed!
- We strongly recommend that type-tested safety valves are secured by means of wiring and sealing to the housing/block (bore hole available in setting element), to prevent their unauthorized removal from the screw-in housing/block.

Note

The rising flow rate causes the system pressure to increase by the amount of the back pressure in the flow line (port T). Note AD2000 code of practice A2, item 6.3.
In order to ensure that this rise in system pressure due to the flow rate does not exceed 10 % of the set response pressure, the permitted flow rate must be reduced as a function of the back pressure in the flow line (port T) (see pages 8 to 11).

Characteristic curves NG4 with back pressure in the flow line

As far as possible, the valve should basically be operated with no back pressure in the flow line. If there is back pressure in the flow line, the maximum possible flow rate is reduced. There is a relationship between the maximum permitted back pressure p_T in the flow line and the flow rate q_V, which can be seen in the characteristic curves below.

The curves for intermediate response pressure values that are not shown below must be calculated by means of interpolation.

When the flow rate is around zero, the maximum permitted back pressure p_T is 10 % of the respective response pressure. As the flow rate increases, the maximum permitted back pressure p_T decreases.

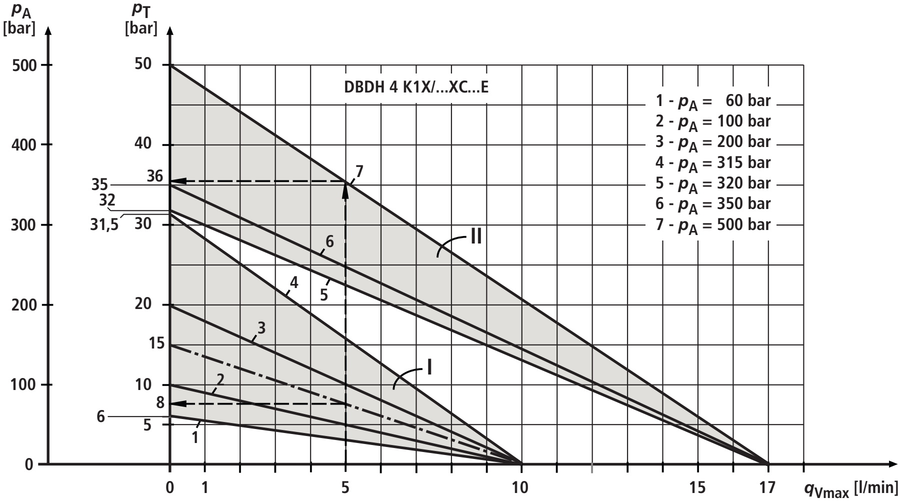


Diagram for determining the maximum permitted back pressure p_T in the flow line at port T of the valve as a function of the flow rate q_{Vmax} for DBDH **4**K1X/...XC...E valves with different response pressures p_A.

p_A Response pressure in bar

p_T Maximum permitted back pressure in the flow line (port T) in bar

q_{Vmax} Max. maximum flow rate in l/min

I Interpolation area **I**, for DBDH **4**K1X/...XC...E valves with response pressure $p_A = 60 \dots 315$ bar and maximum flow rate $q_{Vmax} = 10$ l/min

II Interpolation area **II**, for DBDH **4**K1X/...XC...E E valves with response pressure $p_A = 320 \dots 500$ bar and maximum flow rate $q_{Vmax} = 17$ l/min

Interpolation of intermediate values from the diagram

1. Enter the 1/10 value of the response pressure p_A on the p_T axis.
2. From the above point, draw a straight line to where the q_{Vmax} axis crosses zero, keeping inside the interpolation area (here, 10 l/min for interpolation area **I** or 17 l/min for interpolation area **II**).
3. On the q_{Vmax} axis, enter the system flow rate that is not to be exceeded.
4. For this value, ascertain the maximum permitted back pressure on the basis of the line on the p_T axis that you have just drawn.

Example 1 with available curve

System/accumulator flow rate that is not to be exceeded: $q_{Vmax} = 5$ l/min
Safety valve set to: $p_A = 500$ bar.
From the diagram (see arrows, curve 7), read the maximum permitted back pressure p_T of approx. 36 bar.

Example 2 with interpolated curve

System/accumulator flow rate that is not to be exceeded: $q_{Vmax} = 5$ l/min
Safety valve set to: $p_A = 150$ bar.
Value to be entered on the p_T axis: 1/10 x 150 bar = 15 bar.
From the diagram (see arrows, dotted curve), read the maximum permitted back pressure p_T of approx. 8 bar.

Characteristic curves NG6 with back pressure in the flow line

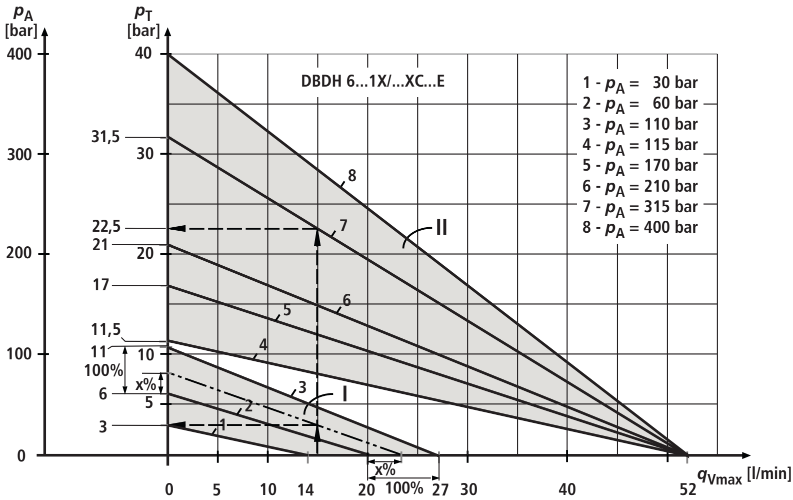


Diagram for determining the maximum permitted back pressure p_T in the flow line at port T of the valve as a function of the flow rate q_{Vmax} for DBDH **6**…1X/…XC…E valves with different response pressures p_A.

p_A Response pressure in bar

p_T Maximum permitted back pressure in the flow line (port T) in bar

q_{Vmax} Max. maximum flow rate in l/min

▭ **I** Interpolation area **I**, for DBDH **6**…1X/…XC…E valves with response pressure p_A = 30 ... 110 bar and maximum flow rate q_{Vmax} = 14 … 27 l/min

▭ **II** Interpolation area **II**, for DBDH **6**…1X/…XC…E valves with response pressure p_A = 115 ... 400 bar and maximum flow rate q_{Vmax} = 52 l/min

Interpolation of intermediate values in the diagram

1. Enter the 1/10 value of the response pressure p_A on the p_T axis.
2. Determine the neighboring, lower and higher curve from this point. The point entered on p_T divides the section between the lower and higher curve on the p_T axis with a certain percentage
3. On the q_{Vmax} axis, divide the section between neighboring, lower and higher curves, using the same percentage as the section on the p_T axis. Draw a straight line from the point where the q_{Vmax} axis crosses zero, which you have just determined, and the previously entered value on the p_T axis.
4. On the q_{Vmax} axis, enter the system flow rate that is not to be exceeded.
5. For this value, ascertain the maximum permitted back pressure on the basis of the line on the p_T axis that you have just drawn.

Determining the permitted back pressure

Example 1 with available curve

System/accumulator flow rate that is not to be exceeded: q_{Vmax} = 15 l/min
Safety valve set to: p_A = 315 bar.
From the diagram (see arrows, curve 7), read the maximum permitted back pressure p_T of approx. 22.5 bar.

Example 2 with interpolated curve

System/accumulator flow rate that is not to be exceeded: q_{Vmax} = 15 l/min
Safety valve set to: p_A = 80 bar.
Value to be entered on the axis designated as p_T: 1/10 x 80 bar = 8 bar.
From the diagram (see arrows, dotted curve), read the maximum permitted back pressure p_T of approx. 3 bar.

Characteristic curves NG10 with back pressure in the flow line

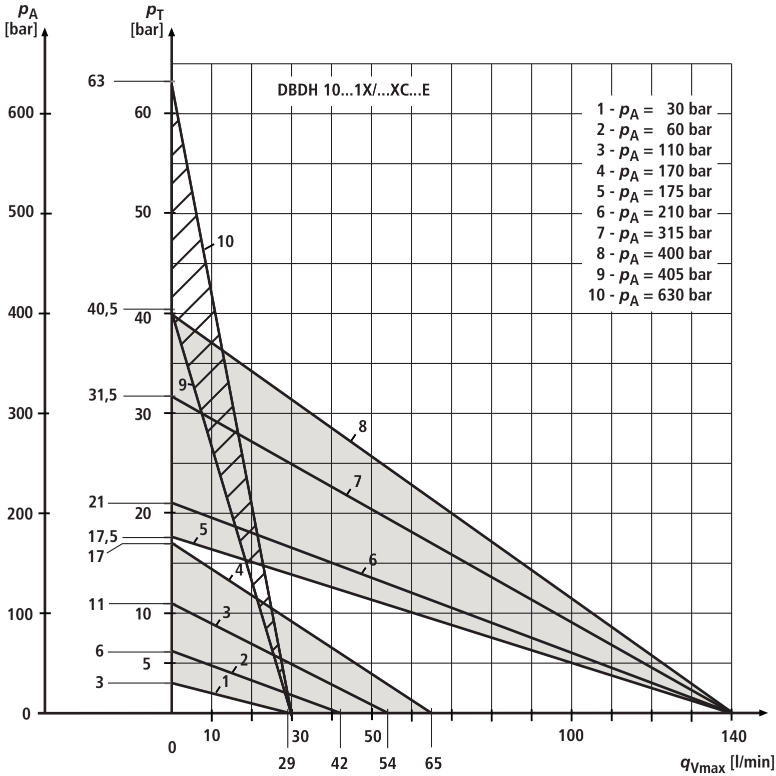


Diagram for determining the maximum permitted back pressure p_T in the flow line at port T of the valve as a function of the flow rate q_{Vmax} for DBDH **10**…1X/…XC…E valves with different response pressures p_A.

ntermediate values can be ascertained with the aid of interpolation. Please refer to the explanations on the previous pages for the interpolation process.

p_A	Response pressure in bar
p_T	Maximum permitted back pressure in the flow line (port T) in bar
q_{Vmax}	Max. maximum flow rate in l/min
▨ ▢	Interpolation areas

Characteristic curves NG20 and NG30 with back pressure in the flow line

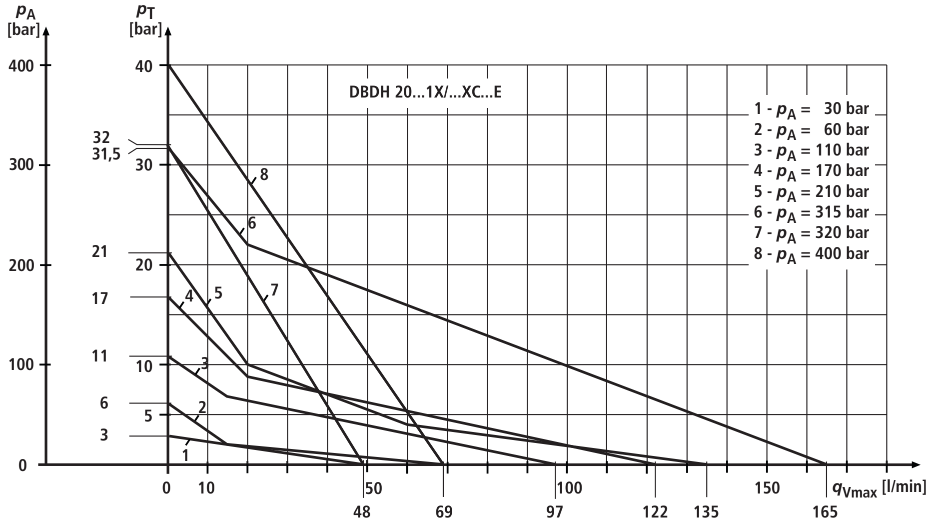
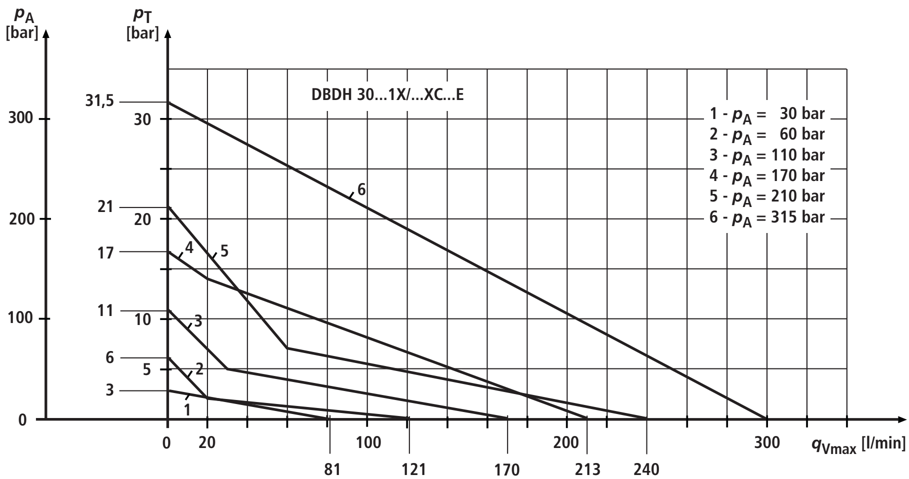
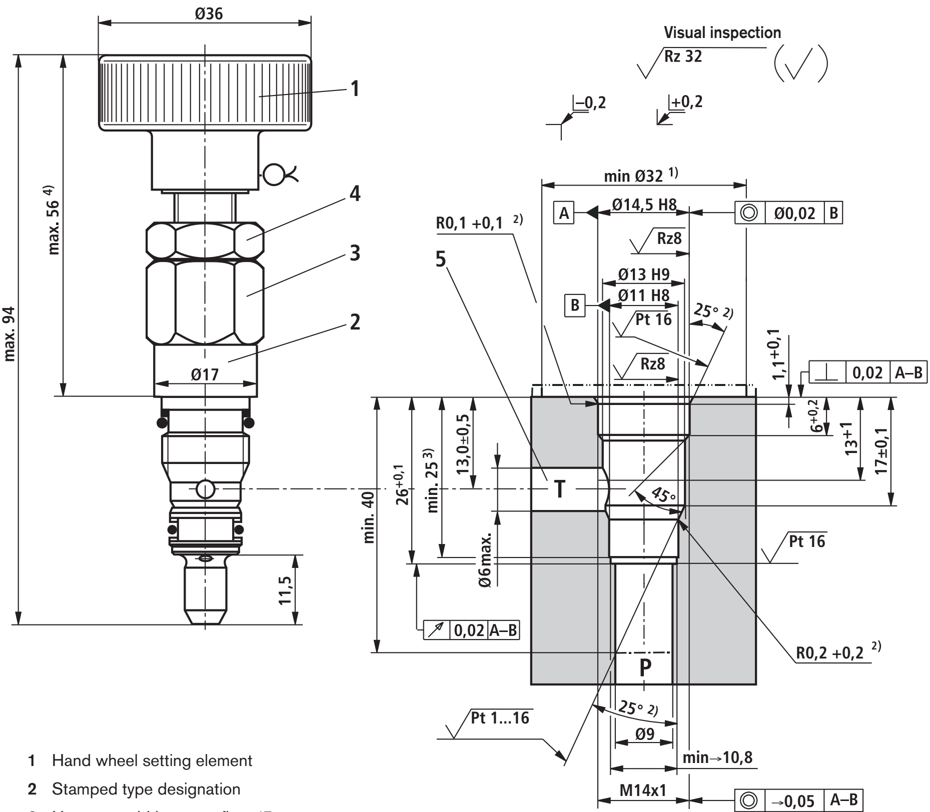


Diagram for determining the maximum permitted back pressure p_T in the flow line at port T of the valve as a function of the flow rate q_{Vmax} for DBDH **20**…1X/…XC…E valves (diagram above) and DBDH **30**…1X/…XC…E valves (diagram below) with different response pressures p_A.

Intermediate values can be ascertained with the aid of interpolation. Please refer to the explanations on the previous pages for the interpolation process.



Unit dimensions: Screw-in valve NG4 (in mm)

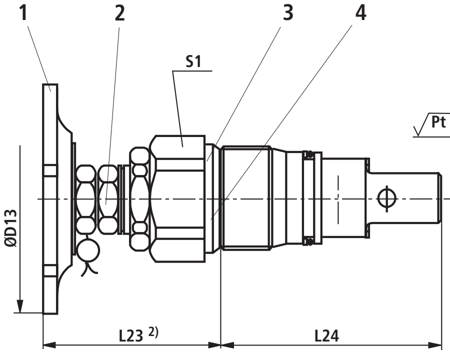


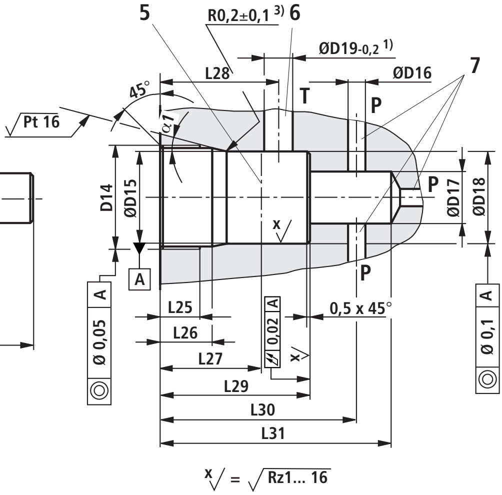
1 Hand wheel setting element
2 Stamped type designation
3 Hexagon, width across flats 17 mm
4 Lock nut, width across flats 17 mm
5 Port T, anywhere on the perimeter

Tolerancing: DIN 7167
General tolerances: ISO 2768-mk

1) Minimum diameter in recess
2) All edges of sealing ring insertion taper rounded and free from burrs
3) Fitting depth
4) Maximum dimension with response pressure at lowest setting

Unit dimensions: Screw-in valves NG6 to NG30 (in mm)





1 Hand wheel setting element
2 Lock nut, width across flats 19 mm
3 Stamped component code
4 Stamped type designation and response pressure
5 Fitting depth
6 Port T, anywhere on perimeter
7 Port P, anywhere on perimeter or on end face

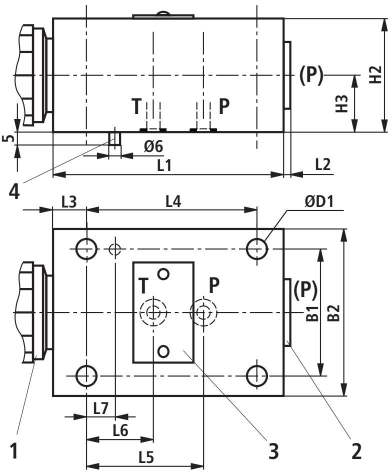
Tolerancing: DIN 7167
General tolerances: ISO 2768-mk

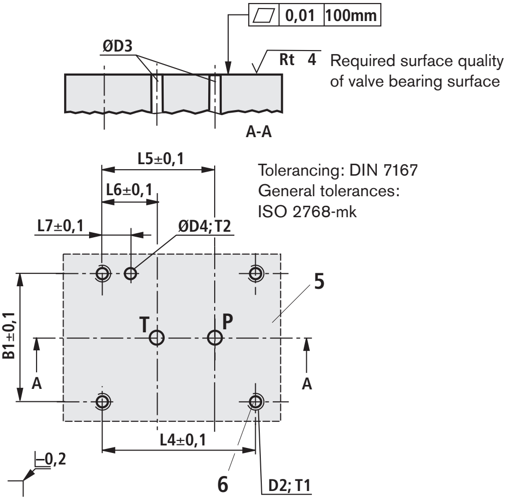
1) Maximum dimension
2) Maximum dimension with response pressure at lowest setting
3) Edge of sealing ring insertion taper rounded and free from burrs

Screw-in valve					
NG	**ØD13**	**L23**	**L24**	**S1**	**Weight**
6	40	81	64,5	32	ca. 0.4 kg
10	40	77	77	36	ca. 0.5 kg
20	40	71	106	46	ca. 1 kg
30	80	97	131	60	ca. 2.2 kg

Screw-in bore hole														
NG	**D14**	**ØD15**	**ØD16**	**ØD17**	**ØD18**	**ØD19**	**L25**	**L26**	**L27**	**L28**	**L29**	**L30**	**L31**	**α1**
6	M28 x 1.5	25 H9	6	15	$24.9^{+0.152}_{-0.2}$	12	15	19	30	36	45	56.5 ± 5.5	65	15°
10	M35 x 1.5	32 H9	10	18.5	$31.9^{+0.162}_{-0.2}$	15	18	23	35	41.5	52	67.5 ± 7.5	80	15°
20	M45 x 1.5	40 H9	20	24	$39.9^{+0.162}_{-0.2}$	22	21	27	45	55	70	91.5 ± 8.5	110	20°
30	M60 x 2	55 H9	30	38.75	$54.9^{+0.174}_{-0.2}$	34	23	29	45	63	84	113.5 ± 11.5	140	20°

Unit dimensions: Sub plate mounting, NG6 to NG30 (in mm)





1 Screw-in valve, example illustration [1]
2 Connecting bore **(P)**, e.g. for pressure measurement, sealed when supplied with screw plug (see dimension table for **(P)**)
Not available for NG10 with pressure stages > 400 bar
3 Nameplate
4 Locating pin
5 Valve bearing surface
6 Four valve fastening bores

[1] See page 13 for dimensions

In order to ensure a secure connection, use only the following valve fastening bolts (order separately)**:**

– **4 hexagon socket head cap screws ISO 4762…-flZn-240h-L**
(coefficient of friction μ_{total} = 0.09 to 0.14)

Valve fastening bolts to ISO 4762 [2]			
NG	Dimensions	Property class	Material number
6	M6 x 50	10.9	**R913000151**
10	M8 x 70	10.9	**R913000149**
20	M8 x 90	12.9	**R913000150**
30	M10 x 110	12.9	**R913000148**

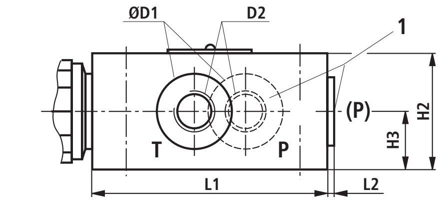
[2] Appropriate specified bolts to DIN 912 may also be used as an alternative.

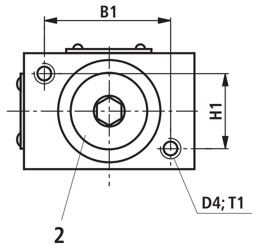
Pressure relief valve														
NG	**B1**	**B2**	**ØD1**	**H2**	**H3**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**L7**	**(P)**	**Weight**
6	45	60	6.6	40	20	80	4	15	55	40	20	15	G1/4	ca. 1.5 kg
10	60	80	9	60	30	100	4	20	70	45	21	15	G1/2	ca. 3.7 kg
20	70	100	9	70	35	135	5.5	20	100	65	34	15	G3/4	ca. 6.4 kg
30	100	130	11	90	45	180	5.5	25	130	85	35	15	G1 1/4	ca. 13.9 kg

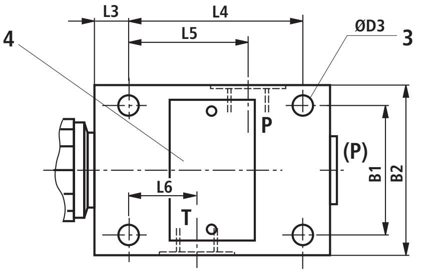
NG	**Maximum overall length with response pressure at lowest setting**
6	165
10	181
20	212
30	283

Detail dimensions of mounting hole configurations										
NG	**B1**	**D2**	**ØD3**	**ØD4**	**L4**	**L5**	**L6**	**L7**	**T1**	**T2**
6	45	M6	6	7.5	55	40	20	15	15	6.5
10	60	M8	10	7.5	70	45	21	15	15	6.5
20	70	M8	20	7.5	100	65	34	15	22	6.5
30	100	M10	30	7.5	130	88	35	15	22	6.5

Unit dimensions: Threaded connection, NG6 to NG30 (in mm)







Tolerancing: DIN 7167
General tolerances: ISO 2768-mk

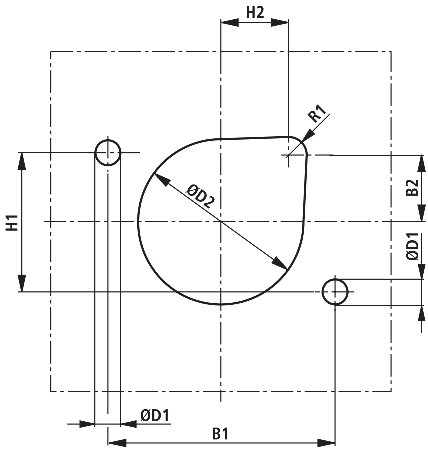
1 Connecting bore **(P)**, (e.g. for pressure measurement), with screw plug, for dimensions see D2
Not available for NG10 with pressure stages > 400 bar
2 Screw-in valve, example illustration [1)]
3 Four valve fastening bores
4 Nameplate

[1)] See page 13 for dimensions

Pressure relief valve																		
NG	**B1**	**B2**	**ØD1**	**D2**	**ØD3**	**D4**	**H1**	**H2**	**H3**	**L1**	**L2**	**L3**	**L4**	**L5**	**L6**	**T1**	**(P)**	**Weight**
6	45	60	25	G1/4	6.6	M6	25	40	20	80	4	15	55	40	20	10	G1/4	ca. 1.5 kg
10	60	80	34	G1/2	9	M8	40	60	30	100	4	20	70	48	21	15	G1/2	ca. 3.7 kg
20	70	100	47	G1	9	M8	50	70	35	135	5.5	20	100	65	34	18	G1	ca. 6.4 kg
30	100	130	65	G1 1/2	11	M10	60	90	45	180	5.5	25	130	85	35	20	G1 1/2	ca. 13.9 kg

NG	Maximum overall length with response pressure at lowest setting
6	165
10	181
20	212
30	283

Unit dimensions: Cut-out in sheet metal for valve mounting in version for subplate mounting (in mm)



NG	B1	B2	H1	H2	$ØD1^{H13}$	$ØD2^{H13}$	R1
6	45	12.5	25	22.5	7	40	8
10	60	20.5	40	20.5	9	44	8
20	70	24	50	24	9	55	8
30	100	29.5	60	29.5	11	73	8

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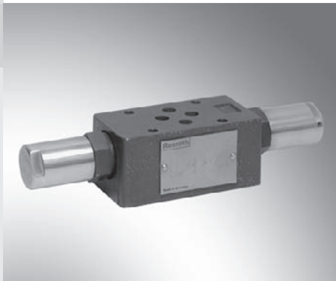
Twin throttle-type check valve, directly operated

RE 27506-XC-B2/06.09
Replaces: 08.06

Type Z2FS 6...XC

Nominal size 6
Unit series 4X
Maximum operating pressure 315 bar
Maximum flow rate 80 l/min



TB0041

ATEX units
For potentially explosive atmospheres

Part II Technical Data Sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive and type of protection

- Range of application as per Directive 94/9/EG IM2, II2G, II2D
- Type of protection of valve: c (EN 13463-5:2004-03)

What you need to know about these Operating Instructions

These Operating Instructions apply to the explosion-proof version of Rexroth valves, and consist of the following three parts:

Part I	General Information RE 07010-X-B1	**RE 27506-XC-B0**
Part II	Technical Data Sheet RE 27506-XC-B2	
Part III	Product-specific Instructions RE 27506-XC-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication “General Product Information on Hydraulic Products”, RE 07008.

Overview of Contents

Contents	**Page**

Features

– Modular valve
  - Position of ports to ISO 4401-03-02-0-05 with tension pin and locating bore
  - Adjusting screw with lock nut and protective cap
  - For limiting the main or pilot flow of two consumer ports
  - For inlet or outlet throttling

Ordering data and scope of delivery

Z2FS	6		2	– 4X /		–	XC	J	

Twin throttle-type check valve, directly operated

Nominal size 6 **= 6**

Throttle-type check valve sides A and B **= –**
Throttle-type valve side A **= A**
Throttle-type valve side B **= B**

Setting element
Adjusting screw with lock nut and protective cap **= 2**

Unit series 40 to 49 **= 4X**
(40 to 49: installation and connection dimensions unchanged)

Inlet throttling on sides A and B (…–4X/**S**) **= S**
Inlet throttling on side A (…**A**–4X/**S**)
Inlet throttling on side B (…**B**–4X/**S**)
Outlet throttling on sides A and B (…–4X/**S2**) **= S2**
Outlet throttling on sides A (…**A**–4X/**S2**)
Outlet throttling on sides B (…**B**–4X/**S2**)

1Q = With precision adjustment
2Q = Standard version

XC = Valve in explosion-proof design, see information on explosion protection, page 5, for details

J = Sea-water protection

No code = NBR-seals
V = FKM-seals
Note:
Take compatibility of seals and pressure fluid into account!

Included in scope of delivery:

Valve operating instructions with Declaration of Conformity in Part IIII

Function, sectional diagram

Type Z2FS 6…XC valves are twin throttle-type check valves with a modular design.

They are used to limit the main or pilot flow of one or two consumer ports.

Two throttle-type check valves positioned symmetrically to one another limit flows in one direction and provide a free return of fluid in the opposite direction.

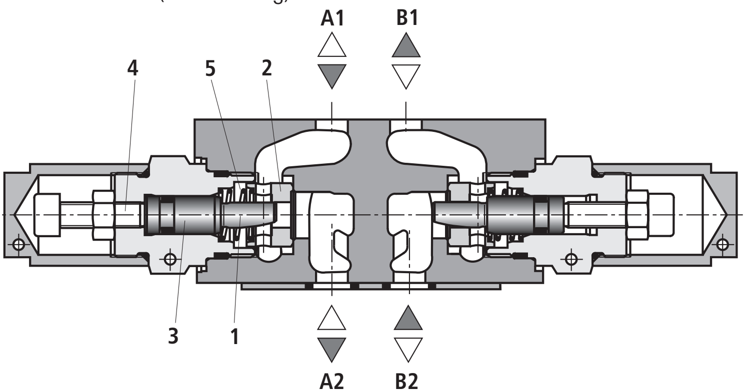
With inlet throttling, the pressure fluid flows through the duct A1 to reach the consumer A2 via the throttling point (1), which is formed by the valve seat (2) and the throttling piston (3). The throttling piston (3) can be axially adjusted by means of the adjusting screw (4), thereby enabling the throttling point (1) to be adjusted as well.

The pressure fluid returning from the consumer B2 pushes the valve seat (2) against the spring (5) in the direction of the throttling piston (3), thereby enabling the fluid to flow unhindered from B2 to B1 via the check valve. The same applies to the flow in the opposite direction. Throttling may take effect in the inlet or the outlet, depending on the valve type.

Main flow limitation (version ..2Q..)
To change the speed of a consumer (main flow limitation), the twin throttle-type check valve is installed between the directional control valve and the subplate.

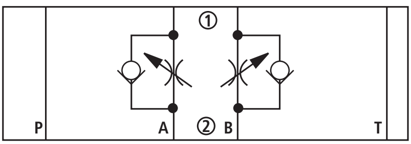
Pilot flow limitation (version ..1Q..)
The twin throttle-type check valve can be used to set the switching delay (pilot flow limitation) of pilot-operated directional control valves. In this case, it is installed between the pilot valve and the main valve.

Type Z2FS 6 –2–4X/S...XC (inlet throttling)

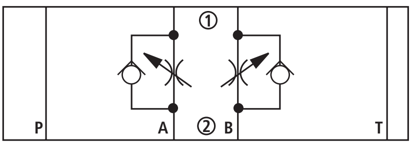


Symbols (① unit side, ② plate side)

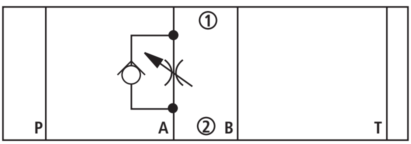
Z2FS 6 **–**..–4X/**S**...XC (inlet throttling)



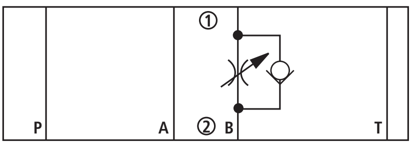
Z2FS 6 **–**..–4X/**S2**...XC (outlet throttling)



Z2FS 6 **A**..–4X/**S2**...XC (outlet throttling)



Z2FS 6 **B**..–4X/**S**...XC (inlet throttling)



Technical data

General

Installation position		Optional
Ambient temperature range	°C	–20 … +80 (FKM-seals) –30 … +80 (NBR-seals)
Storage temperature range	°C	–20 … +80 (FKM-seals) –30 … +80 (NBR-seals)
Weight	kg	0,8
Surface protection		Galvanized and chromated olive green FeZn12Dd DIN 50961

Hydraulic

Maximum operating pressure, primary	bar	315
Maximum flow rate	l/min	80
Maximum leakage at 315 bar pressure difference	l/min	1 (through closed throttle)
Pressure fluid		Mineral oil (HL, HLP) to DIN 51524 other pressure fluids available on request Ignition temperature > 180 °C
Pressure fluid temperature range	°C	–20 … +80 (FKM-seals) –30 … +80 (NBR-seals)
Viscosity range	mm^2/s	10 … 800 (preferably 30 … 60)
Maximum permissible degree of contamination of pressure fluid Purity class to ISO 4406 (c)		Class 20/18/15 [1]

3

Information on explosion protection

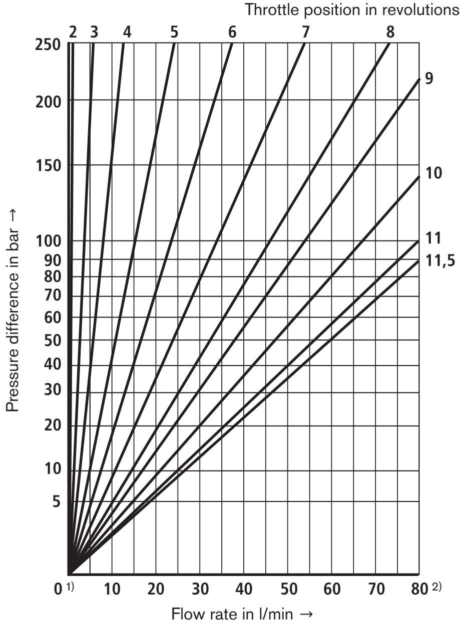
Range of application as per Directive 94/9/EG		IM2, II2G	II2D
Type of protection of valve		c (EN 13463-5:2004-03)	c (EN 13463-5:2004-03)
Maximum surface temperature [2]	°C	–	100
Temperature class		T4	–
Degree of protection		–	IP 67

[1] The purity classes stated for the components must be complied with in hydraulic systems. Effective filtration prevents problems and also extends the service life of components. For a selection of filters, see Technical Data Sheets RE 50070, RE 50076 and RE 50081.

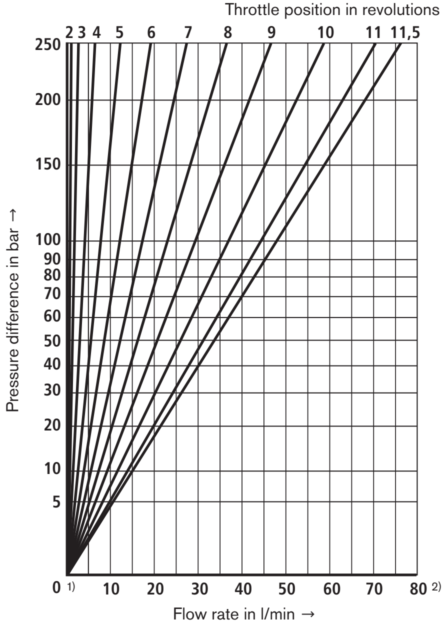
[2] As high surface temperatures may occur, European standards ISO 13732-1 and EN 982 on the prevention of accidental contact must be observed

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Δ*p*-q_V curves for Z2FS 6 ..–4X/.**2Q**XCJ



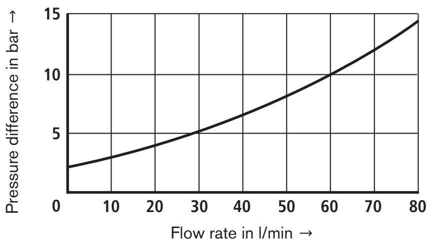
Δ*p*-q_V curves for Z2FS 6 ..–4X/.**1Q**XCJ



1) Clockwise to stop

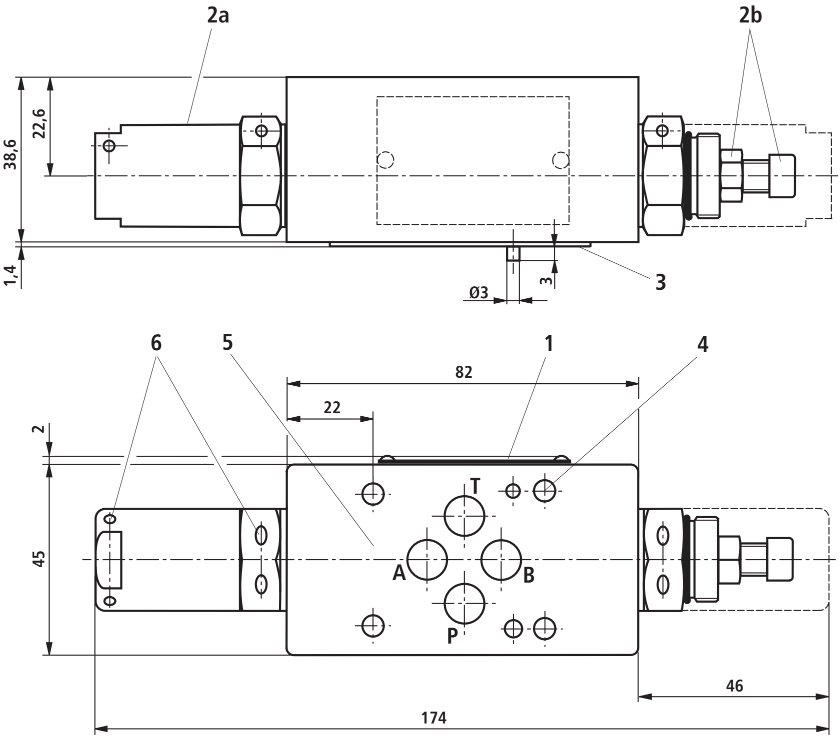
2) Anti-clockwise to stop

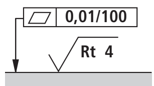
Δ*p*-q_V curves for Z2FS 6 ... via check valve when throttle is closed



Unit dimensions (in mm)

Type Z2FS 6 –2–4X/S…XC (inlet throttling)





Required surface quality of mating component

1 Nameplate

2a Protective cap SW20

2b Hexagon socket adjusting screw SW5 and lock nut SW10

3 Sealing ring plate with identical sealing rings for ports P, A, B, T

4 Valve mounting bores

5 Position of ports to ISO 4401-03-02-0-05, with locating bore and tension pin Ø3 mm

6 Bore for lead sealing by customer. Unless the lead seal is destroyed, the valve can no longer be moved.

Valve fastening bolts
In order to ensure a secure connection, use only the following valve fastening bolts:
4 hexagon socket head cap screws
ISO 4762-M5x…-10.9-flZn-240h-L
(coefficient of friction 0.09–0.14 to VDA 235-101)
(must be ordered separately, also see RE 27506-XC-B3, section 9.1, Available accessories)

Notes

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www.boschrexroth.de

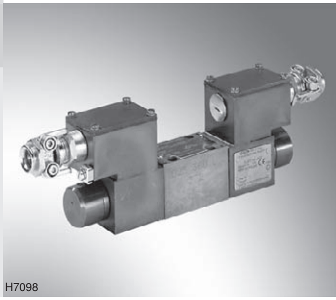
Proportional servo valves

4/2 and 4/3 proportional directional valves, direct operated, without electrical position feedback

RE 29055-XE-B2/09.13
Replaces: 07.04

Type 4WRA 6 ../..XE...

Size 6
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 22 l/min



Actual product may differ

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

– Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
– Type of protection of the valve solenoid: Ex e mb IIC T4 Gb according to EN 60079-7:2007/EN 60079-18:2009

Special features of seawater-resistant valves

– The exterior of the valve housing is galvanically coated.
– The seawater-resistance is defined by "J" in the ordering code.

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29055-XE-B0**
Part II	Data sheet 29055-XE-B2	
Part III	Product-specific instructions 29055-XE-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Direct operated proportional valve for controlling flow direction and flow size for proper use in explosive atmospheres
- Seawater-resistant
- Spring-centered control spool
- For subplate mounting:
  Porting pattern according to ISO 4401-03-02-05
- Subplates available in FE/ZN version (see page 10)
- Wet-pin DC solenoids
- Solenoid coil can be rotated by 90°
- Electrical connection as individual connection with cable gland

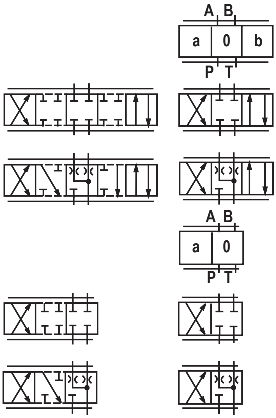
Ordering code and scope of delivery

4WRA	6		–2X/	G24	XE	J /	

Proportional directional valve for external control electronics — 4WRA

Size = 6

Symbols



= E
E1-

= W
W1-

= EA

= WA

For control spools E1- and W1-, the following applies:

P → A: $q_{V\ max}$ and B → T: $q_{V/2}$
P → B: $q_{V/2}$ and A → T: $q_{V\ max}$

In the zero position, control spools W, W1 and WA have a connection from A → T and from B → T with approx. 3 % of the relevant nominal cross-section

Rated flow
07 = 6 l/min
15 = 10 l/min
30 = 18 l/min
Characteristic curves, see page 8

2X = Component series 20 to 29
(20 to 29: Unchanged installation and connection dimensions)

Supply voltage of the control electronics
G24 = 24 V direct voltage

XE = Explosion protection "increased safety", see details on the explosion protection page 6

Surface protection
J = Seawater-resistant, galvanized

M = NBR seals [1)]
V = FKM seals
Important:
Observe compatibility of seals with hydraulic fluid used!

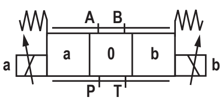
[1)] Suitable for mineral oils (HL, HLP) according to DIN 51524

Included in the scope of delivery:

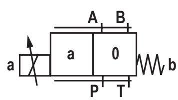
Valve operating instructions with declaration of conformity in Part III

Symbols

Type 4WRA 6 ...XE



Type 4WRA 6 ...**A**...XE



Function, section

The 4/2 and 4/3 proportional directional valves are designed as direct operated valves in plate design. Operation is effected by means of proportional solenoids for explosive areas. The solenoids are actuated by external control electronics.

Set-up:

The valve basically consists of:

- Housing (1) with connection surface
- Control spool (2) with compression springs (3 and 4)
- Solenoids (5 and 6) with central thread

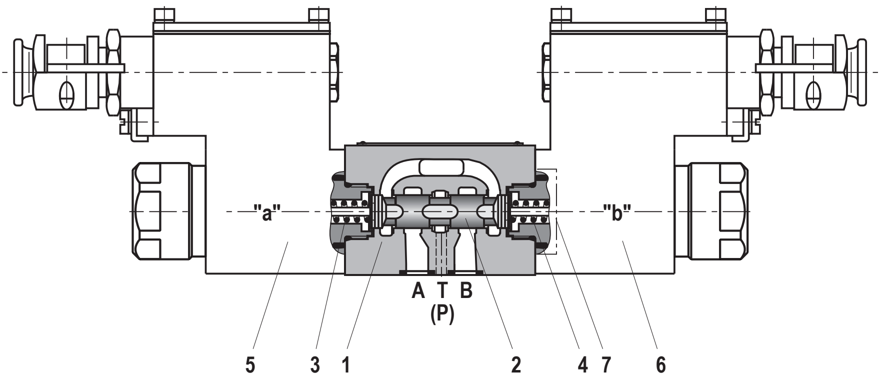
Functional description:

- With de-energized solenoids (5 and 6), central position of the control spool (2) by compression springs (3 and 4)
- Direct operation of the control spool (2) by energizing a proportional solenoid
  e.g. controlling solenoid "b" (6)
  - → Control spool (2) is moved to the left in proportion to the electrical input signal
  - → Connection from P → A and B → T via orifice-type cross-sections with progressive flow characteristics
- De-excitation of the solenoid (6)
  - → The compression spring (3) brings the control spool (2) back into the central position

Important:

Regarding the 4/3 version of the valves, only one solenoid may be actuated at a time.

Type 4WRA 6 ...-2X/G24XEJ/V



Valve with 2 spool positions (type 4WRA 6 .**A**...XEJ...)**:**

The function of this valve version basically corresponds to the valve with three spool positions. The 2 spool position valves are, however, only equipped with solenoid "a" (5). Instead of the 2nd proportional solenoid, there is a plug screw (7).

Important:

The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve (preload pressure approx. 2 bar) must be installed.

Technical data

general

Installation position			Any; preferably horizontal
Storage temperature range		°C	–20 … +50
Ambient temperature range		°C	–20 … +60
Weight	4WRA 6...XE	kg	4.4
	4WRA 6...A...XE	kg	2.7
Surface protection			Galvanized coating

hydraulic

Operating pressure range	Ports P, A, B	bar	Up to 315
	Port T	bar	Up to 210
Rated flows $q_{v\ rated}$ with Δ_p = 10 bar		l/min	6
		l/min	10
		l/min	18
Maximum flow		l/min	22
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 additional hydraulic fluids upon request! Ignition temperature > 180 °C
Hydraulic fluid temperature range		°C	–20 ... +80 (NBR seals)
			–15 ... +80 (FKM seals)
Viscosity range		mm^2/s	15 ... 380 (preferably 30 ... 46)
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 17/15/12 [1)]
Hysteresis		%	≤ 6
Range of inversion		%	≤ 2
Response sensitivity		%	≤ 1

electric

Voltage type		Direct current or pulse-width modulated signal with pulse voltage ≤ 28 V and frequency ≥ 160 Hz up to max. 500 Hz
Type of signal		Analog
Maximum current per solenoid	A	1.03
Duty cycle	%	100
Coil temperature	°C	Up to 125

[1)] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

Information on the explosion protection

Area of application in accordance with the Explosion Protection Directive 94/9/EC	II 2G
Type of protection Valve according to EN 13463-1:2009 / EN 13463-5:2011	c T4 X
Type of protection Valve solenoid according to EN 60079-7:2007 / EN 60079-18:2009	Ex e mb IIC T4 Gb [1]
Type examination certificate Solenoid	KEMA 02ATEX2240 X
"IECEx Certificate of Conformity" Solenoid	IECEx DEK 12.0068X
Special operating conditions for a safe application	– In case of bank assembly, only one solenoid of all valves may be energized at a time. – In case of valves with two solenoids, maximally one of the solenoids may be energized at a time. – For the operation, only direct current or a pulse-width modulated signal with pulse voltage ≤ 28 V and frequency ≥ 160 Hz up to max. 500 Hz may be used.

Control electronics [2]

Amplifier module for the control of explosion-proof proportional directional valves 4WRA...XE, 3DREP 6...XE and 4WRZ...XE	VT-MSPA2-200-1X/V0/0 according to data sheet 30228-200
Module for monitoring and limiting the solenoid currents with proportional valves	VT-MUXA2-2-1X/V0/1A according to data sheet 30290

[1] Surface temperature > 50 °C, provide contact protection

[2] **Important:**
A monitoring circuit is to be provided for the monitoring of the solenoid current. We recommend operating the valves with the assemblies described herein.

Electrical connection

The type-examination tested valve solenoid is equipped with a terminal box and a type-tested cable gland.

The connection is polarity-independent.

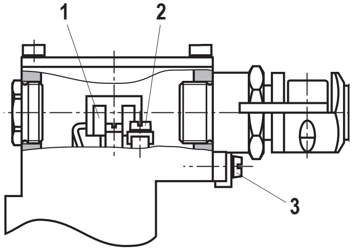
Important:

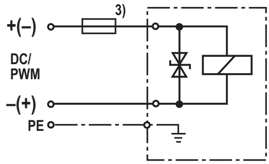
Corresponding to the rated current, a fuse according to DIN 41571 and EN / IEC 60127 has to be connected ahead of every valve solenoid (max. 3 x I_{rated}).

The shut-off threshold of the fuse has to match the prospective short-circuit current of the supply source.

The prospective short-circuit current of the supply source may ampunt to a maximum of 1500 A.

This fuse may only be installed outside the explosive area or must be of an explosion-proof design.





3) Recommended pre-fuse
Characteristics medium time-lag according to DIN 41571; 1.25 A

Properties of the connection terminals

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 … 2.5 mm² Finely stranded 0.75 … 1.5 mm²
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm² Finely stranded max. 1.5 mm²
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm² Finely stranded 4 mm²

Cable gland

Type approval		II 2G Ex e IIC Gb
Threaded connection		M20 x 1.5
Protection class according to EN 60529		IP66 [1]
Line diameter	mm	9 … 11
Sealing		Outer sheath sealing

Connection line

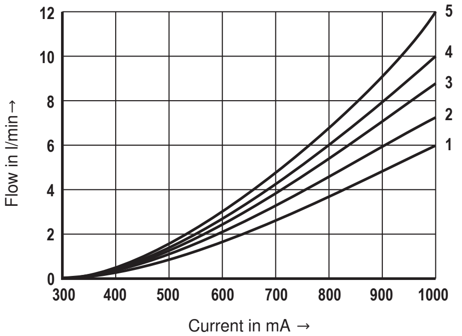
Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–30 … > +110

1) If installed properly

4

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

Ordering code 07: 6 l/min with 10 bar valve pressure differential

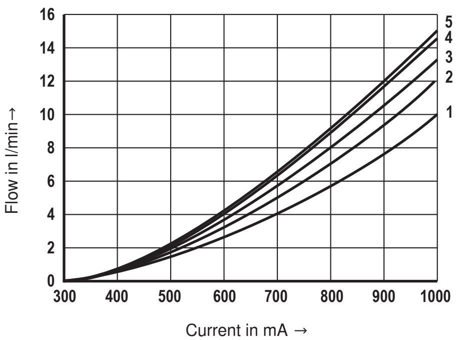


The following applies to all figures on this page:

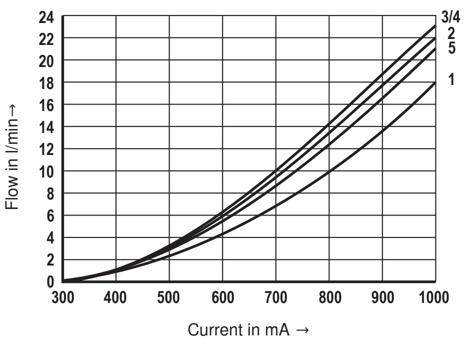
1 Δ_p = 10 bar constant
2 Δ_p = 20 bar constant
3 Δ_p = 30 bar constant
4 Δ_p = 50 bar constant
5 Δ_p = 100 bar constant

Δ_p = valve pressure differential according to DIN 24311 (inlet pressure minus load pressure and minus return flow pressure)

Ordering code 15: 10 l/min at a valve pressure differential of 10 bar

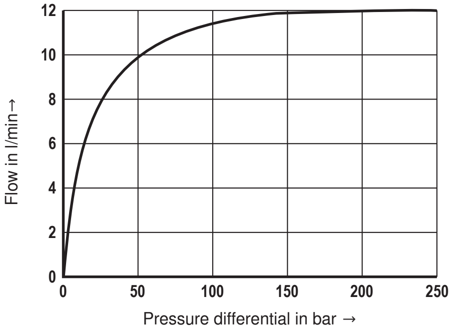


Ordering code 30: 18 l/min at a valve pressure differential of 10 bar

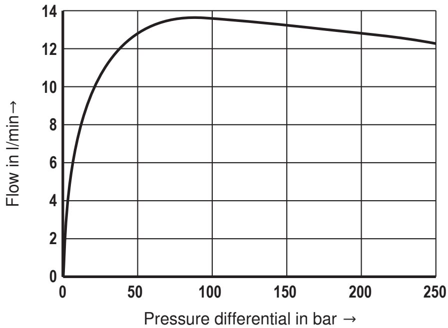


Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C)

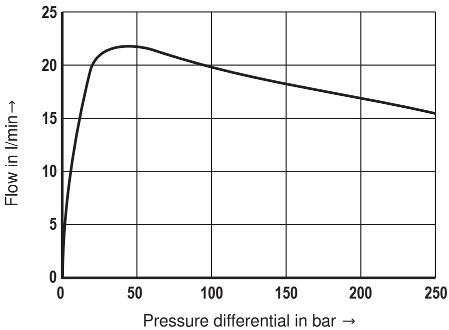
Performance limit
6 l/min rated flow



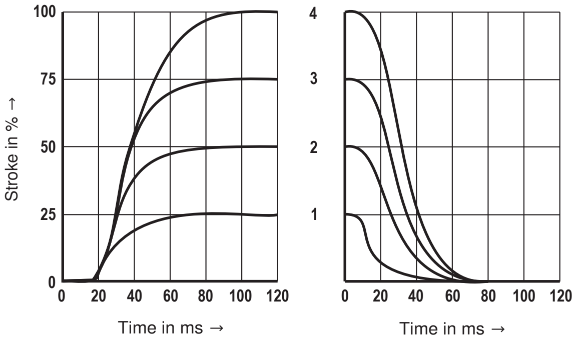
Performance limit
10 l/min rated flow



Performance limit
18 l/min rated flow



Transition function with stepped electric input signals

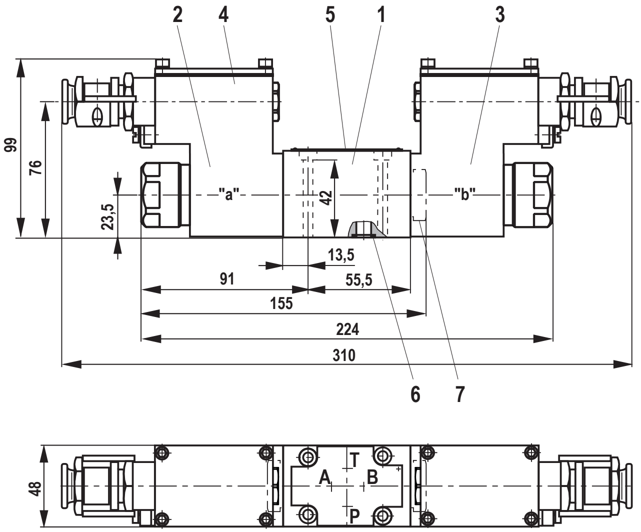


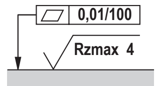
	Change of input signal [%]
1	0 → 25 → 0
2	0 → 50 → 0
3	0 → 75 → 0
4	0 → 100 → 0

Measured at
pilot pressure p_{ST} = 10 bar

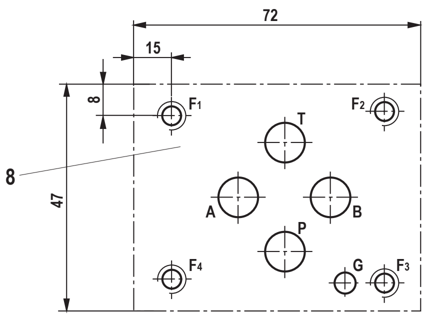
4

Dimensions (dimensions in mm)





Required surface quality of the valve contact surface



1 Valve housing
2 Proportional solenoid "a"
3 Proportional solenoid "b"
4 Terminal box
5 Name plate
6 Identical seal rings for ports P, A, B and T
7 Plug screw for valve with one solenoid (2 spool positions, version EA or WA)
8 Porting pattern according to ISO 4401-03-02-0-05
Deviating from the standard:
– Without locating pin
– Ports P, A, B and T with Ø 8 mm

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 – 0.14 according to VDA 235-101)

Material no. **R913000064**
(must be ordered separately)

Subplates

(**without** locating hole) G 341/01 FE/ZN (G1/4)
G 342/01 FE/ZN (G3/8)
G 502/01 FE/ZN (G1/2)

with dimensions as in the data sheet 45052
(must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

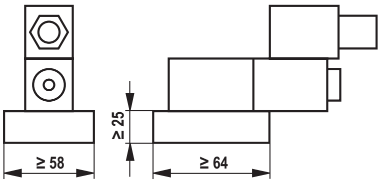
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Installation conditions (dimensions in mm)

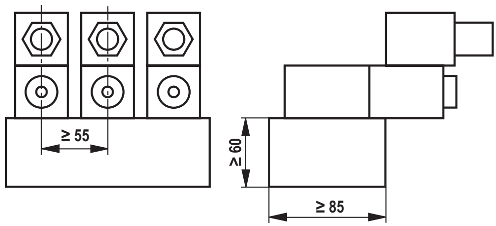
	Individual assembly	Bank assembly
Dimensions of the subplate	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram

Individual assembly



Bank assembly



Important:
In case of bank assembly, only one solenoid of all valves may be energized at a time.

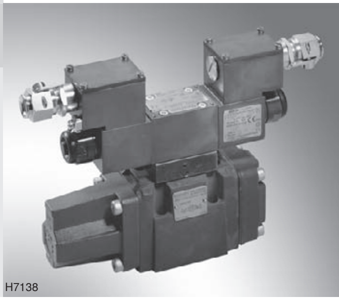
Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

4/2, 4/3 proportional directional valves, pilot operated, without electrical position feedback

RE 29115-XE-B2/09.13
Replaces: 05.11

Type 4WRZ…XE...



Actual product may differ

Sizes 10, 16, 25, 32
Component series 7X
Maximum operating pressure 350 bar
Maximum flow 1600 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

– Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
– Type of protection of the valve solenoid: Ex e mb IIC T4 Gb according to EN 60079-7:2007/EN 60079-18:2009

Special features of seawater-resistant valves

– The exterior of the valve housing is galvanically coated.
– The seawater resistance is defined by "J" in the ordering code.

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29115-XE-B0**
Part II	Data sheet 29115-XE-B2	
Part III	Product-specific instructions 29115-XE-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Contents **Page**

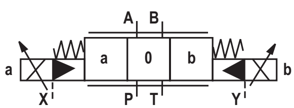
Features

- Pilot operated 2-stage proportional directional valves for controlling the flow direction and size
- Spring-centered control spool
- Actuation by means of the pilot control valve (3-way pressure reducing valve)
- Solenoid coil can be rotated by 90°
- For subplate mounting:
  Porting pattern according to ISO 4401 - … (information depending on the size)
  Subplates available in FE/ZN version (see pages 13 to 16)

Symbols (simplified)

with electrohydraulic actuation

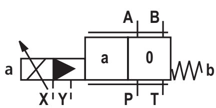
Type 4WRZ…-7X./…



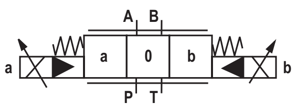
Pilot oil supply

X = external
Y = external

Type 4WRZ…A.-7X./…

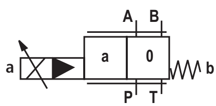


Type 4WRZ…-7X./…ET…



X = internal
Y = internal

Type 4WRZ…A.-7X./…ET…



Ordering code and scope of delivery

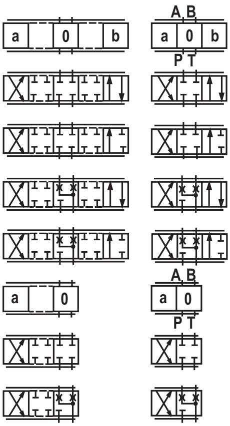
4WRZ			–7X	/ 6E	G24	XE	J		/ D3	

Electro-hydraulic actuation **= Z**

Size

Size 10 **= 10**
Size 16 **= 16**
Size 25 **= 25**
Size 32 **= 32**

Symbols



= E
E1-
= E3
= W6-
W8-
= W9-
= EA
= W6A

For control spools E1- and W8-:
P → A: $q_{V\ max}$ B → T: $q_V/2$
P → B: $q_V/2$ A → T: $q_{V\ max}$
For control spools E3- and W9-:
P → A: $q_{V\ max}$ B → T: Blocked
P → B: $q_V/2$ A → T: $q_{V\ max}$
(differential circuit, piston top at port A)
Important: In spool position "0", control spools W6-, W8-, W9-, W6A have a connection from A → T and B → T with approx. 2 % of the relevant nominal cross-section.

M = [1] NBR seals
V = FKM seals
Important: Observe compatibility of seals with hydraulic fluid used!

D3 = With pressure reducing valve (preset)

Pilot oil supply and return

no code = Pilot oil supply external, pilot oil return external
E = Pilot oil supply internal, pilot oil return external
ET = Pilot oil supply internal, pilot oil return internal
T = Pilot oil supply external, pilot oil return internal
For details, see page 17.

Surface protection

J = Seawater-resistant, galvanically coated

XE = Explosion protection, "increased safety", for details see information on the explosion protection, page 7

Supply voltage of the control electronics

G24 = 24 V direct voltage

6E = Proportional solenoid

7X = Component series 70 to 79 (70 to 79: Unchanged installation and connection dimensions)

Rated flow

25 = 25 l/min (size 10)
50 = 50 l/min (size 10)
85 = 85 l/min (size 10)

100 = 100 l/min (size 16)
150 = 150 l/min (size 16)

220 = 220 l/min (size 25)
325 = 325 l/min (size 25)

360 = 360 l/min (size 32)
520 = 520 l/min (size 32)
Characteristic curves, see pages 9 to 12

Included in the scope of delivery:

Valve operating instructions with declaration of conformity in Part III

[1] Suitable for mineral oils (HL, HLP) according to DIN 51524

4

Function, section

Pilot control valve type 3DREP 6…

The pilot control valve is a 3-way pressure reducing valve that is actuated by a proportional solenoid. It converts an electrical input signal into a proportional pressure output signal and is used for all valves type 4WRZ ...

The proportional solenoids are controllable wet-pin DC solenoids. The solenoids are actuated by external control electronics.

Set-up:

The valve basically consists of:

- Housing (1) with connection surface
- Control spool (2) with pressure measuring pins (3 and 4)
- Solenoids (5 and 6) with central thread

Functional description:

The pressure in A or B is set by means of the proportional solenoids. The amount of the pressure depends on the current.

With de-energized solenoids (5, 6), the control spool (2) is held in the central position by means of the compression springs (8). Ports A and B are connected with T so that the hydraulic fluid can flow off to the tank without obstructions.

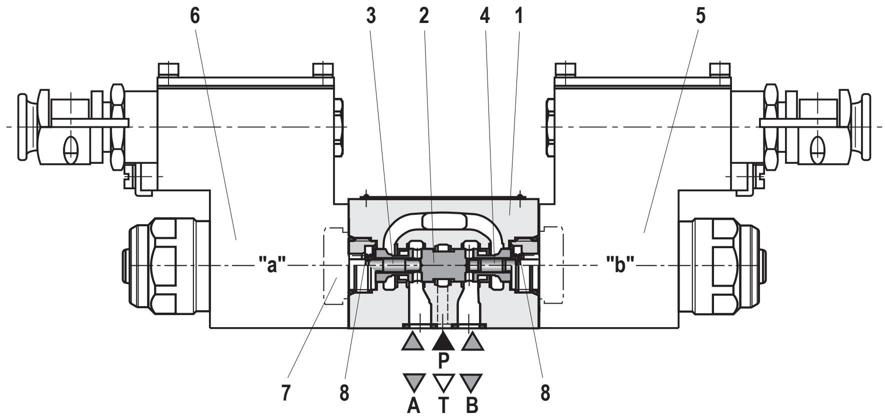
By actuating a proportional solenoid, e.g. solenoid "b" (5), the pressure measuring pin (4) and the control spool (2) with it are moved to the left. This opens the connection from P to A and B to T via orifice-type cross-sections with progressive flow characteristics. With the surface of the pressure measuring pin (3) the pressure that builds up in channel A acts on the control spool and against the solenoid force. The pressure measuring pin (3) is supported by the solenoid "a". If the pressure exceeds the value set at solenoid "b", the control spool (2) is pushed back against the solenoid force and connects A with T until the set pressure is achieved again. The pressure is proportional to the solenoid current.

When the solenoid is switched off, the control spool (2) is returned to the central position by the compression springs (8).

Important:

If valves version 3DREP 6 **C** are used, only one solenoid may be actuated at a time.

Type 3DREP 6..2X/..XE...



Valve with two spool positions

(type 3DREP 6…A…)

The function of this valve version basically corresponds to the valve with three spool positions. This 2 spool position valve is, however, only equipped with solenoid "b" (5). Instead of the 2nd proportional solenoid, there is a plug screw (7).

Important:

The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve (preload pressure approx. 2 bar) must be installed.

Function, section

Pilot operated proportional directional valves

Type 4WRZ…-7X/..XE...

Valves of the type 4WRZ... are pilot operated 4-way directional valves that are actuated by means of proportional solenoids. Their function is to control the flow direction and size.

Set-up:

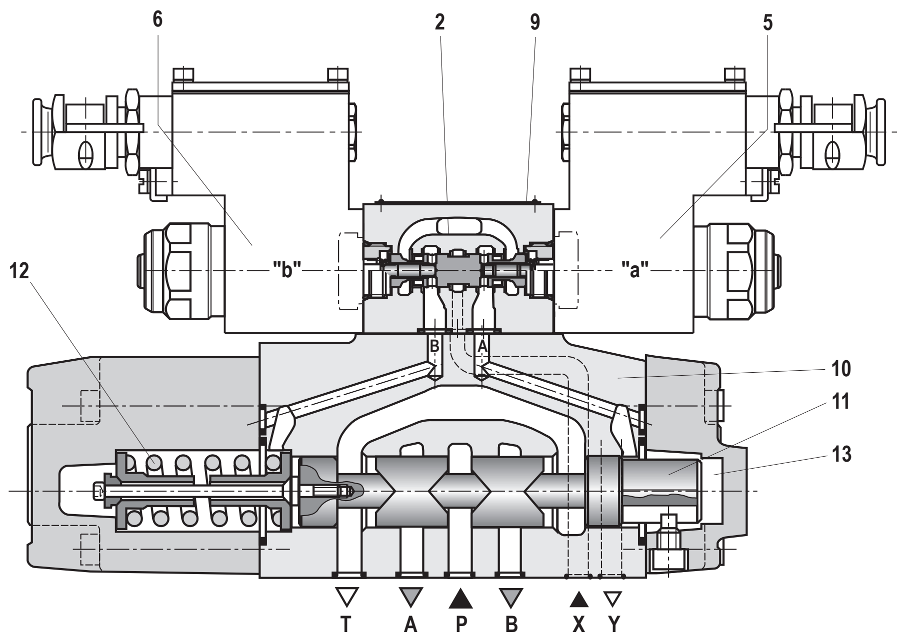
The valve basically consists of:

- Pilot control valve (9) with proportional solenoids (5 and 6)
- Main valve (10) with main control spool (11) and centering spring (12)

Functional description:

- With de-energized solenoids (5 and 6), the main control spool (11) is held in central position by means of a centering spring (12).
- Actuation of the main control spool (11) by means of the pilot control valve (9) – the main control spool is proportionally moved – e.g. actuation of solenoid "b" (6)
  - → Displacement of the control spool (2) to the right, pilot oil reaches the pressure chamber (13) pilot control valve (9) and displaces the main control spool (11) proportionally to the electrical input signal to the left
  - → Connection of P → A and B → T via orifice-type cross-sections with progressive flow characteristics
- Pilot oil supply to the pilot control valve internally via port P or externally via port X
- Switching off the solenoid (6)
  - → Control spool (2) and main control spool (11) are returned to central position
- Flow depending on spool position from P → A and B → T or P → B and A → T.

Type 4WRZ…-7X/..XE...



Technical data

general

Installation position			Any, preferably horizontal
Storage temperature range		°C	–20 … +50
Ambient temperature range		°C	–20 … +60
Weight, maximum	Size 10	kg	10
	Size 16	kg	16
	Size 25	kg	21
	Size 32	kg	45
Surface protection			Galvanized coating

hydraulic

Size		Size	**10**	**16**	**25**	**32**
Operating pressure range						
Pilot control valve	Pilot oil supply external or internal	bar	30 … 315	30 … 350	30 … 350	30 … 350
Main valve		bar	Up to 315	Up to 350	Up to 350	Up to 350
Return flow pressure	Port T (external pilot oil return)	bar	Up to 315	Up to 250	Up to 250	Up to 150
	Port T (internal pilot oil return)	bar	Up to 30	Up to 30	Up to 30	Up to 30
	Port Y	bar	Up to 30	Up to 30	Up to 30	Up to 30
Pilot volume for switching process 0 → 100 %		cm^3	1.7	4.6	10	26.5
Pilot flow at port X and Y with stepped input signal 0 → 100 %		l/min	3.5	5.5	7	15.9
Flow of the main valve		l/min	Up to 170	Up to 460	Up to 870	Up to 1600
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Additional hydraulic fluids upon request! Ignition temperature > 180 °C			
Hydraulic fluid temperature range		°C	–20 ... +80 (NBR seals)			
		°C	–15 ... +80 (FKM seals)			
Viscosity range		mm^2/s	20 ... 380 (preferably 30 ... 46)			
Maximum admissible degree of contamination of the hydraulic fluid						
Cleanliness class according to ISO4406 (c)	Pilot control valve		Class 17/15/12 [1]			
	Main valve		Class 18/16/13 [1]			
Hysteresis		%	≤ 6			

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

Technical data

electric

Voltage type		Direct current or pulse-width modulated signal with a pulse voltage ≤ 28 V and a frequency ≥ 160 Hz up to max. 500 Hz
Type of signal		Analog
Maximum current per solenoid	A	1.03
Duty cycle	%	100
Coil temperature	°C	Up to 125

Information on the explosion protection

Area of application in accordance with the Explosion Protection Directive 94/9/EC	II 2G
Type of protection Valve according to EN 13463-1:2009 / EN 13463-5:2011	c T4 X
Type of protection Valve solenoid according to EN 60079-7:2007 / EN 60079-18:2009	Ex e mb IIC T4 Gb [1]
Type examination certificate Solenoid	KEMA 02ATEX2240 X
"IECEx Certificate of Conformity" Solenoid	IECEx DEK 12.0068X
Special operating conditions for a safe application	– In case of bank assembly, only one solenoid of all valves may be energized at a time. – In case of valves with two solenoids, maximally one of the solenoids may be energized at a time. – Only direct current or a pulse-width modulated signal with a pulse voltage ≤ 28 V and frequency ≥ 160 Hz up to max. 500 Hz may be used.

Control electronics [2]

Amplifier module for the control of explosion-proof proportional directional valves 4WRA...XE, 3DREP 6...XE and 4WRZ...XE	VT-MSPA2-200-1X/V0/0 according to data sheet 30228-200
Module for monitoring and limiting the solenoid currents with proportional valves	VT-MUXA2-2-1X/V0/1A according to data sheet 30290

[1] Surface temperature > 50 °C, provide contact protection

[2] **Important:**
A monitoring circuit is to be provided for the monitoring of the solenoid current. We recommend operating the valves with the assemblies described herein.

Electrical connection

The type-examination tested valve solenoid is equipped with a terminal box and a type-tested cable gland.

The connection is polarity-independent.

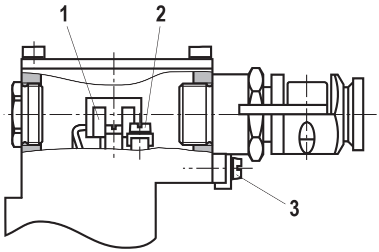
Important:

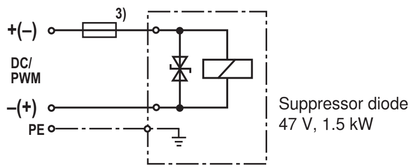
Corresponding to the rated current, a fuse according to DIN 41571 and EN / IEC 60127 has to be connected ahead of every valve solenoid (max. 3 x I_{rated}).

The shut-off threshold of the fuse has to match the prospective short-circuit current of the supply source.

The prospective short-circuit current of the supply source may amount to a maximum of 1500 A.

This fuse may only be installed outside the explosive area or must be of an explosion-proof design.





3) Recommended pre-fuse
Characteristics medium time-lag according to DIN 41571, 1.25 A

Properties of the connection terminals

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 … 2.5 mm² Finely stranded 0.75 … 1.5 mm²
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm² Finely stranded max. 1.5 mm²
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm² Finely stranded 4 mm²

Cable gland

Type approval		II 2G Ex e IIC Gb
Threaded connection		M20 x 1.5
Protection class according to EN 60529		IP66 1)
Line diameter	mm	9 … 11
Sealing		Outer sheath sealing

Connection line

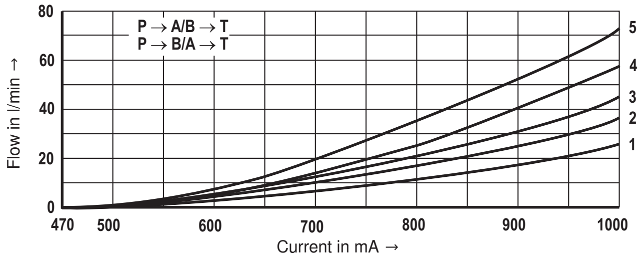
Line type		**Non-armored** cables and lines (outer sheath sealing)
Temperature range	°C	–30 … > +110

1) If installed properly

Characteristic curves size 10
(measured with control spools E, W6-, EA, W6A as well as HLP46, ϑ_{oil} = 40 °C ± 5 °C)

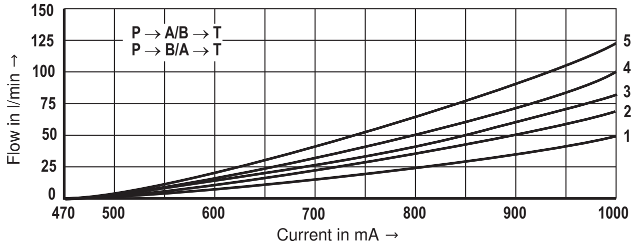
Ordering code 25: Flow

1 Δp = 10 bar constant
2 Δp = 20 bar constant
3 Δp = 30 bar constant
4 Δp = 50 bar constant
5 Δp = 100 bar constant



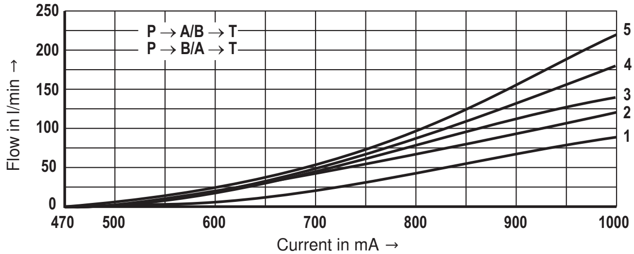
Ordering code 50: Flow

1 Δp = 10 bar constant
2 Δp = 20 bar constant
3 Δp = 30 bar constant
4 Δp = 50 bar constant
5 Δp = 100 bar constant



Ordering code 85: Flow

1 Δp = 10 bar constant
2 Δp = 20 bar constant
3 Δp = 30 bar constant
4 Δp = 50 bar constant
5 Δp = 100 bar constant

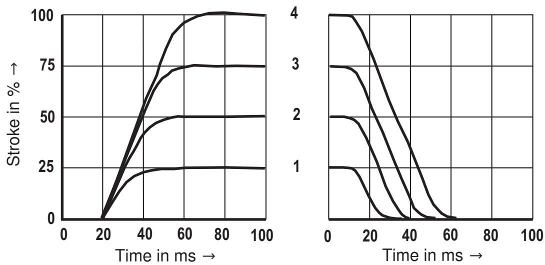


Δp = valve pressure differential according to DIN 24311 (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Transition function with stepped electric input signals

	Change of input signal [%]
1	0 → 25 → 0
2	0 → 50 → 0
3	0 → 75 → 0
4	0 → 100 → 0

Measured at pilot pressure
p_{ST} = 50 bar

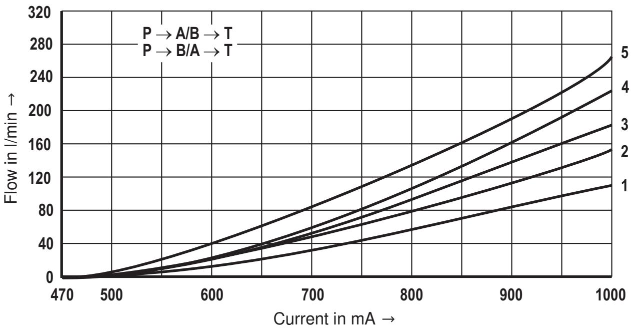


4

Characteristic curves size 16
(measured with control spools E, W6-, EA, W6A as well as HLP46, ϑ_{oil} = 40 °C ± 5 °C)

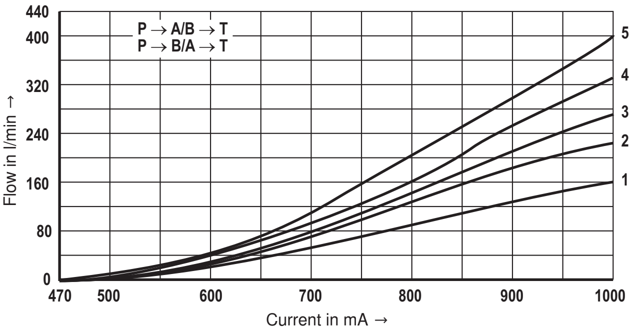
Ordering code 100: Flow

1. Δp = 10 bar constant
2. Δp = 20 bar constant
3. Δp = 30 bar constant
4. Δp = 50 bar constant
5. Δp = 100 bar constant



Ordering code 150: Flow

1. Δp = 10 bar constant
2. Δp = 20 bar constant
3. Δp = 30 bar constant
4. Δp = 50 bar constant
5. Δp = 100 bar constant

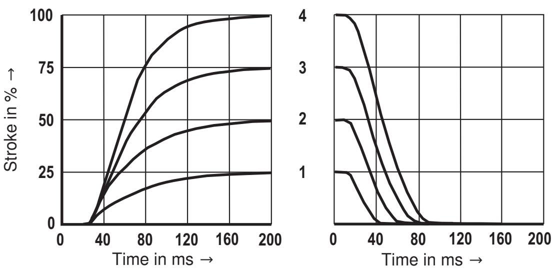


Δp = valve pressure differential according to DIN 24311 (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Transition function with stepped electric input signals

	Change of input signal [%]
1	0 → 25 → 0
2	0 → 50 → 0
3	0 → 75 → 0
4	0 → 100 → 0

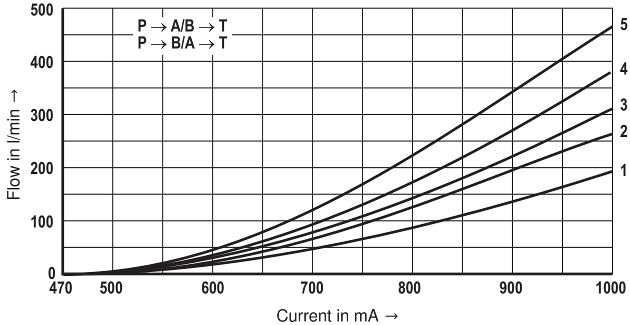
Measured at pilot pressure
p_{ST} = 50 bar



Characteristic curves size 25
(measured with control spools E, W6-, EA, W6A as well as HLP46, ϑ_{oil} = 40 °C ± 5 °C)

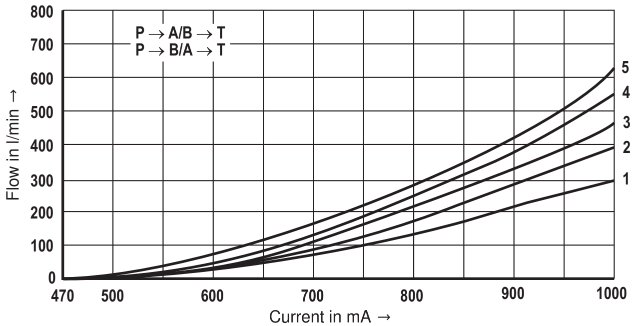
Ordering code 220: Flow

1 Δp = 10 bar constant
2 Δp = 20 bar constant
3 Δp = 30 bar constant
4 Δp = 50 bar constant
5 Δp = 100 bar constant



Ordering code 325: Flow

1 Δp = 10 bar constant
2 Δp = 20 bar constant
3 Δp = 30 bar constant
4 Δp = 50 bar constant
5 Δp = 100 bar constant

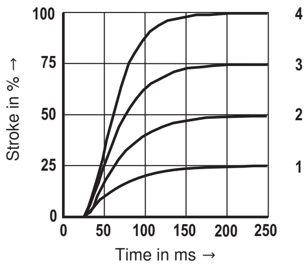


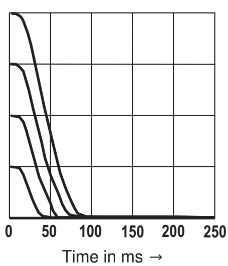
Δp = valve pressure differential according to DIN 24311 (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Transition function with stepped electric input signals

	Change of input signal [%]
1	0 → 25 → 0
2	0 → 50 → 0
3	0 → 75 → 0
4	0 → 100 → 0

Measured at pilot pressure p_{ST} = 50 bar

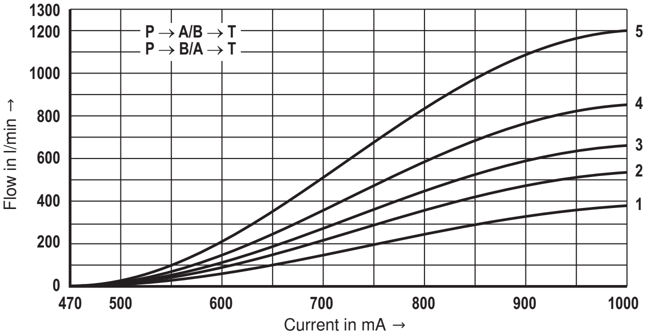




Characteristic curves size 32
(measured with control spools E, W6-, EA, W6A as well as HLP46, ϑ_{oil} = 40 °C ± 5 °C)

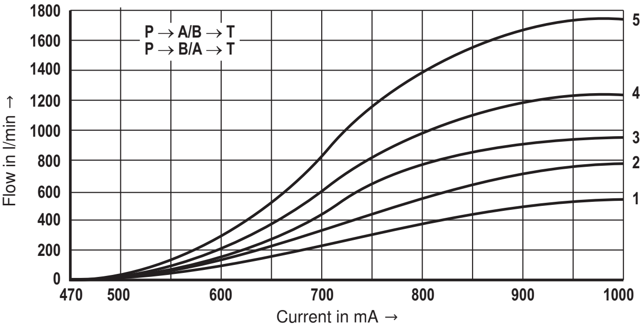
Ordering code 360: Flow

1 Δp = 10 bar constant
2 Δp = 20 bar constant
3 Δp = 30 bar constant
4 Δp = 50 bar constant
5 Δp = 100 bar constant



Ordering code 520: Flow

1 Δp = 10 bar constant
2 Δp = 20 bar constant
3 Δp = 30 bar constant
4 Δp = 50 bar constant
5 Δp = 100 bar constant

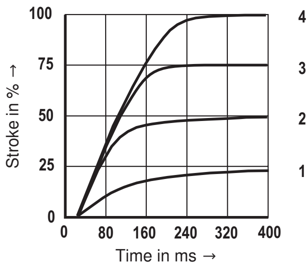


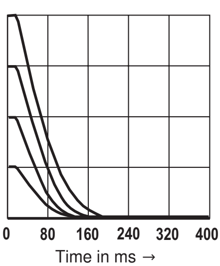
Δp = valve pressure differential according to DIN 24311 (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Transition function with stepped electric input signals

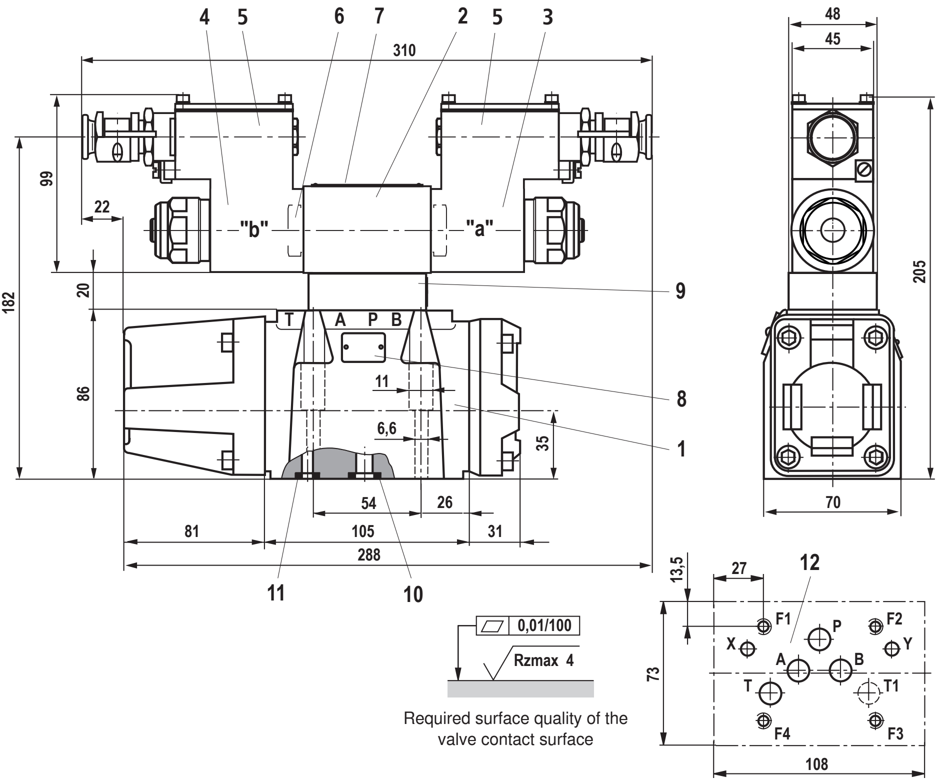
	Change of input signal [%]
1	0 → 25 → 0
2	0 → 50 → 0
3	0 → 75 → 0
4	0 → 100 → 0

Measured at pilot pressure
p_{ST} = 50 bar





Dimensions size 10 (dimensions in mm)



Required surface quality of the valve contact surface

1 Main valve
2 Pilot control valve
3 Proportional solenoid "a"
4 Proportional solenoid "b"
5 Terminal box
6 Plug screw for valves with one solenoid
7 Name plate for pilot control valve
8 Name plate for main valve
9 Pressure reducing valve (always available)
10 Identical seal rings for ports P, A, B, T and T1
11 Identical seal rings for X and Y
12 Machined valve contact surface, porting pattern according to ISO 4401-05-05-0-05 (X, Y as required, T1 is available at the valve and can optionally be provided)

Deviating from the standard:
- Locating pin not available

Subplates

G 534/01 FE/ZN (G3/4) **without** ports X and Y
G 535/01 FE/ZN (G3/4) **with** ports X and Y
G 536/01 FE/ZN (G1) **with** ports X and Y

with dimensions as in the data sheet 45054 must be ordered separately.

Valve mounting screws

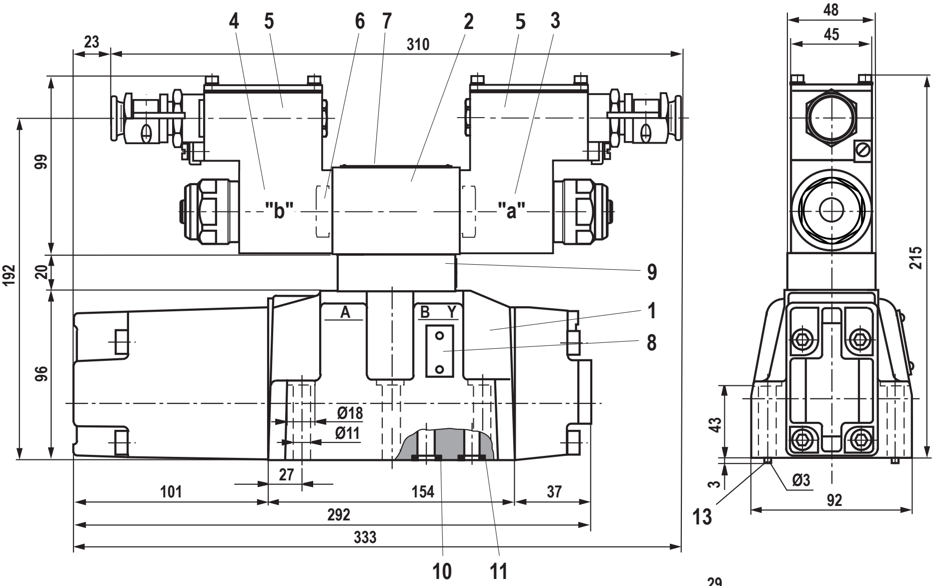
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x45-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

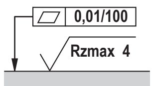
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

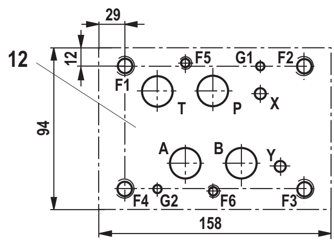
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Dimensions size 16 (dimensions in mm)





Required surface quality of the valve contact surface



1 Main valve
2 Pilot control valve
3 Proportional solenoid "a"
4 Proportional solenoid "b"
5 Terminal box
6 Plug screw for valves with one solenoid
7 Name plate for pilot control valve
8 Name plate for main valve
9 Pressure reducing valve (always available)
10 Identical seal rings for ports P, A, B and T
11 Identical seal rings for X and Y
12 Machined valve contact surface valve contact face, porting pattern according to ISO 4401-07-07-0-05 (X, Y as required)
Deviating from the standard:
– Ports P, A, B and T with Ø 20 mm
13 Locating pin

Subplates

G 172/01 FE/ZN (G3/4) G 172/02 FE/ZN (M27 x 2)
G 174/01 FE/ZN (G1)
G 174/02 FE/ZN (M33 x 2) G 174/08 FE/ZN (flange)

with dimensions as in the data sheet 45056 must be ordered separately.

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:

2 hexagon socket head cap screws
ISO 4762-M6x60-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

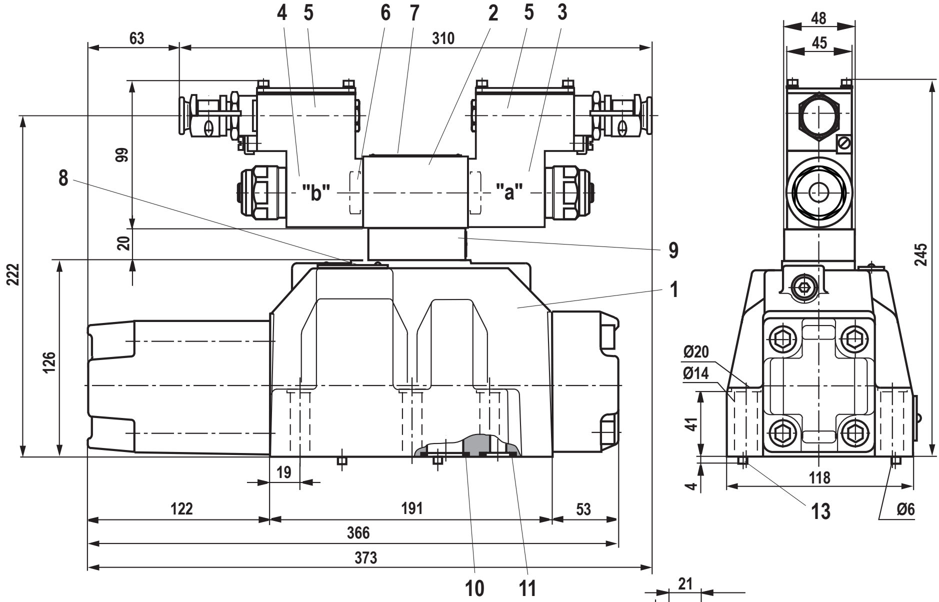
4 hexagon socket head cap screws
ISO 4762-M10x60-10.9-flZn-240h-L
(total friction coefficient: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

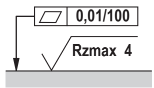
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

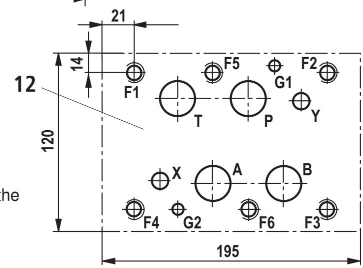
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Dimensions size 25 (dimensions in mm)





Required surface quality of the valve contact surface



1. Main valve
2. Pilot control valve
3. Proportional solenoid "a"
4. Proportional solenoid "b"
5. Terminal box
6. Plug screw for valves with one solenoid
7. Name plate for pilot control valve
8. Name plate for main valve
9. Pressure reducing valve (always available)
10. Identical seal rings for ports P, A, B and T
11. Identical seal rings for X and Y
12. Machined valve contact surface, porting pattern according to ISO 4401-08-08-0-05 (X, Y as required)
13. Locating pin

Subplates

G 151/01 FE/ZN (G1)
G 154/01 FE/ZN (G1 1/4) G 154/08 FE/ZN (flange)
G 156/01 FE/ZN (G1 1/2)

with dimensions as in the data sheet 45058 must be ordered separately.

Valve mounting screws

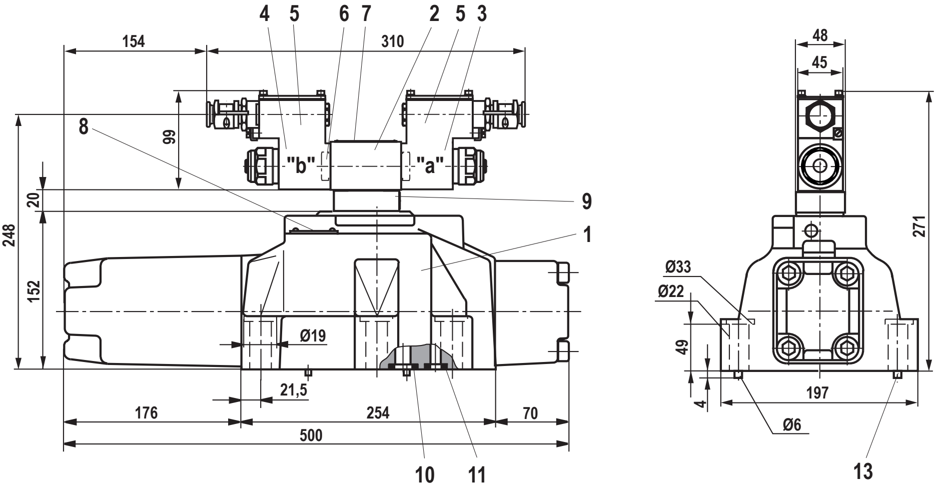
For reasons of stability, exclusively use the following valve mounting screws:
6 hexagon socket head cap screws
ISO 4762-M12x60-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

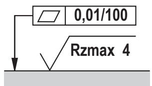
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

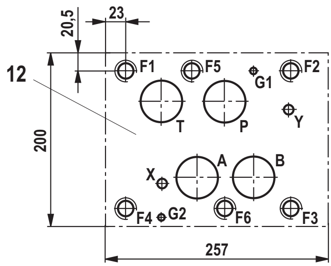
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Dimensions size 32 (dimensions in mm)





Required surface quality of the valve contact surface



1 Main valve
2 Pilot control valve
3 Proportional solenoid "a"
4 Proportional solenoid "b"
5 Terminal box
6 Plug screw for valves with one solenoid
7 Name plate for pilot control valve
8 Name plate for main valve
9 Pressure reducing valve (always available)
10 Identical seal rings for ports P, A, B and T
11 Identical seal rings for X and Y
12 Machined valve contact surface, porting pattern according to ISO 4401-10-09-0-05 (X, Y as required)

Deviating from the standard:
– Ports P, A, B and T with Ø 38 mm

13 Locating pin

Subplates

G 157/01 FE/ZN (G1 1/2)
G 157/02 FE/ZN (M48 x 2)
G 158/10 FE/ZN (flange)

with dimensions as in the data sheet 45060 must be ordered separately.

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
6 hexagon socket head cap screws
ISO 4762-M20x80-10.9-flZn-240h-L
(friction coefficient total: 0.09-0.14 according to VDA 235-101)
(must be ordered separately)

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Pilot oil supply

Type 4WRZ…-…/…

Pilot oil supply external
Pilot oil return external

In this version, the pilot oil is supplied from a separate pilot circuit (external).

The pilot oil return is not directed into the T channel of the main valve, but is separately directed to the tank via port Y (external).

Type 4WRZ…-…/…E…

Pilot oil supply internal
Pilot oil return external

In this version, the pilot oil is supplied via the P channel of the main valve (internal).

The pilot oil return is not directed into the T channel of the main valve, but is separately directed to the tank via port Y (external).

In the subplate, port X is to be closed.

Type 4WRZ…-…/…ET…

Pilot oil supply internal
Pilot oil return internal

In this version, the pilot oil is supplied via the P channel of the main valve (internal).

The pilot oil is directly returned to channel T of the main valve (internal).

In the subplate, ports X and Y are to be closed.

Type 4WRZ…-…/…T…

Pilot oil supply external
Pilot oil return internal

In this version, the pilot oil is supplied from a separate pilot circuit (external).

The pilot oil is directly returned to channel T of the main valve (internal).

In the subplate, port Y is to be closed.

Notes

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Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

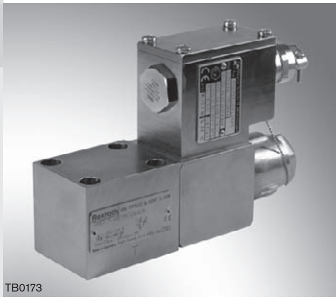
Rexroth
Bosch Group

Proportional pressure relief valve directly operated

RE 29162-XE-B2/01.08

Type DBET…/…XE

Nominal size 6
Unit series 6X
Maximum operating pressure 420 bar
Maximum flow rate 2 l/min



TB0173

ATEX units
For potentially explosive atmospheres

Part II Technical Data Sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive and type of protection

– Range of application as per 94/9/EG
– **II2G:** Type of protection Ex e mb IIT4 as per EN 60079-0:2004, EN 60079-7:2003 and EN 60079-18:2004
– **II2D:** Type of protection Ex tD A21 T130°C IP67 as per prEN 61241-0:2005 and EN 61241-1:2005

What you need to know about these Operating Instructions

These Operating Instructions apply to the explosion-proof version of Rexroth valves, and consist of the following three parts:

Part I General Information RE 07010-X-B1
Part II Technical Data Sheet RE 29162-XE-B2
Part III Product-specific Instructions RE 29162-XE-B3

Mat. No. R901172919

You can find further information on the correct handling of Rexroth hydraulic products in our publication “General product information for hydraulic products”, RE 07008.

Overview of Contents

Features

– Directly operated proportional pressure relief valve with solenoid actuation for proper use in potentially explosive atmospheres
– For subplate mounting:
  Mounting hole configuration as per ISO 4401-03-02-0-05
– Wet-pin DC solenoid
– Electrical connection is a single terminal with cable gland
– The metal outer parts are galvanized for protection against corrosion (resistance to seawater)

Ordering data and scope of delivery

DBET	–	–	6X	/			G24	XE	J	V

Proportional pressure relief valve

Solenoid position
Viewing direction: looking at cable gland

Facing upwards	**= 1**
To the right	**= 2**
Facing downwards	**= 3**
To the left	**= 4**

Unit series 60 to 69 **= 6X**
(60 to 69: installation and connection dimensions unchanged)

Max. pressure stage

Up to 50 bar	**= 50**
Up to 100 bar	**= 100**
Up to 200 bar	**= 200**
Up to 315 bar	**= 315**
Up to 350 bar	**= 350**
Up to 420 bar	**= 420**

Internal control oil return **= no code**
External control oil return
(Y connected internally to T) **= Y**

Voltage 24 V DC **= G24**

XE = "Increased safety" explosion protection
See information on explosion protection, page 6, for details

Surface protection
J = Resistant to seawater

Seal material
V = FKM seals

Note:
Ensure that seals and pressure fluid are compatible!

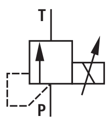
Included in scope of delivery:

Valve operating instructions with Declaration of Conformity in Part III

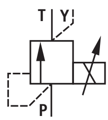
4

Symbols

Internal control oil return



External control oil return



Function, sectional diagram

General

DBET…/…XE proportional pressure relief valves are remote control poppet valves that are used to limit system pressure. They are actuated by a proportional solenoid with central thread and removable coil. The interior of the solenoid is connected to port T or Y, and is filled with pressure fluid. These valves can infinitely adjust the system pressure that needs to be limited, on the basis of an electric setpoint.

The solenoid is actuated by an external VT-MSPA1-200 amplifier (see Technical Data Sheet RE 30233-200). This amplifier must not supply the solenoid with a current in excess of 1.0 A. To achieve this required level of safety when operating the valve in a potentially explosive atmosphere, the solenoid current must be monitored and limited. For this, the VT-MUXA2 safety module (see Technical Data Sheet RE 30290) must be used.

Construction

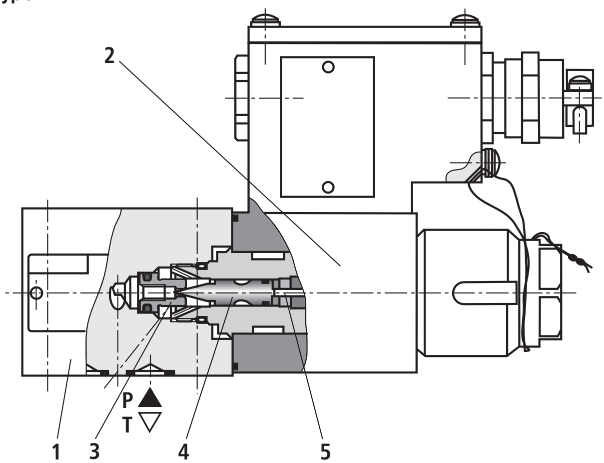
The valve basically comprises:

- Housing with mounting surface (1)
- A proportional solenoid (2)
- Valve seat (3)
- Valve cone (4)
- Armature plunger (5)

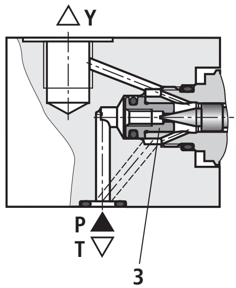
Basic principle

To adjust the system pressure, a sepoint is input in the trigger electronics. Based on this setpoint, the electronics actuate the solenoid coil with electrical current. The proportional solenoid converts the current to a mechanical force, which acts on the valve cone (4) by means of the armature plunger (5). The valve cone (4) presses onto the valve seat (3) and shuts off the connection between ports P and T or Y. If the hydraulic force acting on the valve cone (4) is equivalent to the magnetic force, the valve regulates the set pressure by lifting the valve cone (4) off the valve seat (3), so that pressure fluid can flow from port P to port T or Y. If the setpoint is zero, the proportional solenoid (2) only receives the minimum control current, and the set pressure is at the minimum level.

Type DBET…/…XE



Type DBET…/…Y…XE



Technical data

General

Installation position			Optional, preferably horizontal
Storage temperature range		°C	–20 … +70
Ambient temperature range		°C	–20 … +70
Weight		kg	2.7

Hydraulic

Max. operating pressure	Port P	bar	420
Max. set pressure at setpoint 10 V	Pressure stage 50 bar	bar	52.5
	Pressure stage 100 bar	bar	105
	Pressure stage 200 bar	bar	210
	Pressure stage 315 bar	bar	330
	Pressure stage 350 bar	bar	370
	Pressure stage 420 bar	bar	420
Max. set pressure at setpoint 0		bar	See characteristic curves, page 8
Return pressure	Ports T, Y	bar	0 (separate return line to tank)
Max. operating pressure	Dummy countersink A, B	bar	350
Max. flow rate		l/min	See characteristic curves, page 9 [1]
Pressure fluid			Mineral oil (HL, HLP) nach DIN 51524 Ignition temperature > 180 °C
Pressure fluid temperature range		°C	–15 … +80 (preferably +40 … +50)
Viscosity range		mm^2/s	20 … 380 (preferably 30 … 46)
Maximum permissible degree of contamination of pressure fluid Purity class to ISO 4406(c)			Class 20/18/15 [2]
Hysteresis		%	< 7 of max. set pressure
Range of inversion		%	< 0.5 of max. set pressure
Sensitivity		%	< 0.5 of max. set pressure
Linearity		%	See characteristic curves, page 8
Manufacturing tolerance of setpoint/pressure curve based on 0.8 l/min, pressure rising	at setpoint 20 %	%	< ±1.5 of max. set pressure [3]
	at setpoint 100 %	%	< ±5 of max. set pressure [4]
Step response ($T_u + T_g$) 0 → 100 % or 100 % → 0 Line volume < 20 cm^3; q_V = 0.8 l/min		ms	100 (depending on the system!)

[1] Exceeding the maximum flow rate of the pressure stage results in back pressure in port P that lies above the maximum nominal pressure of the valve.

[2] The purity classes stated for the components must be complied with in hydraulic systems. Effective filtration prevents problems and also extends the service life of components.

For a selection of filters, see Technical Data Sheets RE 50070, RE 50076 and RE 50081.

[3] Zero is calibrated at the factory

[4] Calibration is possible via the amplifier

4

Technical data

Electrical

Voltage type			DC; PWM signal 100 … 500 Hz
Signal type			Analog
Maximum current		A	1.03
Limit rating		W	13.3
Solenoid coil resistance	Cold value at 20 °C	Ω	8.3
	Maximum hot value	Ω	12.56
Cyclic duration factor		%	100
Coil temperature		°C	Up to 130
Cable gland	Threaded connection		M20 x 1.5
	Cable diameter	mm	6 … 12
	Thermal resistance	°C	–20 … +130
	Degree of protection to EN 60529:1991+A1:2000		IP 67 when mounted
	Seal material		FKM
Required thermal resistance of connecting cable		°C	≥ 115

Information on explosion protection

Range of application as per Directive RL 94/9/EG	II2G, II2D
Type of protection of valve	c (EN 13463-5:2001-01)
Maximum surface temperature [1]	130°C (T4)
Type of protection of solenoid	II2G Ex e mb IIT4 as per EN 60079-0:2004, EN 60079-7:2003 as per EN 60079-18:2004 II2D Ex tD A21 T130°C IP67 as per prEN 61241-0:2005 and EN 61241-1:2005
Type test certification of solenoid	EX5 06 04 39919 009
Special conditions for safe use	

Trigger electronics

Amplifier in modular design [2]	VT-MSPA1-200 (Data Sheet RE 30223-200)
Safety module [2]	VT-MUXA2-1(Data Sheet RE 30290-B2)

[1] As the solenoid coils may reach a high surface temperature, European standards ISO 13732-1 and EN 982 on the prevention of accidental contact must be observed

[2] See RE 30290-B2 for the electric circuitry of the valve, amplifier and safety module.

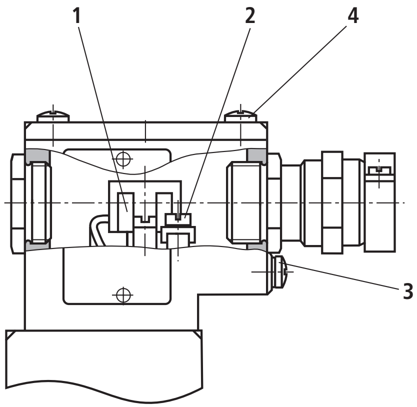
Electrical connection

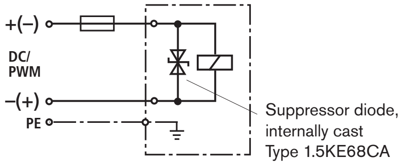
The type-tested actuating solenoid of the valve is equipped with a terminal box and a type-tested cable gland.

The connection is insensitive to polarity.

Note:

A fuse appropriate for the valve solenoid's nominal current (max. 3 x I_{nom} to EN 60127) must be connected to the solenoid on the line side, to protect against short circuit. The breaking capacity of the fuse must match the possible short-circuit current of the supply source.





Properties of terminals and fastening elements

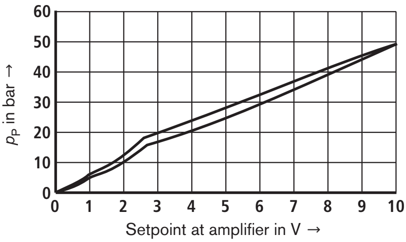
Item	Function	Connectable conductor cross-section	Tightening torque
1	Operating voltage connection	Single wire 0.75...2.5 mm^2 Stranded 0.75...1.5 mm^2	0.4 … 0.5 Nm
2	Connection for protective earth conductor	Single wire up to 2.5 mm^2 Stranded up to 1.5 mm^2	1.4 … 2.4 Nm
3	Connection for equipotential bonding conductor	Single wire up to 4 mm^2 Stranded up to 4 mm^2	3.5 … 4.5 Nm
4	Cover screws	–	1.0 … 1.1 Nm

Characteristic curves (measured with HLP46, $\vartheta_{oil} = 40\ °C \pm 5\ °C$)

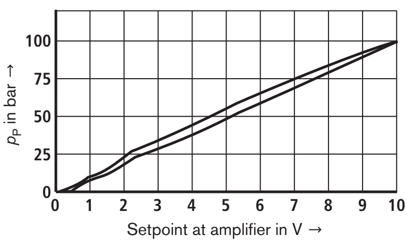
Pressure in port P (p_P) as a function of the setpoint

Measured with: Flow rate: 0.8 l/min
VT-MSPA1-200 amplifier with VT-MUXA2-1 safety module

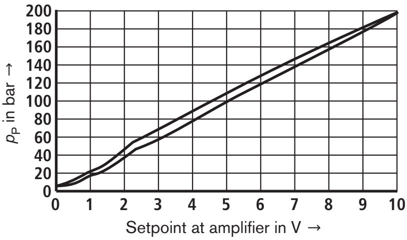
Pressure stage 50 bar



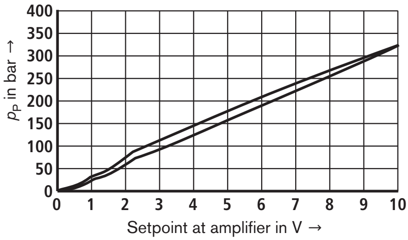
Pressure stage 100 bar



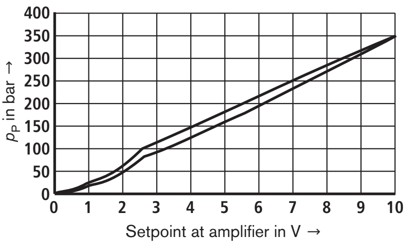
Pressure stage 200 bar



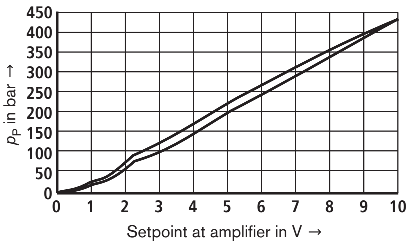
Pressure stage 315 bar



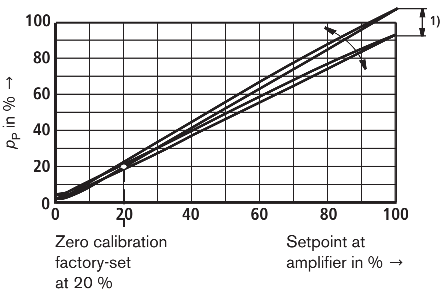
Pressure stage 350 bar



Pressure stage 420 bar



Calibration of manufacturing tolerance



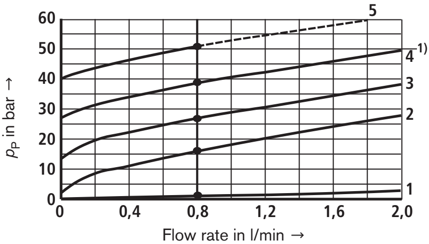
1) The manufacturing tolerance can be compensated using the Gw potentiometer of the series-connected VT-MSPA1-200 amplifier.

Characteristic curves (measured with HLP46, $\vartheta_{oil} = 40\ °C \pm 5\ °C$)

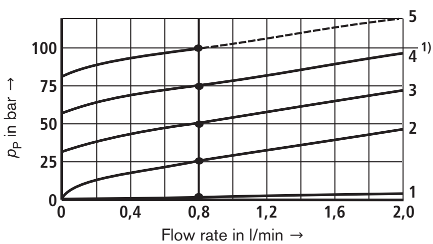
Pressure in port P (p_P) as a function of the flow rate

VT-MSPA1-200 amplifier with VT-MUXA2-1 safety module.

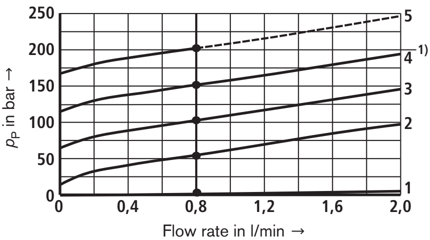
Pressure stage 50 bar



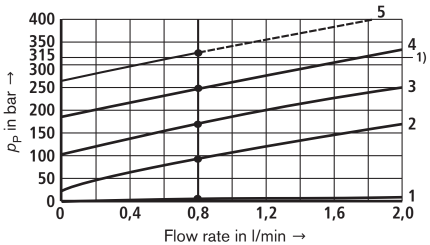
Pressure stage 100 bar



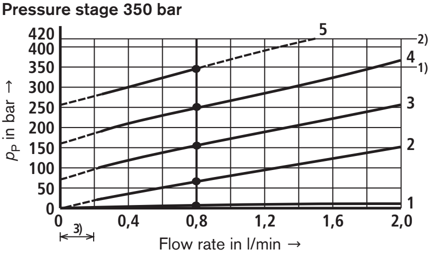
Pressure stage 200 bar



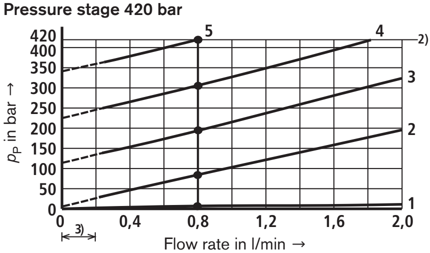
Pressure stage 315 bar



Pressure stage 350 bar



Pressure stage 420 bar



1) Flow rate limit of pressure stage

2) Flow rate limit and maximum pressure

3) Theoretical curve profile at a flow rate less than 0.2 l/min

Applicable for all pressure stages:

Curve 1 = 0 % setpoint

Curve 2 = 25 % setpoint

Curve 3 = 50 % setpoint

Curve 4 = 75 % setpoint

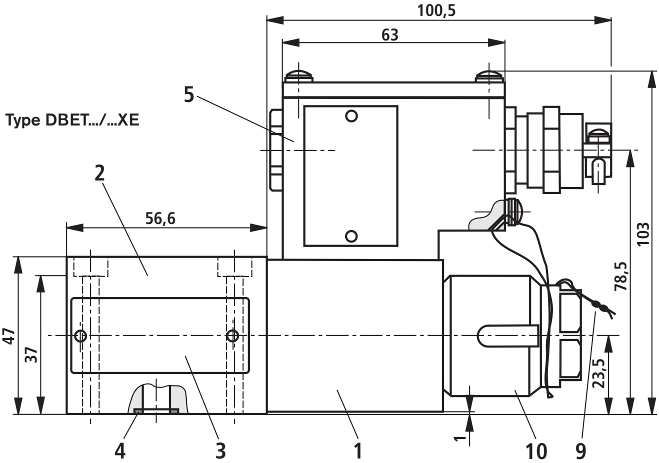
Curve 5 = 100 % setpoint

The curves were measured without back pressure in port T ($p_T = 0$ bar).

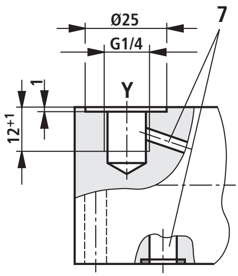
4

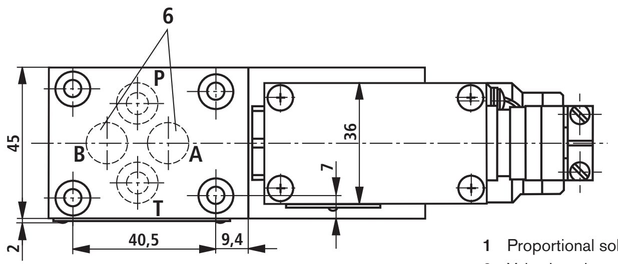
Unit dimensions (in mm)

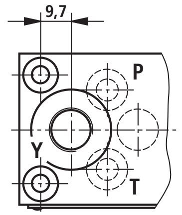
Type DBET.../...XE

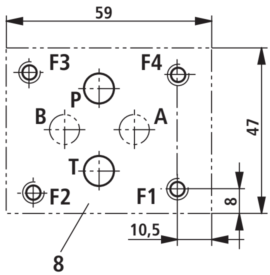


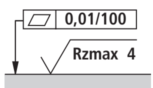
Type DBET.../...Y...XE











Required surface quality of valve bearing surface

1 Proportional solenoid
2 Valve housing
3 Nameplate
4 Same seals for ports P, A, B and T
5 Terminal box
6 Dummy countersinks A and B
7 In version ..Y.. (external control oil return), port Y is internally connected to port T
Port T is **not** plugged
8 Machined valve bearing surface, position of ports as per ISO 4401-03-02-0-05
Different from the standard:
– No locating pin
– "A" and "B" ducts **not** drilled
9 Factory setting secured by retaining wire
10 Fastening nuts for solenoid

Valve fastening bolts:
(not included in scope of delivery)
In order to ensure a secure connection, use only the following valve fastening bolts:

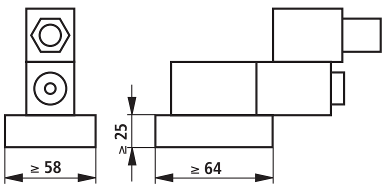
4 cheese-head bolts
ISO 4762-M5X45-10.9-flZn-240h-L
(coefficient of friction 0.09 - 0.14 to VDA 235-101);
Order separately, Mat. No. **R913000140**

Installation conditions (dimensions in mm)

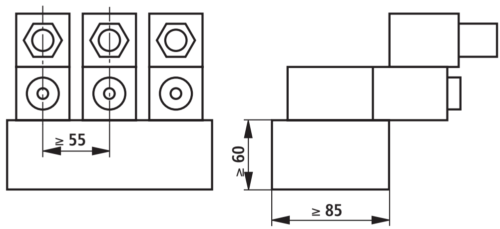
	Single assembly	Bank assembly
Subplate dimensions	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of subplate (based on 300°C)	≥ 35,2 W / (K · m), (EN-GJS-500-7 to DIN EN 1563:2005)	
Minimum distance between valve longitudinal axes	≥ 55 mm	

Block diagram

Single assembly



Bank assembly



Notes

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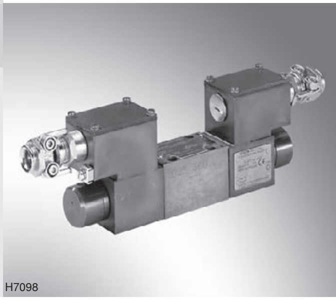
Telefax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

Proportional pressure reducing valve in 3-way version

RE 29184-XE-B2/09.13
Replaces: 12.03

Type 3DREP 6 ../..XE...

Size 6
Component series 2X
Maximum operating pressure 100 bar
Maximum flow 15 l/min



Actual product may differ

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
- Type of protection of the valve solenoid: Ex e mb IIC T4 Gb according to EN 60079-7:2007/EN 60079-18:2009

Special features of seawater-resistant valves

- The exterior of the valve housing is galvanically coated.
- The seawater-resistance is defined by "J" in the ordering code.

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29184-XE-B0**
Part II	Data sheet 29184-XE-B2	
Part III	Product-specific instructions 29184-XE-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

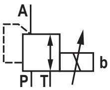
- Direct operated proportional pressure reducing valve with solenoid actuation for proper use in explosive atmospheres
- For subplate mounting:
  Porting pattern according to ISO 4401-03 -02-05
- Subplates available in FE/ZN version (see page 9)
- Wet-pin DC solenoids
- Solenoid coil can be rotated by 90°
- Electrical connection as individual connection with cable gland

Ordering code and scope of delivery

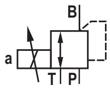
3DREP	6		–2X /		E	G24	XE	J /	

Size = 6

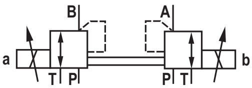
Symbols (simplified)



= A



= B



= C

Component series 20 to 29 = 2X
(20 to 29: Unchanged installation and mounting dimensions)

Pressure rating 16 bar = 16
Pressure rating 25 bar = 25
Pressure rating 45 bar = 45

E = Proportional solenoid

Supply voltage of the control electronics
G24 = 24 V direct voltage

XE = Explosion protection "increased safety", for details see information on the explosion protection page 6

Surface protection
J = Seawater-resistant, galvanized

M = NBR seals [1)]
V = FKM seals
Important:
Observe compatibility of seals with hydraulic fluid used!

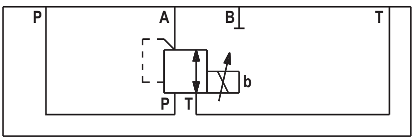
Included in the scope of delivery:
Valve operating instructions with declaration of conformity in Part III

[1)] Suitable for mineral oils (HL, HLP) according to DIN 51524

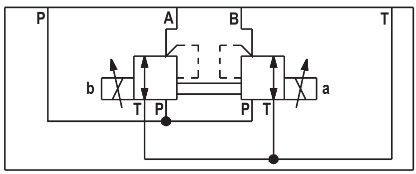
4

Symbols

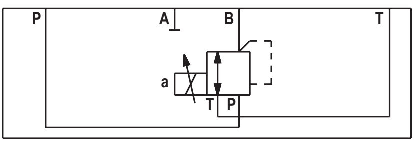
Type 3DREP.. 6 **A** 2X/... (detailed)



Type 3DREP.. 6 **C** 2X/... (detailed)



Type 3DREP.. 6 **B** 2X/... (detailed)



Function, section

The 3-way pressure reducing valve type 3DREP 6.. is direct operated by proportional solenoids. It converts an electrical input signal into a proportional pressure output signal.

The proportional solenoids are controllable wet-pin DC solenoids. The solenoids are actuated by external control electronics.

Set-up:

The valve basically consists of:

– Housing (1) with connection surface
– Control spool (2) with pressure measuring pins (3 and 4)
– Solenoids (5 and 6) with central thread

Functional description:

The pressure in A or B is set by means of the proportional solenoids. The amount of the pressure depends on the current.

With de-energized solenoids (5, 6), the control spool (2) is held in the central position by means of the compression springs (8). Ports A and B are connected with T so that the hydraulic fluid can flow off to the tank without obstructions.

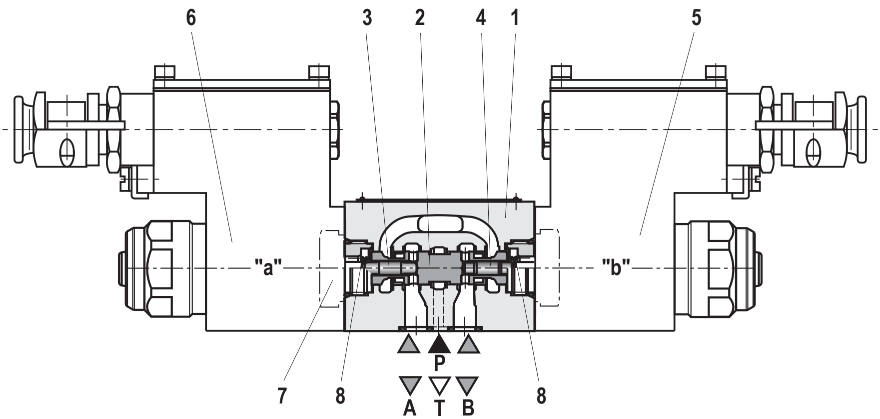
When one proportional solenoid is actuated, e.g. solenoid "b" (5), the pressure measuring pin and the control spool (2) are moved to the left. This opens the connection from P to A and B to T via orifice-type cross-sections with progressive flow characteristics. With the surface of the pressure measuring pin (3) the pressure that builds up in channel A acts on the control spool and against the solenoid force. The pressure measuring pin (3) is supported by the solenoid "a". If the pressure exceeds the value set at solenoid "b", the control spool (2) is pushed back against the solenoid force and connects A with T until the set pressure is achieved again. The pressure is proportional to the solenoid current.

When the solenoid is switched off, the control spool (2) is returned into the central position by the compression springs (8).

Important:

Regarding valves of the version 3DREP 6 **C,** only one solenoid may be actuated at a time.

Type 3DREP 6..2X/..XE..



Valve with two spool positions

(type 3DREP 6…A…)

The function of this valve version basically corresponds to the valve with three spool positions. This 2 spool position valve is, however, only equipped with solenoid "b" (5). Instead of the 2nd proportional solenoid, there is a plug screw (7).

Important:

The tank line must not be allowed to run empty. With corresponding installation conditions, a preload valve (preload pressure approx. 2 bar) must be installed.

Technical data

general

Installation position			Any; preferably horizontal
Storage temperature range		°C	–20 … +50
Ambient temperature range		°C	–20 … +60
Weight	3DREP6 A/B	kg	2.7
	3DREP6 C	kg	4.4
Surface protection			Galvanized coating

hydraulic

Operating pressure range	Port P	bar	20 … 100 for pressure rating 16
		bar	30 … 100 for pressure rating 25
		bar	50 … 100 for pressure rating 45
	Port T	bar	0 … 30
Maximum flow P → A or P → B		l/min	15 (Δp = 50 bar) see characteristic curves page 7
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Additional hydraulic fluids upon request! Ignition temperature > 180 °C
Hydraulic fluid temperature range		°C	–20 ... +80 (NBR seals)
			–15 ... +80 (FKM seals)
Viscosity range		mm^2/s	20 ... 380 (preferably 30 ... 46)
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 17/15/12 [1]
Hysteresis		%	≤ 6
Repetition accuracy		%	≤ 2
Response sensitivity		%	≤ 1
Range of inversion		%	≤ 2

electric

Voltage type		Direct current or pulse-width modulated signal with pulse voltage ≤ 28 V and frequency ≥ 160 Hz up to max. 500 Hz
Type of signal		Analog
Maximum current per solenoid	A	1.03
Duty cycle	%	100
Coil temperature	°C	up to 125

4

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the life cycle of the components. For the selection of the filters see www.boschrexroth.com/filter.

Information on the explosion protection

Area of application in accordance with the Explosion Protection Directive 94/9/EC	II 2G
Type of protection Valve according to EN 13463-1:2009 / EN 13463-5:2011	c T4 X
Type of protection Valve solenoid according to EN 60079-7:2007 / EN 60079-18:2009	Ex e mb IIC T4 Gb [1]
Type examination certificate Solenoid	KEMA 02ATEX2240 X
"IECEx Certificate of Conformity" Solenoid	IECEx DEK 12.0068X
Special operating conditions for a safe application	– In case of bank assembly, only one solenoid of all valves may be energized at a time. – In case of valves with two solenoids, maximally one of the solenoids may be energized at a time. – For the operation, only direct current or a pulse-width modulated signal with pulse voltage ≤ 28 V and frequency ≥ 160 Hz up to max. 500 Hz may be used.

Control electronics [2]

Amplifier module for the control of explosion-proof proportional directional valves 4WRA...XE, 3DREP 6...XE and 4WRZ...XE	VT-MSPA2-200-1X/V0/0 according to data sheet 30228-200
Module for monitoring and limiting the solenoid currents with proportional valves	VT-MUXA2-2-1X/V0/1A according to data sheet 30290

[1] Surface temperature > 50 °C, provide contact protection

[2] **Important:**
A monitoring circuit is to be provided for the monitoring of the solenoid current. We recommend operating the valves with the assemblies described herein.

Electrical connection

The type-examination tested valve solenoid is equipped with a terminal box and a type-tested cable gland.

The connection is polarity-independent.

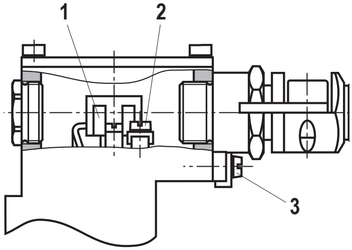
Important:

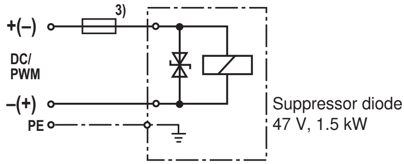
Corresponding to the rated current, a fuse according to DIN 41571 and EN / IEC 60127 has to be connected ahead of every valve solenoid (max. 3 x I_{rated}).

The shut-off threshold of the fuse has to match the prospective short-circuit current of the supply source.

The prospective short-circuit current of the supply source may amount to a maximum of 1500 A.

This fuse may only be installed outside the explosive area or must be of an explosion-proof design.





3) Recommended pre-fuse
Characteristics medium time-lag according to DIN 41571; 1.25 A

Properties of the connection terminals

Position	Function	Connectable line cross-section
1	Operating voltage connection	Single-wire 0.75 … 2.5 mm² Finely stranded 0.75 … 1.5 mm²
2	Connection for protective earthing conductor	Single-wire max. 2.5 mm² Finely stranded max. 1.5 mm²
3	Connection for potential equalization conductor	Single-wire 4 … 6 mm² Finely stranded 4 mm²

Cable gland

Type approval	II 2G Ex e IIC Gb
Threaded connection	M20 x 1.5
Protection class according to EN 60529	IP66 1)
Line diameter mm	9 … 11
Sealing	Outer sheath sealing

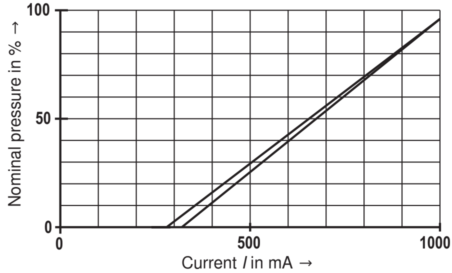
Connection line

Line type	**Non-armored** cables and lines (outer sheath sealing)
Temperature range °C	–30 … > +110

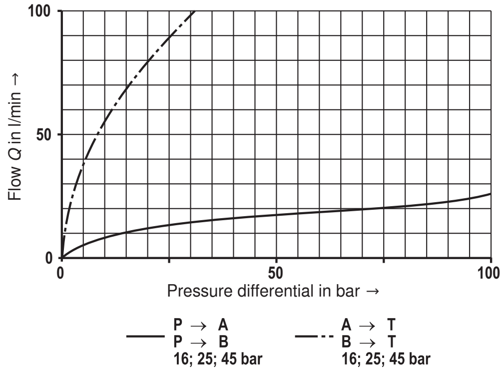
1) If installed properly

Characteristic curves (measured with HLP46, ϑ_{oil} = 40 °C ± 5 °C and p = 100 bar)

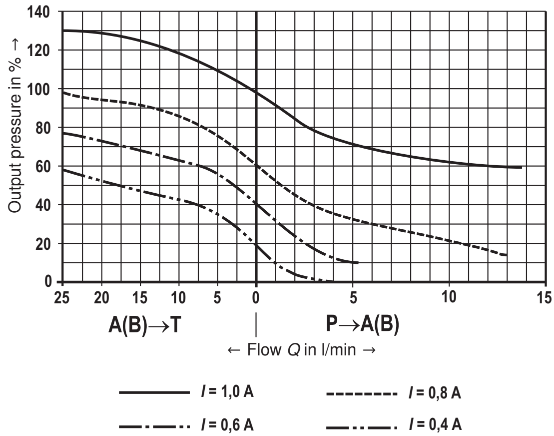
Pressure ratings 16, 25, and 45 bar



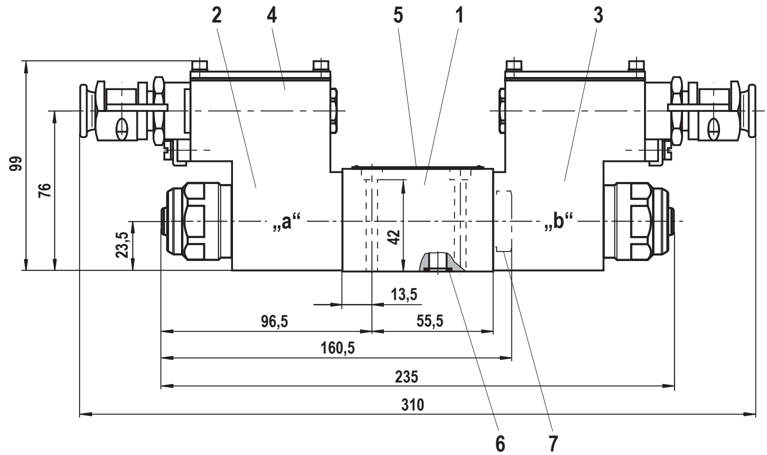
Pressure ratings 16, 25, and 45 bar

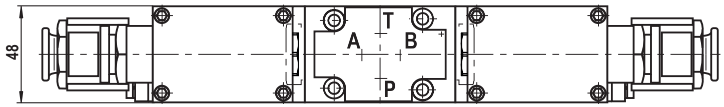


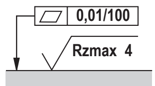
Pressure as a function of flow



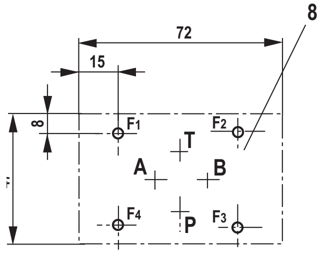
Dimensions (dimensions in mm)







Required surface quality of
the valve contact surface



1 Valve housing
2 Proportional solenoid "a"
3 Proportional solenoid "b"
4 Terminal box
5 Name plate
6 Identical seal rings for A, B, P and T
7 Plug screw for valve with one solenoid
(2 spool positions, version A or B)
8 Porting pattern according to ISO 4401-03-02-0-05

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M5x50-10.9-flZn-240h-L
(friction coefficient 0.09 – 0.14 according to VDA 235-101)
Material no. **R913000064**
(must be ordered separately)

Subplates

(**without** locating hole)	G 341/01 FE/ZN (G1/4)
	G 342/01 FE/ZN (G3/8)
	G 502/01 FE/ZN (G1/2)

with dimensions as in the data sheet 45052
(must be ordered separately)

Important:

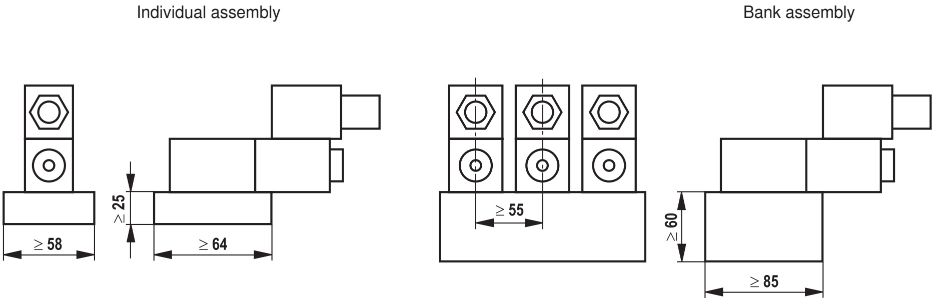
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Installation conditions (dimensions in mm)

	Individual assembly	Bank assembly
Dimensions of the subplate	Minimum dimensions Length ≥ 64, width ≥ 58, height ≥ 25	Minimum cross-section Height ≥ 60, width ≥ 85
Thermal conductivity of the subplate	≥ 38 W/mK (EN-GJS-500-7)	
Minimum distance between the longitudinal valve axes	≥ 55 mm	

Schematic diagram



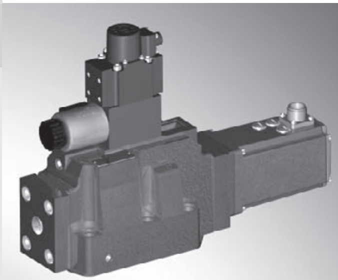
Important:
In case of bank assembly, only one solenoid of all valves may be energized at a time.

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional control valves, pilot operated, with electric position feedback

RE 29094-XN-B2/07.11
Replaces: 11.10

Type 4WRD...XN



Type 4WRD25...XN

Sizes 10, 16, 25, 27, 32, 35
Component series 5X
Maximum operating pressure 350 bar

ATEX units
For explosive areas
Part II Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II3G: Type of protection
Ex nA II T5X **without** directional sandwich plate valve
Ex nA II T3X **with** directional sandwich plate valve
according to EN 60079-0:2006 / EN 60079-15:2005

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29094-XN-B0**
Part II	Data sheet 29094-XN-B2	
Part III	Product-specific instructions 29094-XN-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Pilot operated 3-stage directional control valve for intended use in explosive areas of zone 2
- Electric position feedback of the main spool
- 2-stage pilot control valve type 4WS2EM 6-2X/...XN
- Particularly suitable for the position, velocity, pressure and force control with simultaneously high requirements on the dynamics and the response sensitivity
- For subplate mounting, porting pattern according to ISO 4401 (size 10 to size 35)
- Subplates available in FE/ZN version (see pages 16 to 21)
- The signal linking of the valve control loop, the supply of the position measurement system and the actuation of the pilot control valve are carried out via external control electronics.

Ordering code and scope of delivery

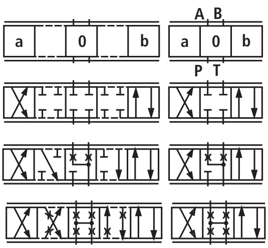
4WRD				– 5X/	6L	24	XN		K31/		V	R

Electrically operated 3-stage directional control valve in 3-way design = 4WRD

Size

Size	**= 10**
	= 16
	= 25
	= 27
	= 32
	= 35

Spool symbols



= E
= E1-
= W
= W1-
= V
= V1-

for spool symbol E1-, W1-, V1-:

P → A: q_{Vmax} B → T: $q_V/2$
P → B: $q_V/2$ A → T: q_{Vmax}

Important:
In the zero position, spools W and W1 have a connection from A to T and B to T with approx. 3 % of the relevant nominal cross-section.

Rated flow in l/min – see also pages 11 to 15

25 [1] **=**	or	**50 =**	or	**100 =**	with size 10
125 =	or	**200 =**			with size 16
220 =	or	**350 =**			with size 25
500 =					with size 27
400 =	or	**600 =**			with size 32
1000 =					with size 35

Characteristic curve form

L = linear
P = linear with fine control range

5X = Component series 50 to 59
(50 to 59: unchanged installation and connection dimensions)

6L = Servo valve control, size 6

XN = Explosion protection "type of protection nA"
Details see information on the explosion protection, page 7

Pilot flow

No code = Pilot oil supply external, pilot oil return external
E = Pilot oil supply internal, pilot oil return external
ET = Pilot oil supply internal, pilot oil return internal
T = Pilot oil supply external, pilot oil return internal

Electrical connection

K31 = Connector **without** mating connector, separate order, see page 9

No code = without directional sandwich plate valve
WG152 = with directional sandwich plate valve, 24 VDC **without** mating connector, separate order, see page 9

V = FKM seals

R = R rings

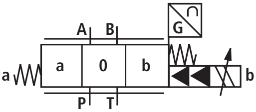
[1] only available with E…; W… and V… spool variant and with characteristic curve form L (linear)

Included in the delivery:

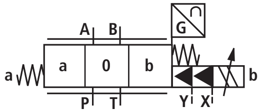
Valve operating instructions with declaration of conformity in part III

Symbols (simplified, detailed)

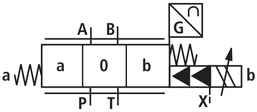
Type 4WRD…–5X/…XNET…
Pilot oil supply and pilot oil return internal



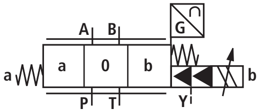
Type 4WRD…–5X/…XN…
Pilot oil supply and pilot oil return external

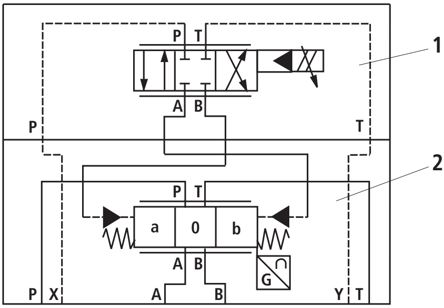


Type 4WRD … –5X/…XNT…
Pilot oil supply external, pilot oil return internal

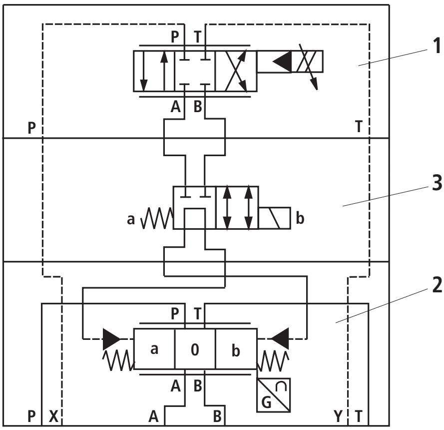


Type 4WRD… –5X/...XNE …
Pilot oil supply internal, pilot oil return external





Example:
Type 4WRD…-5X/…XN…
Pilot oil supply external, pilot oil return external



Example:
Type 4WRD…-5X/…XN…WG152...
Directional sandwich plate valve for centering the main stage
Pilot oil supply external, pilot oil return external

1 Pilot control valve
2 Main valve
3 Directional sandwich plate valve

Function, section

Valves of type 4WRD...XN are 3-stage directional control valves.

They control the quantity and direction of a flow and are mainly used in control loops for different tasks.

It consists of the following assemblies:

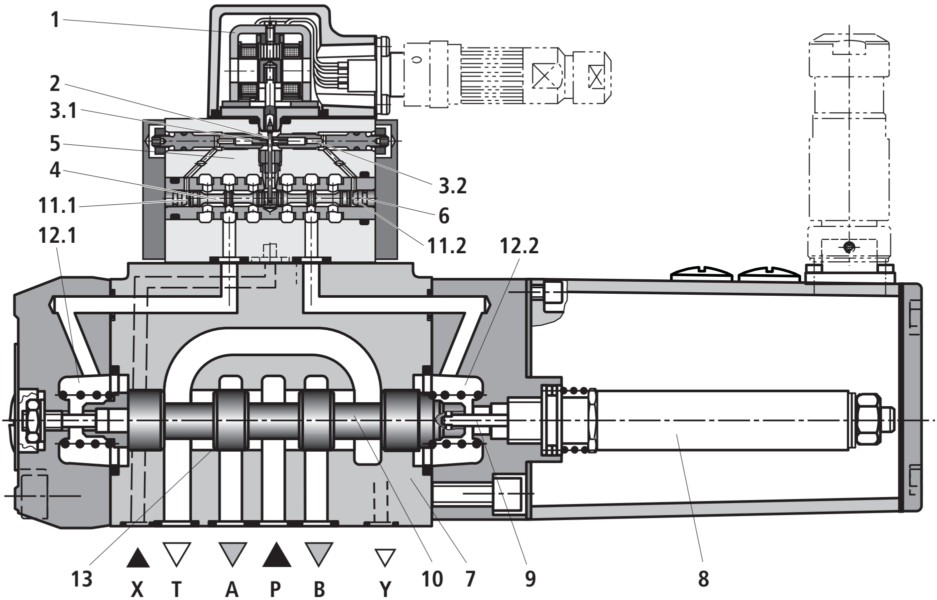
- The 2-stage pilot control valve, consisting of the control motor (1), a hydraulic amplifier (5) designed as nozzle flapper plate valve and the spool socket unit (6) as flow amplifier stage for actuating the 3rd stage (7),
- the 3rd stage (7) for flow control,
- an inductive position transducer (8) the core (9) of which is attached to the spool (10) of the 3rd stage.

The position of the spool (10) is measured by an inductive position transducer (8). The signal linking of the valve control loop, the supply of the position measurement system and the actuation of the pilot control valve are carried out via external control electronics.

The voltage difference created by the command/actual value comparison is amplified in the control electronics and supplied to the 1st stage of the valve as control error. This signal deflects the flapper plate (2) between the two control nozzles (3.1, 3.2). This results in the creation of a pressure differential between the two control chambers (11.1, 11.2). The control spool (4) is displaced and releases a corresponding oil volume into the control chamber (12.1 or 12.2). The spool (10) with the core (9) of the inductive position transducer (8) attached to it is displaced until the actual value corresponds to the command value. In the compensated condition, the spool (10) is held in the position specified by the command value.

The spool stroke is proportional to the command value. For the control of the flow, a corresponding control opening results, depending on the position of the spool (10) to the control edges, to which the flow is proportional. The valve dynamics are optimized by means of the electric gain.

Type 4WRD 10...XN



4

Technical data

general

Sizes		**10**	**16**	**25**	**27**	**32**	**35**
Installation position		Preferably horizontal					
Storage temperature range	°C	–20…+80					
Ambient temperature range	°C	–20…+60					
Weight	kg	6.8	8.9	15.2	15.5	35.2	71

hydraulic (measured with HLP 46, ϑ_{oil} = 40 °C ±5°C)

				10	16	25	27	32	35
Max. operating pressure	Ports P, A, B	Pilot oil supply external [1]	bar	up to 315	up to 350	up to 350	up to 210	up to 350	up to 350
	Port X		bar	250 (min. 25)			210 (min. 25)	250 (min. 25)	
	Ports P, A, B	Pilot oil supply internal	bar	250 (min. 25)			210 (min. 25)	250 (min. 25)	
Max. return flow pressure	Port T	Pilot oil return internal	bar	Pressure peaks < 100 permitted					
		Pilot oil return external	bar	up to 315	up to 250	up to 250	up to 210	up to 250	up to 250
	Port Y	Pilot oil return internal	bar	Pressure peaks < 100 permitted					
Rated flow q_{Vnom} ±10 % with Δp = 10 bar [2] Δp = Valve pressure differential in bar			l/min	25 50 100	– 125 200	– 220 350	– – 500	– 400 600	– – 1000
Flow of the main stage (max. admissible)			l/min	170	460	870	1000	1600	3000
Pilot oil flow at port X or Y with stepped input signal from 0 to 100% (250 bar)			l/min	8.8	13.5	17.4	17.4	32.5	45.3
Hydraulic fluid				Mineral oil (HL, HLP) according to DIN 51524, Ignition temperature > 150 °C					
Hydraulic fluid temperature range			°C	-20 ... +80; preferably +40 ... +50					
Viscosity range			mm^2/s	20…380					
Max. permissible degree of contamination of the hydraulic fluid Cleanliness class according to ISO 4406 (c)		Pilot control valve		Class 18/16/13 [3]					
		Main valve		Class 20/18/15 [3]					
Hysteresis (dither-optimized)			%	≤ 0.2					
Response sensitivity (dither-optimized)			%	≤ 0.1					
Zero point calibration (ex works) [4]			%	≤ 1					
Zero shift upon change of:									
Hydraulic fluid temperature			% / 20 K	≤ 0.7					
Operating pressure			% / 100 bar	≤ 0.5					
Return flow pressure 0 to 10 % of p			%	≤ 0.2					

[1] For a perfect system behavior, we recommend an external pilot oil supply for pressures above 210 bar.

[2] q_{Vnom} = Rated flow (overall valve) in l/min with a V spool

[3] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.
For the selection of the filters, see www.boschrexroth.com/filter.

[4] related to the pressure-signal characteristic curve (V spool)

Technical data

electric

Voltage type		Direct voltage
Type of signal		analog
Rated current per coil	mA	30
Resistance per coil	Ω	85
Inductivity (measured with 60 Hz and I_{Rated})	H	0.25
Protection class of the valve according to EN 60529:1991+A1:2000		IP65 with mating connector correctly mounted and locked

Information on explosion protection

Range of application as per directive 94/9/EC		II 3 G
Type of protection according to EN 60079-0:2006 / EN 60079-15:2005		Ex nA II T5X **without** directional sandwich plate valve Ex nA II T3X **with** directional sandwich plate valve
Maximum surface temperature [1]	°C	100 for version **without** directional sandwich plate valve (T5) 140 for version **with** directional sandwich plate valve (T3)
Ambient temperature range	°C	–20 … +60
Hydraulic fluid temperature range	°C	–15 … +80
Max. admissible operating voltage of the external control electronics	V	32 (DC)
Conditions for use in zone 2		The valve may only be used in explosive areas of device group II, category 3, with "low" risk of mechanical hazards according to the harmonized standards EN 60079-0:2006, section 26.4.2. If used in areas with a "high" risk of mechanical load according to these standards , the user must take measures with “low” risk of mechanical load.

4

[1] Surface temperature > 50 °C, provide contact protection

External control electronics (separate order)

Amplifier in Eurocard format according to data sheet 30211	for size	Type	Material no.
	10	VT-SR11-1X/1/V002/4WRD10-5X	R901305504
	16	VT-SR11-1X/1/V002/4WRD16-5X	R901305503
	25/27	VT-SR11-1X/1/V002/4WRD25-5X	R901305502
	32	VT-SR11-1X/1/V002/4WRD32-5X	R901305501
	35	on request	

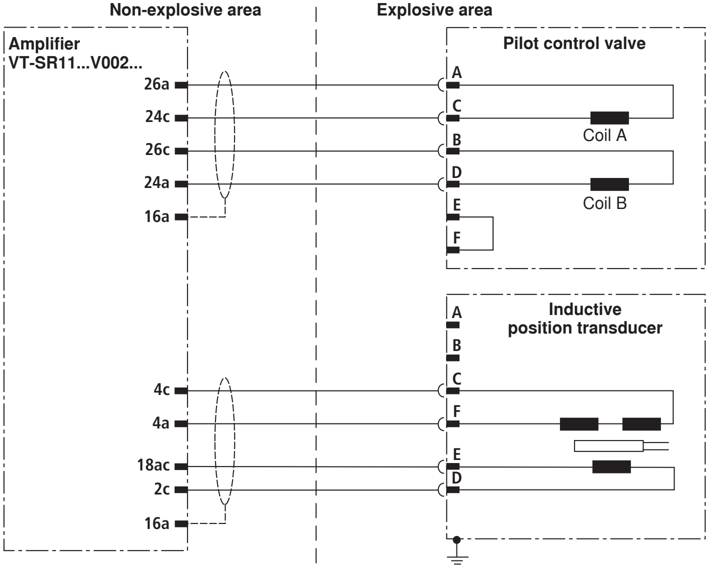
The coils of the valve may only be connected in parallel to the amplifier!

⚠ **WARNING – Risk of explosion**

– The external amplifier must be operated outside the explosive area!

Electrical connection

Pinout

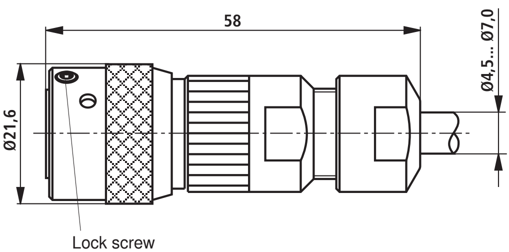


Note:
With the VT-SR11...V002... amplifier card, the control logics differ from the standard:
Positive command value results in flow from P → B and A → T.
Negative command value results in flow from P → A and B → T.

Mating connector for the pilot control valve

The pilot control valve may only be supplied through this mating connector.

Separate order, Material no. **R901043330**



Connection:

Contact sockets with connection cross-section for litz wires 0.4 … 0.75 mm² are supplied unpacked.

The connection of the litz wires to the contact sockets is possible by crimping or soldering.

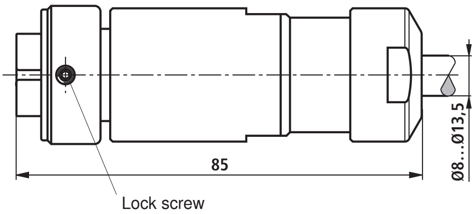
A list of the required tools for the crimping connection is available in the assembly instructions which are supplied with the mating connector.

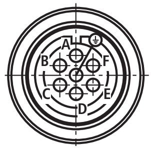
Electrical connection

Mating connector for the inductive position transducer

The position transducer may only be supplied through this mating connector.

Separate order, Material no. **R901044595**





Mating connector according to EN 175201-804

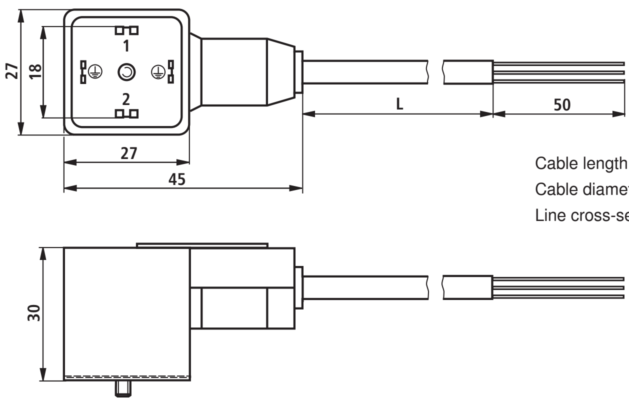
Metal version

Connection:
Contact sockets with soldered joint for litz wires 0.5…1.5 mm^2

Mating connector for directional sandwich plate valve WG152

The directional sandwich plate valve may only be supplied through this mating connector.

Separate order, Material no. **R901269455**

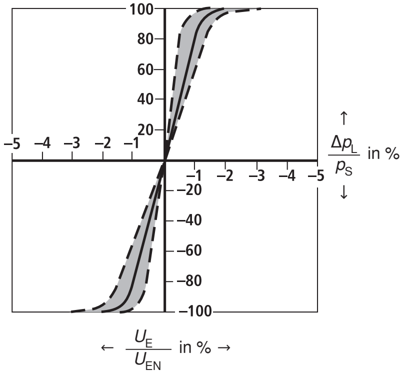


Cable length L:	10 m
Cable diameter:	5.9 mm
Line cross-section:	3 x 0.75 mm^2

Characteristic curves (measured with v = 32 mm²/s and ϑ = 40 °C)

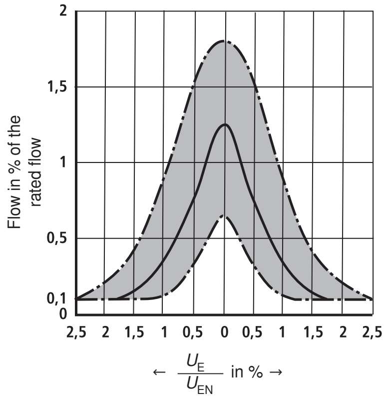
Pressure-signal characteristic curve (V spool)

measured with p_S = 100 bar



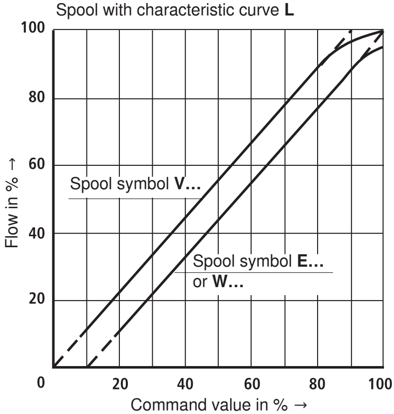
Zero flow of the main stage (V spool)
without pilot control valve

measured with p_S = 100 bar

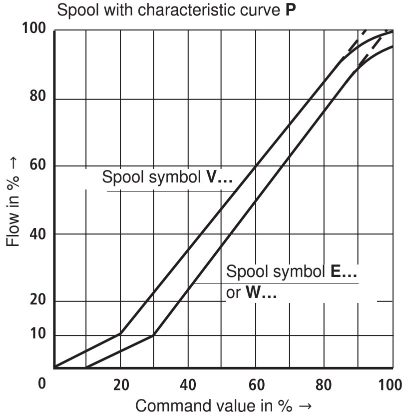


Flow command value functions (with 10 bar valve pressure differential or 5 bar per control edge)

Spool with characteristic curve **L**

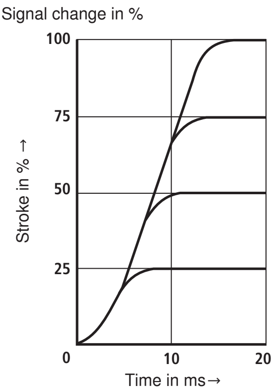


Spool with characteristic curve **P**



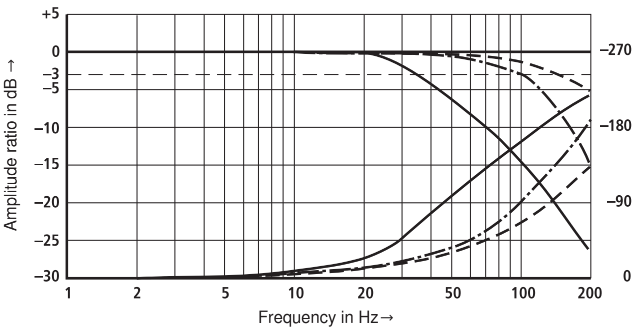
Characteristic curves size 10 (measured with HLP 46 with 40 °C ± 5 °C)

Transition function with stepped electric input signals



measured with:
– Pilot control valve
Port "X" = 140 bar
– Main valve
Port "P" = 10 bar

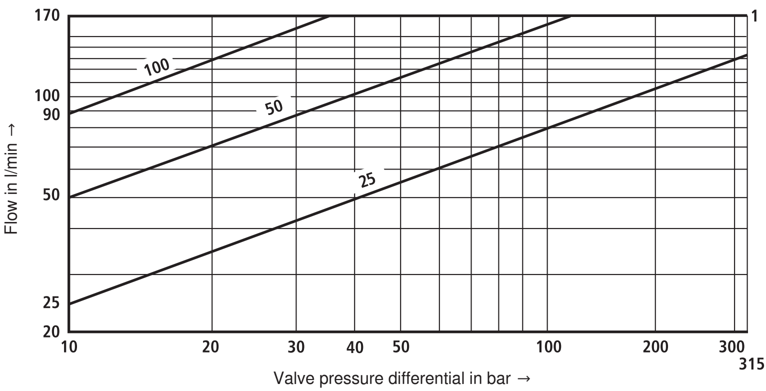
Frequency response characteristic curves



measured with:
– Pilot control valve
Port "X" = 140 bar
– Main valve
Port "P" = 10 bar

Signal ±5 %
Signal ±25 %
Signal ±100 %

Flow load function with max. valve opening (tolerance ±10 %)

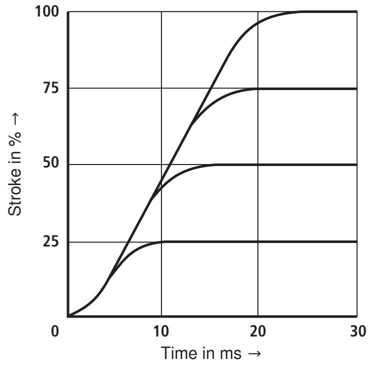


1 = recommended flow limitation (Flow velocity 30 m/s)

4

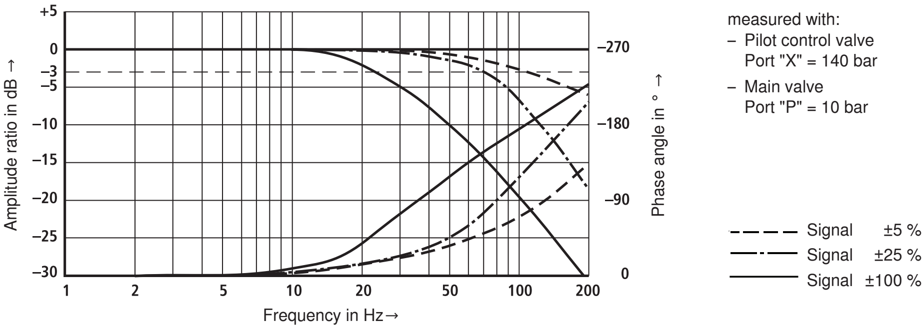
Characteristic curves size 16 (measured with HLP 46 with 40 °C ± 5 °C)

Transition function with stepped electric input signals



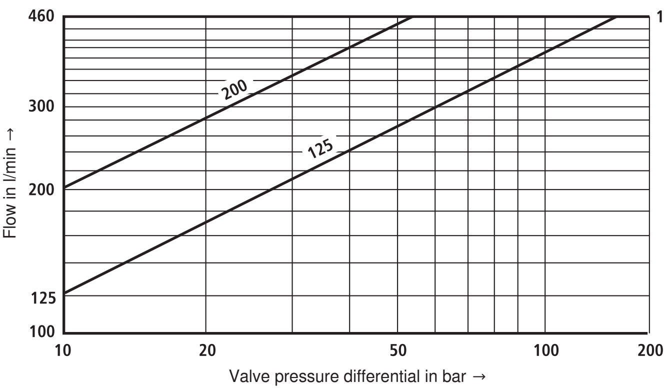
measured with:
- Pilot control valve
  Port "X" = 140 bar
- Main valve
  Port "P" = 10 bar

Frequency response characteristic curves



measured with:
- Pilot control valve
  Port "X" = 140 bar
- Main valve
  Port "P" = 10 bar

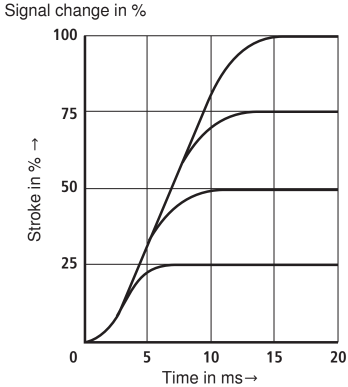
Flow load function with max. valve opening (tolerance ±10 %)



1 = recommended flow limitation (Flow velocity 30 m/s)

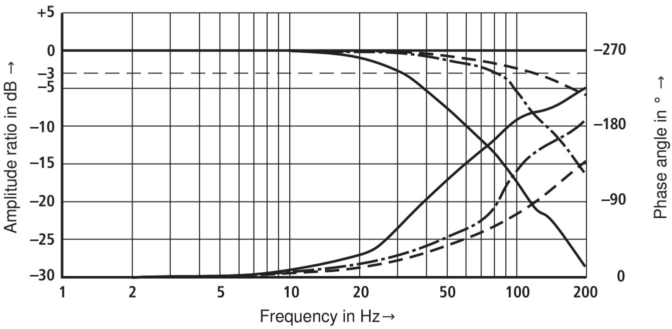
Characteristic curves size 25 and size 27 (measured with HLP 46 with 40 °C ± 5 °C)

Transition function with stepped electric input signals

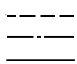


measured with:
- Pilot control valve Port "X" = 140 bar
- Main valve Port "P" = 10 bar

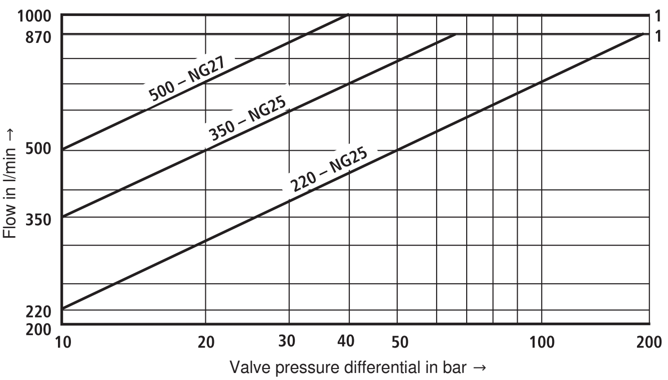
Frequency response characteristic curves



measured with:
- Pilot control valve Port "X" = 140 bar
- Main valve Port "P" = 10 bar



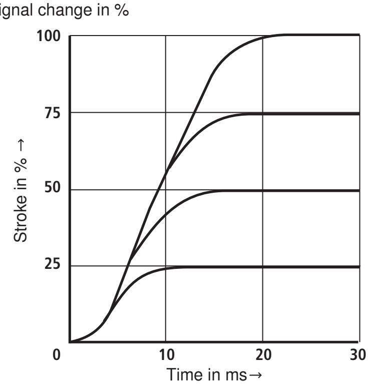
Flow load function with max. valve opening (tolerance ±10 %)



1 = recommended flow limitation (Flow velocity 30 m/s)

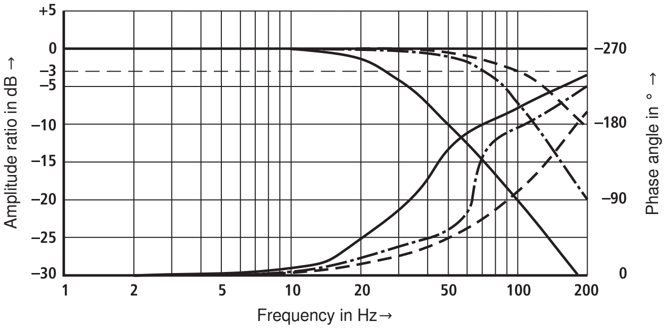
Characteristic curves size 32 (measured with HLP 46 with 40 °C ± 5 °C)

Transition function with stepped electric input signals



measured with:
- Pilot control valve
  Port "X" = 140 bar
- Main valve
  Port "P" = 10 bar

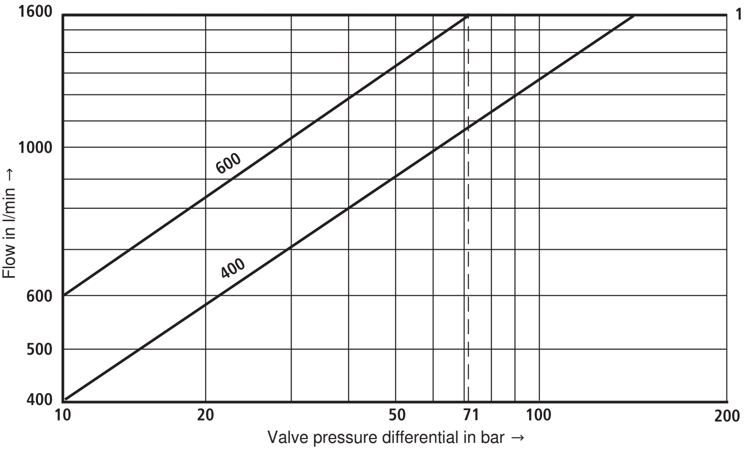
Frequency response characteristic curves



measured with:
- Pilot control valve
  Port "X" = 140 bar
- Main valve
  Port "P" = 10 bar

Signal ±5 %
Signal ±25 %
Signal ±100 %

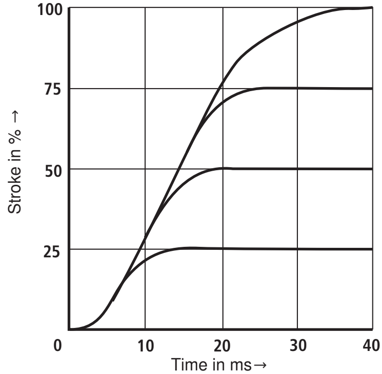
Flow load function with max. valve opening (tolerance ±10 %)



1 = recommended flow limitation (Flow velocity 30 m/s)

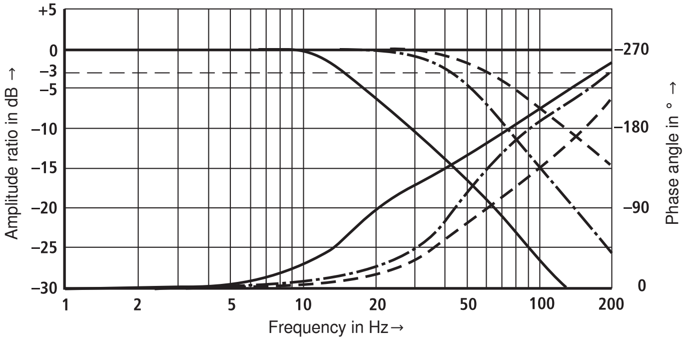
Characteristic curves size 35 (measured with HLP 46 with 40 °C ± 5 °C)

Transition function with stepped electric input signals



measured with:
– Pilot control valve
Port "X" = 140 bar
– Main valve
Port "P" = 10 bar

Frequency response characteristic curves

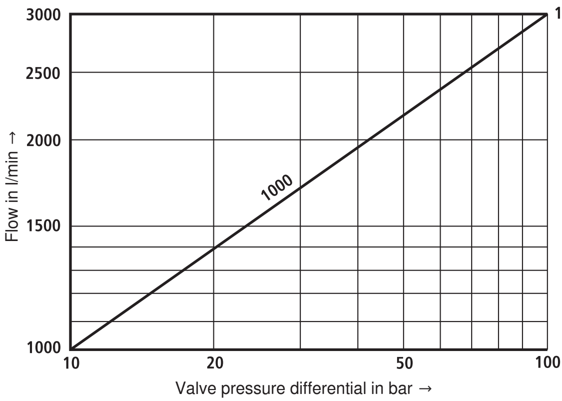


measured with:
– Pilot control valve
Port "X" = 140 bar
– Main valve
Port "P" = 10 bar

Signal ±5 %
Signal ±25 %
Signal ±100 %

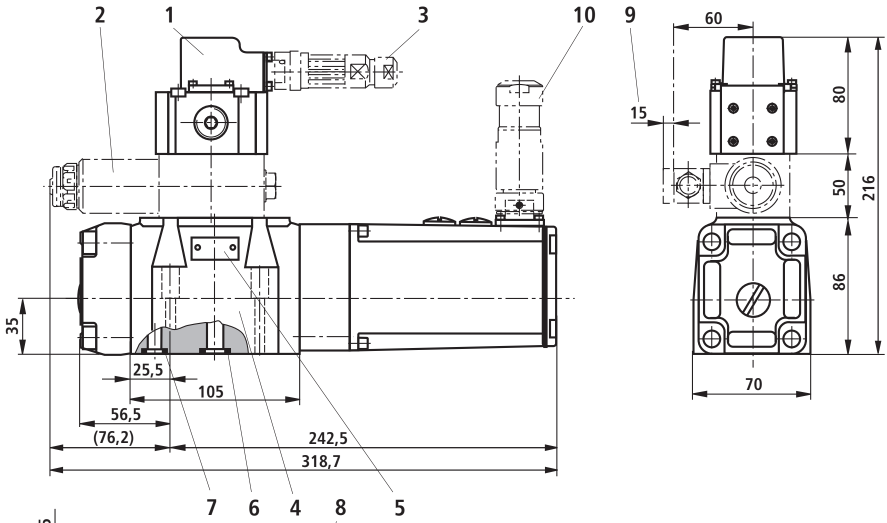
4

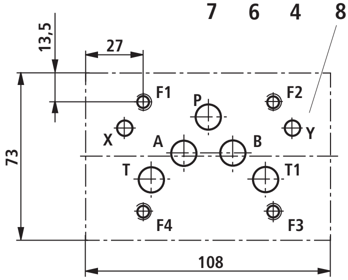
Flow load function with max. valve opening (tolerance ±10 %)

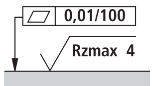


1 = recommended flow limitation (Flow velocity 30 m/s)

Unit dimensions size 10 (dimensions in mm)







Required surface quality of the valve mounting face

1 Pilot control valve

2 Directional sandwich plate valve (only contained with version "...WG152")

3 Mating connector for pilot control valve, see page 8

4 Main valve

5 Name plate

6 Identical seal rings for ports P, A, B, T and T1

7 Identical seal rings for ports X and Y

8 Machined valve mounting face,
porting pattern according to ISO 4401-05-05-0-05
(ports X, Y as required)
deviating from the standard:
- ports P, A, B, T and T1 Ø 11 mm

9 Space required for removing the mating connector

10 Mating connector for inductive position transducer, see page 9

Subplates with dimensions as in the data sheet 45054 and valve mounting screws must be ordered separately.

Subplates

without ports X, Y	G 534/01 FE/ZN (G3/4)
with ports X, Y	G 535/01 FE/ZN (G3/4)
	G 536/01 FE/ZN (G1)

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:

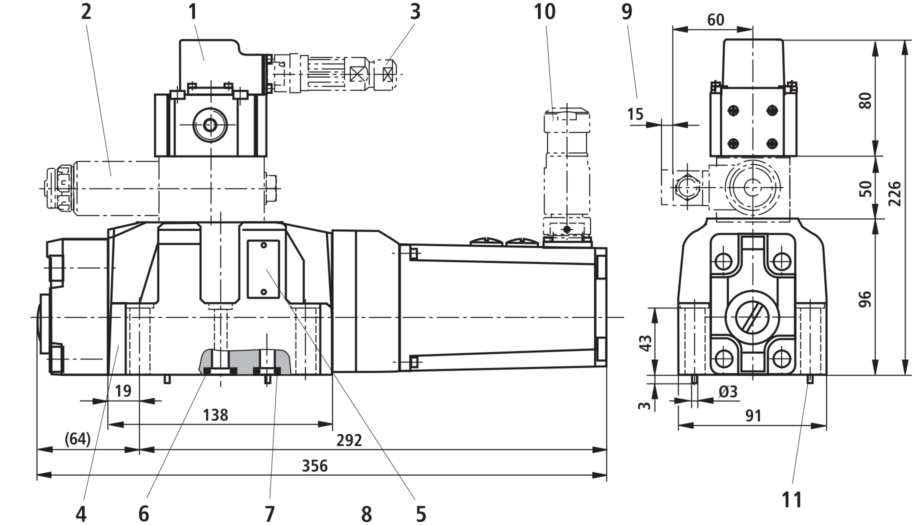
4 hexagon socket head cap screws
ISO 4762-M6x45-10.9-flZn-240h-L,
(Friction coefficient 0.09 - 0.14
according to VDA 235-101),
Material no. **R913000258**

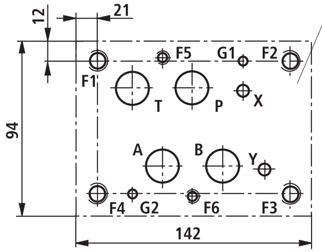
Important:

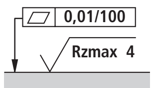
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Unit dimensions size 16 (dimensions in mm)







Required surface quality of the valve mounting face

Subplates with dimensions as in the data sheet 45056 and valve mounting screws must be ordered separately.

Subplates

G 172/01 FE/ZN (G3/4)	G 172/02 FE/ZN (M27 x 2)
G 174/01 FE/ZN (G1)	G 174/02 FE/ZN (M33 x 2)

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:

– **2 hexagon socket head cap screws ISO 4762-M6x60-10.9-flZn-240h-L, (Friction coefficient 0.09 - 0.14 according to VDA 235-101)** material no. **R913000115**

– **4 hexagon socket head cap screws ISO 4762-M10x60-10.9-flZn-240h-L, (Friction coefficient 0.09 - 0.14 according to VDA 235-101)** Material no. **R913000116**

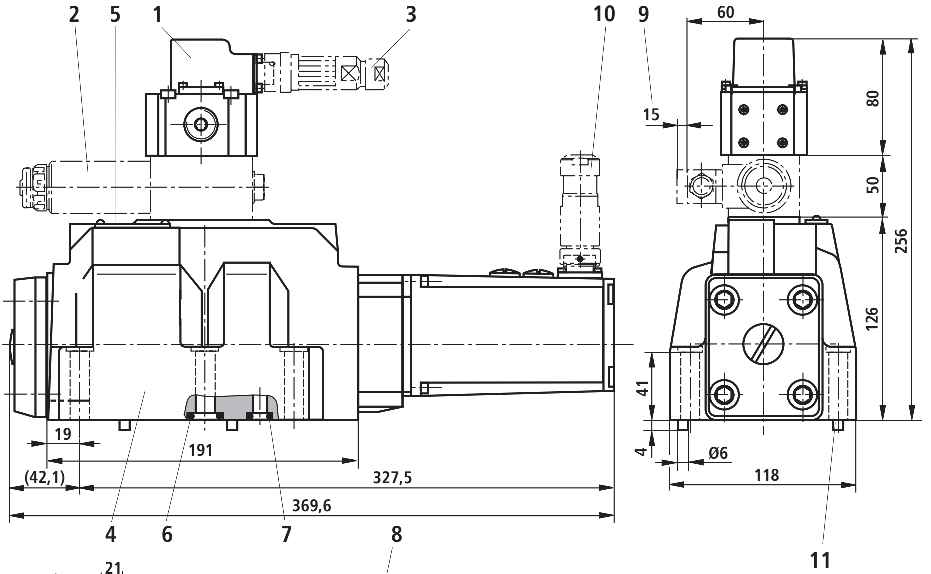
Important:

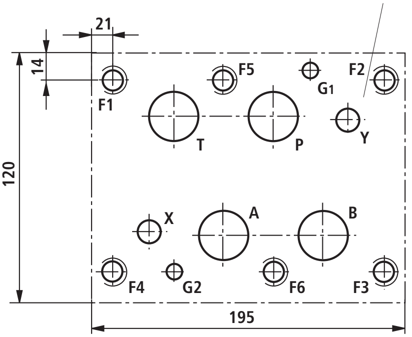
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

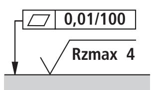
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

1 Pilot control valve
2 Directional sandwich plate valve (only contained with version "...WG152")
3 Mating connector for pilot control valve, see page 8
4 Main valve
5 Name plate
6 Identical seal rings for ports P, A, B and T
7 Identical seal rings for ports X and Y
8 Machined valve mounting face, porting pattern according to ISO 4401-07-07-0-05 (ports X, Y as required) deviating from the standard:
- ports P, A, B and T Ø 20 mm
9 Space required for removing the mating connector
10 Mating connector for inductive position transducer, see page 9
11 Locating pins (2x)

Unit dimensions size 25 (dimensions in mm)







Required surface quality of the valve mounting face

1 Pilot control valve
2 Directional sandwich plate valve (only contained with version "...WG152")
3 Mating connector for pilot control valve, see page 8
4 Main valve
5 Name plate
6 Identical seal rings for ports P, A, B and T
7 Identical seal rings for ports X and Y
8 Machined valve mounting face, porting pattern according to ISO 4401-08-08-0-05 (ports X, Y as required) deviating from the standard:
- ports A, B and T Ø 25 mm
- port P Ø 24 mm
9 Space required for removing the mating connector
10 Mating connector for inductive position transducer, see page 9
11 Locating pins (2x)

Subplates with dimensions as in the data sheet 45058 and valve mounting screws must be ordered separately.

Subplates

G 151/01 FE/ZN (G1)	G 154/01 FE/ZN (G1 1/4)
G 154/08 FE/ZN (flange)	G 156/01 FE/ZN (G1 1/2)

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:

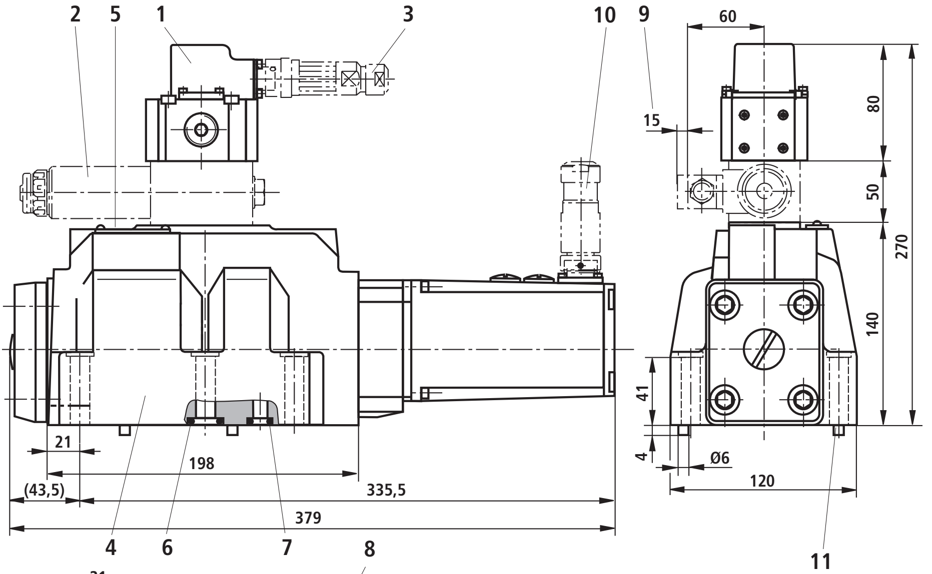
6 hexagon socket head cap screws ISO 4762-M12x60-10.9-flZn-240h-L, (Friction coefficient 0.09 - 0.14 according to VDA 235-101)
Material no. **R913000121**

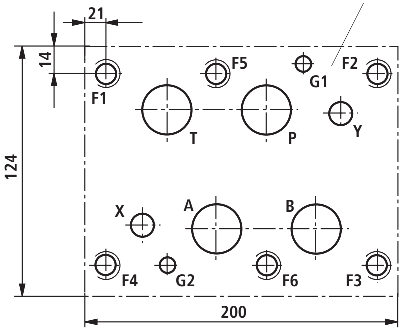
Important:

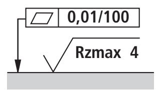
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Unit dimensions size 27 (dimensions in mm)







Required surface quality of the valve mounting face

1 Pilot control valve

2 Directional sandwich plate valve (only contained with version "...WG152")

3 Mating connector for pilot control valve, see page 8

4 Main valve

5 Name plate

6 Identical seal rings for ports P, A, B and T

7 Identical seal rings for ports X and Y

8 Machined valve mounting face,
porting pattern according to ISO 4401-08-08-0-05
(ports X, Y as required)
deviating from the standard:
- ports P, A, B and T Ø 32 mm

9 Space required for removing the mating connector

10 Mating connector for inductive position transducer, see page 9

11 Locating pins (2x)

Subplates with dimensions as in the data sheet 45058 and valve mounting screws must be ordered separately.

Subplates

G 151/01 FE/ZN (G1)	G 154/01 FE/ZN (G1 1/4)
G 154/08 FE/ZN (flange)	G 156/01 FE/ZN (G1 1/2)

Valve mounting screws

For reasons of stability, exclusively use the following valve mounting screws:

6 hexagon socket head cap screws
ISO 4762-M12x60-10.9-flZn-240h-L,
(Friction coefficient 0.09 - 0.14
according to VDA 235-101)
Material no. **R913000121**

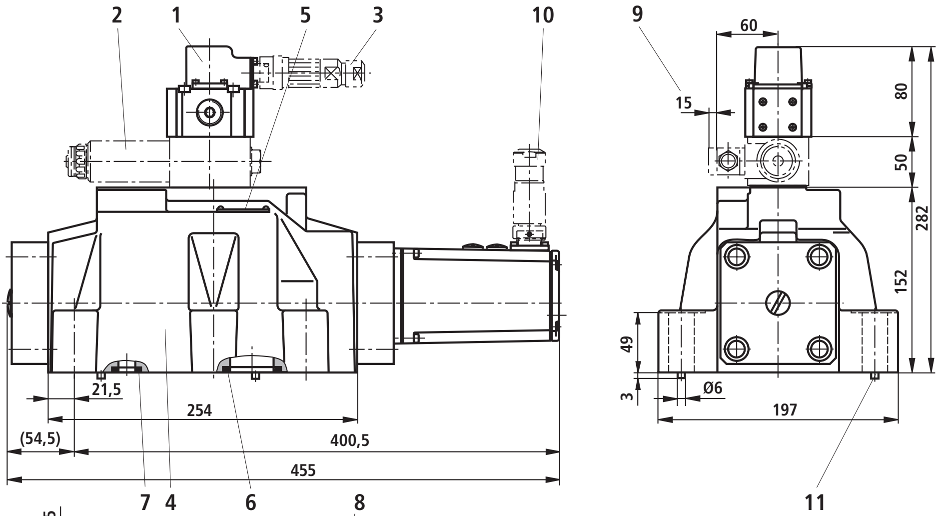
Important:

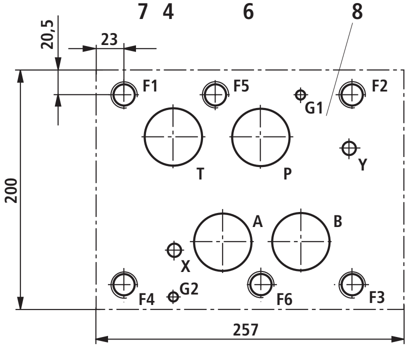
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

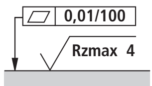
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

4

Unit dimensions size 32 (dimensions in mm)







Required surface quality of the valve mounting face

1 Pilot control valve

2 Directional sandwich plate valve (only contained with version "...WG152")

3 Mating connector for pilot control valve, see page 8

4 Main valve

5 Name plate

6 Identical seal rings for ports P, A, B and T

7 Identical seal rings for ports X and Y

8 Machined valve mounting face,
porting pattern according to ISO 4401-10-09-0-05
(ports X, Y as required)
deviating from the standard:
- ports P, A, B and T Ø 38 mm

9 Space required for removing the mating connector

10 Mating connector for inductive position transducer, see page 9

11 Locating pin (2x)

Subplates with dimensions as in the data sheet 45060 and valve mounting screws must be ordered separately.

Subplates

G 157/01 FE/ZN (G1 1/2)
G 157/02 FE/ZN (M48 x 2)
G 158/10 FE/ZN (flange)

Valve mounting screws

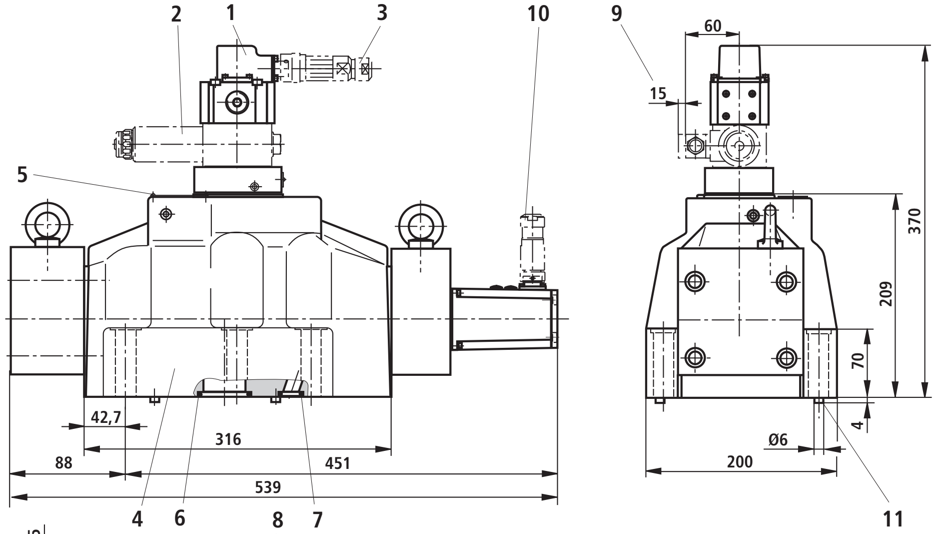
For reasons of stability, exclusively the following valve mounting screws may be used:
6 hexagon socket head cap screws
ISO 4762-M20x80-10.9-flZn-240h-L
(Friction coefficient 0.09 - 0.14
according to VDA 235-101)
Material no. **R901035246**

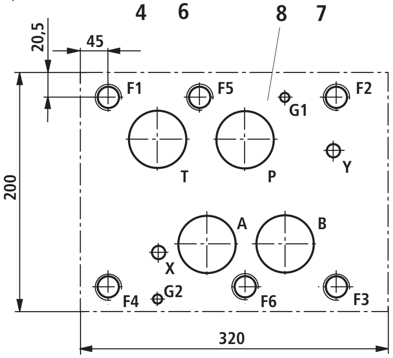
Important:

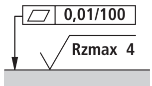
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Unit dimensions size 35 (dimensions in mm)







Required surface quality of the valve mounting face

4

1 Pilot control valve

2 Directional sandwich plate valve (only contained with version "...WG152")

3 Mating connector for pilot control valve, see page 8

4 Main valve

5 Name plate

6 Identical seal rings for ports P, A, B and T

7 Identical seal rings for ports X and Y

8 Machined valve mounting face, porting pattern according to ISO 4401-10-09-0-05 (ports X, Y as required) deviating from the standard:
- ports P, A, B and T Ø 50 mm

9 Space required for removing the mating connector

10 Mating connector for inductive position transducer, see page 9

11 Locating pin (2x)

Subplates with dimensions as in the data sheet 45060 and valve mounting screws must be ordered separately.

Subplates
G 157/01 FE/ZN (G1 1/2)
G 157/02 FE/ZN (M48 x 2)
G 158/10 FE/ZN (flange)

Valve mounting screws

For reasons of stability, exclusively the following valve mounting screws may be used:
6 hexagon socket head cap screws
ISO 4762-M20x100-10.9-flZn-240h-L
(Friction coefficient 0.09 - 0.14
according to VDA 235-101)
Material no. **R913000386**

Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Notes

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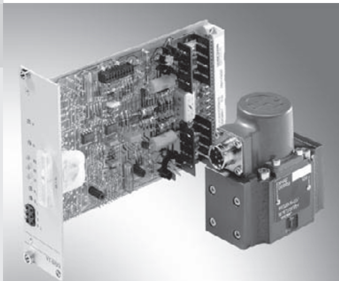
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional servo-valve with mechanical position feedback

RE 29564-XN-B2/04.10
Replaces: 11.06

Type 4WS2EM 6...XN

Size 6
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 48 l/min



H5994

ATEX units
For explosive areas

Part II Technical data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II3G: Type of protection Ex nA II T5X according to EN 60079-0:2006 / EN 60079-15:2005

II3D: Type of protection Ex tD A22 IP 65 TX according to EN 61241-0:2006 / EN 61241-1:2004

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information RE 07010-X-B1	**RE 29564-XN-B0**
Part II	Technical data sheet RE 29564-XN-B2	
Part III	Product-specific instructions RE 29564-XN-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication “General product information on hydraulic products” RE 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 2 and 22
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-03-02-0-05
  subplates available in FE/ZN version (see page 10)
- Dry control motor, no contamination of the solenoid gap by the hydraulic fluid
- Can also be used as 3-way variant
- Wear-free spool feedback element
- Control:
  External control electronics in Eurocard format or in modular design (separate order), see page 6
- Valve is adjusted and tested
- Pressure chambers at the control sleeve with gap seals, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2EM	6	–	2X	/		B	11	XN	ET		K17		V

Electrically actuated 2-stage servo valve in 4/3 directional design with mechanical feedback for **external** control electronics

Size **= 6**

Component series 20 to 29 **= 2X**
(20 to 29: unchanged installation and connection dimensions)

Nominal flow [1]

2 l/min	**= 2**
5 l/min	**= 5**
10 l/min	**= 10**
15 l/min	**= 15**
20 l/min	**= 20**
25 l/min	**= 25**

Characteristic curves, see page 8 (observe tolerance field of flow signal function)

Valve for **external** control electronics **= 11**
coil no. 11 (30 mA/85 Ω per coil) [2]

XN = Explosion protection “Type nA”
For details see information on the explosion protection, page 6

ET = Internal pilot oil supply and return [3]

Inlet pressure range [4]
210 = 10 to 210 bar
315 = 10 to 315 bar

K17 = Electrical connection via unit connector
Order mating connector separately, see page 7

Spool overlap [5]
E = 0 … 0.5 % negative
D = 0 … 0.5 % positive
C = 3 … 5 % positive

Seal material
V = FKM seals, suitable for mineral oill (HL, HLP) according to DIN 51524

Included in the delivery:
Valve operating instructions with declaration of conformity in part III

[1] **Rated flow**
The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10 % must be taken into account (see flow signal function page 8).

[2] **External control electronics**
The actuating signal must be formed by a current controlled output step. Control electronics (servo amplifier) see page 6.

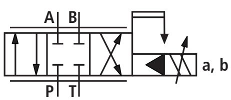
[3] **Pilot oil**
The valve is only delivered with internal control oil supply and return.

[4] **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible.
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range of 10 ... 210 bar and/or 10 ... 315 bar.

[5] **Spool overlap**
The spool overlap is specified in % of the control spool stroke.

4

Symbol



Function, section

4WS2EM 6-2X/...XN

Valves of this type are electrically actuated, 2-stage directional servo-valves with porting pattern according to ISO 4401-03-02-0-05. They are mainly used to control position, force, pressure or velocity .

These valves are made of an electromechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanic feedback.

An electric input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

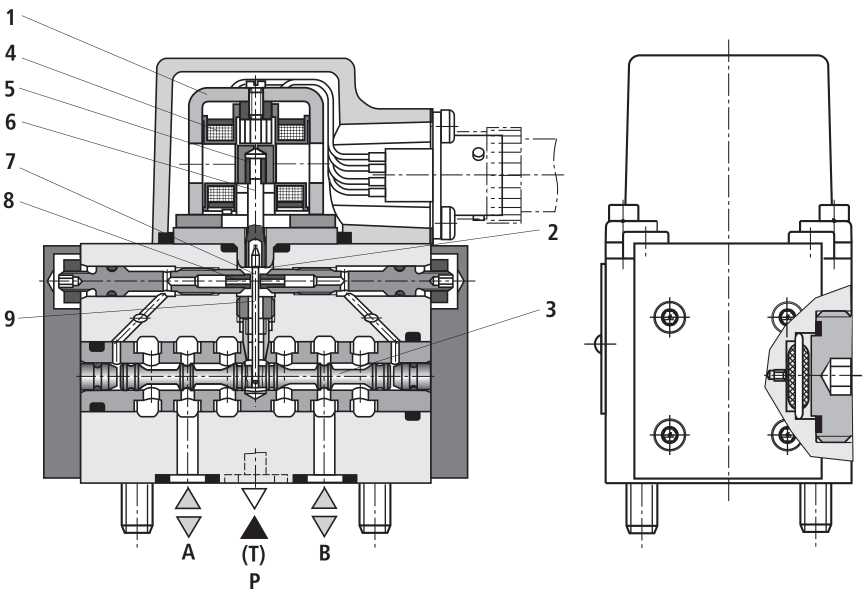
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 6-2X/...XN



Technical data

general

Porting pattern			ISO 4401-03-02-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +80
Ambient temperature range		°C	–30 … +80
Weight		kg	1.1

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Ports P, A, B	bar	10 … 210 or 10 … 315
Return flow pressure	Port T	bar	Pressure peaks < 100, static < 10
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524, ignition temperature > 150 °C
Hydraulic fluid temperature range		°C	–15 ... +80; preferably +40 ... +50
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1)]
Zero flow $q_{V,L}$ [2)] with spool overlap E measured without dither signal		l/min	$\sqrt{p_P / 70\ \text{bar}} \cdot (0.4\ \text{l/min} + 0.02 \cdot q_{V\ rated})$ [3); 4)]
Rated flows $q_{v\ rated}$ [3)], tolerance ±10 % with valve pressure differential Δ_p = 70 bar		l/min	2; 5; 10; 15; 20; 25
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170
Feedback system			Mechanical
Hysteresis (dither-optimized)		%	≤ 1.5
Range of inversion (dither-optimized)		%	≤ 0.2
Response sensitivity (dither-optimized)		%	≤ 0.2
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4)]	≥ 50
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5
Zero drift upon change of:			
	Hydraulic fluid temperature	% / 20 °C	≤ 1
	Ambient temperature	% / 20 °C	≤ 1
	Operating pressure 80 … 120 % of p_P [4)]	% / 100 bar	≤ 2
	Return flow pressure 0 … 10 % of p_P [4)]	% / bar	≤ 1

1) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.

For the selection of filters, see technical data sheets RE 50070, RE 50076 and RE 50081.

2) $q_{V,L}$ = Zero flow in l/min

3) $q_{v\ rated}$ = Rated flow in l/min

4) p_P = Operating pressure in bar

4

Technical data

electrical

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100 % rated current	Connection in series	H	1.0
	Connection in parallel	H	0.25
In case of actuating using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC		II 3 G; II 3 D
Type of protection according to EN 60079-0:2006 / EN 60079-15:2005		Ex nA II T5X
Type of protection according to EN 61241-0:2006 / EN 61241-1:2004		Ex tD A22 IP 65 TX
Maximum surface temperature	°C	100
Ambient temperature range	°C	–30 … +80
Hydraulic fluid temperature range	°C	–15 … +80
Max. admissible operating voltage of the servo amplifier	V	32 (DC)
Conditions for use in zone 2 and 22		The valve may only be used in explosive zones of device group II, category 3, with "low" risk of mechanical hazards according to the harmonized standards EN 60079-0:2006, section 26.4.2 and EN 61241-0:2006, section 23.4.2.1. If used in zones with a "high" risk of mechanical load according to these standards , the user must take measures with a "low" risk of mechanical load.

External control electronics

Servo amplifier (separate order)	Eurocard format	Analog	Type VT-SR2-1X/.60 according to technical data sheet RE 29980
	Modular design	Analog	Type VT 11021 according to technical data sheet RE 29743

The coils of the valve may only be connected in parallel to these amplifiers!

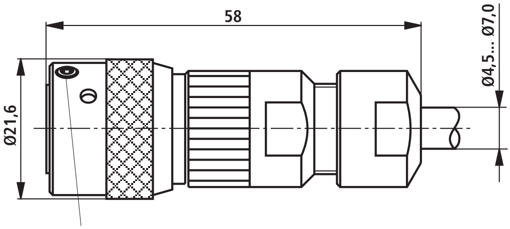
⚠ WARNING – Risk of explosion

– The external servo amplifier must be operated outside the explosive area!

Mating connector

The servo valve may only be supplied through this mating connector.

Separate order, Material no. **R901043330**



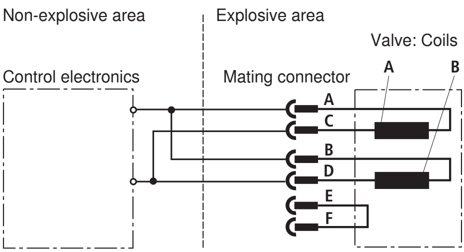
Connection:

Contact bushing with a connection cross-section for litz wires of 0.4 … 0.75 mm^2 are supplied unpacked.

The connection of the litz wires to the contact bushings is possible by crimping or soldering.

A list of the required tools for crimping connection is available in the assembly instructions which are supplied with the mating connector.

Electrical connection (example of parallel connection)



The coils are connected in parallel in the mating connector or at the amplifier (see figure).

In case of serial connection, contact B and C must be connected.

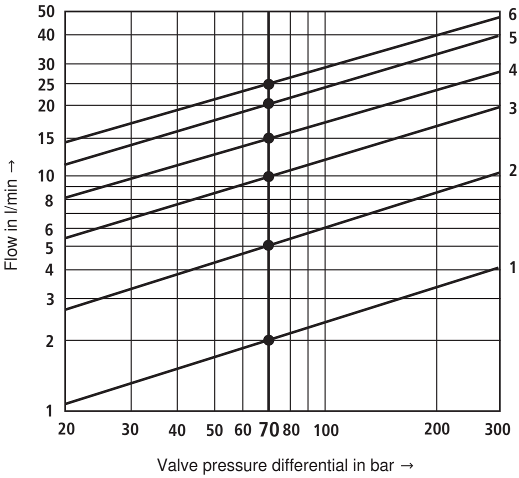
The E-F bridge can be used for the electrical determination of the correct connection of the plug-in connector and/or for the identification of cable break.

The electrical actuation from A (+) to D (–) causes flow direction from P → A and B → T. The reverse electrical actuation causes flow direction from P → B and A → T.

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

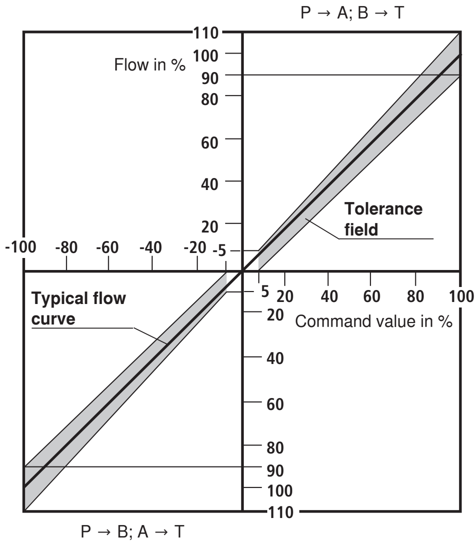
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
2	2 l/min	1
5	5 l/min	2
10	10 l/min	3
15	15 l/min	4
20	20 l/min	5
25	25 l/min	6

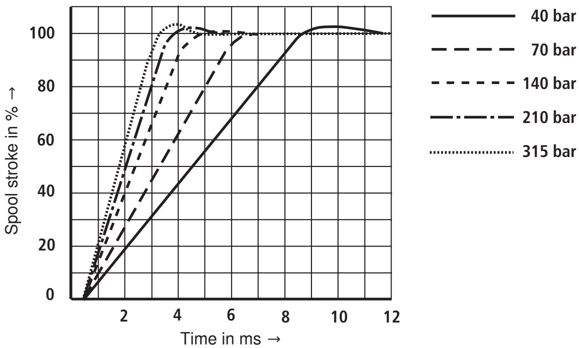
Δ_p = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of flow/signal function
at constant valve pressure difference Δ_p

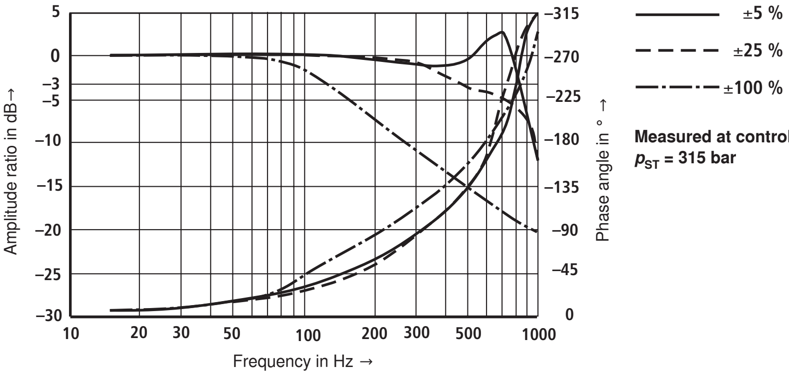


Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

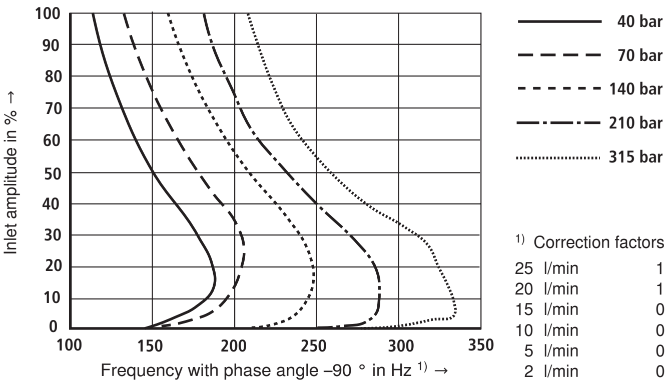


Frequency response with pressure rating 315 bar, stroke frequency without flow



Measured at control pressure
p_{ST} **= 315 bar**

Dependency of the frequency f at –90 ° on the operating pressure p and the inlet amplitude



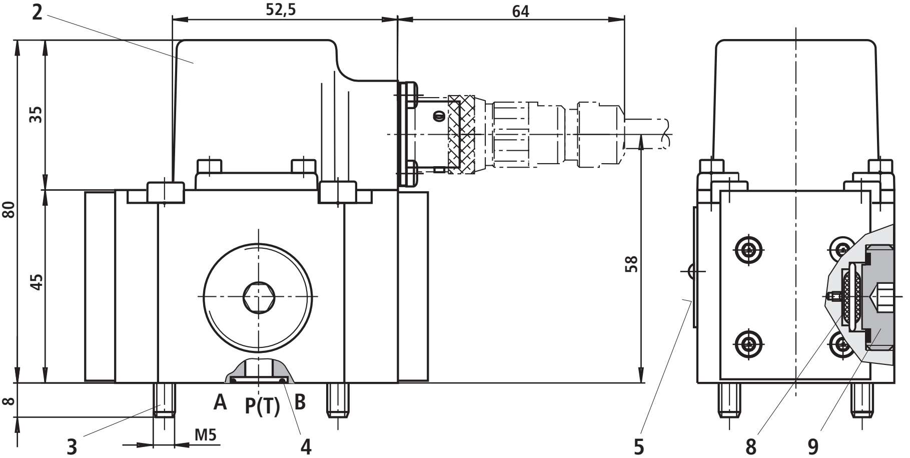
The output signal corresponds to the spool stroke with flow and without load pressure

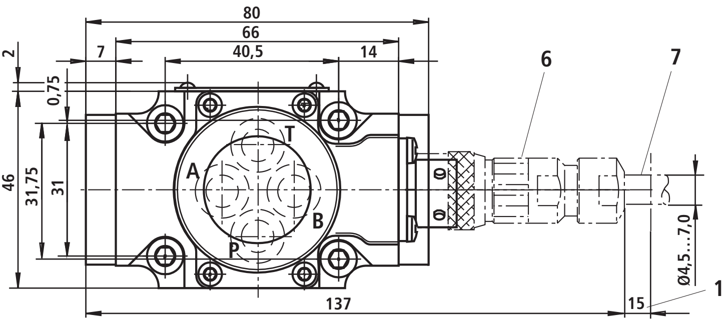
[1] Correction factors at $q_{V\ rated}$

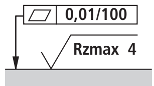
25 l/min	1.00
20 l/min	1.00
15 l/min	0.95
10 l/min	0.90
5 l/min	0.85
2 l/min	0.80

4

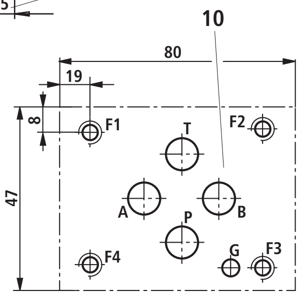
Unit dimensions (dimensions in mm)







Required surface quality of the valve mounting face



1 Required space for the removal of mating connectors, additionally observe the bending radius of the connecting line

2 Cap

3 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws ISO 4762-M5x50-10.9-flZn-240h-L (Friction coefficient 0.09 – 0.14 according to VDA 235-101) (included in the delivery)

4 Identical seal rings for ports P, A, B, T

5 Nameplate

6 Mating connector (order separately, see page 7)

7 Connection line, further information on page 7

8 Filter

9 Plug screw

10 Machined valve mounting face, porting pattern according to ISO 4401-03-02-0-05
Deviating from the standard:
– Locating pin not available (G)

Subplates
G341/01 FE/ZN (G1/4)
G342/01 FE/ZN (G3/8)
G502/01 FE/ZN (G1/2)
with dimensions as in the technical data sheet RE 45052
(must be ordered separately)

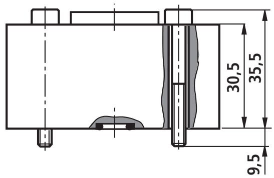
Important:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-03-02-0-05 (dimensions in mm)

Symbol



Ordering code and more information

- Material number: **R900936049**
- Weight: 0.6 kg
- Identical seal rings for ports P, A, B and T
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M5x40-10.9-flZn-240h-L
  (Friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions RE 29564-XN-B3, section 3.2.

Importants

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

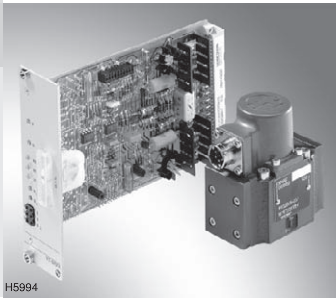
Rexroth
Bosch Group

4/3 directional servo-valve with mechanical position feedback

RE 29564-XN-100-B2/05.10
Replaces: 02.09

Type 4WS2EM 6...XN...-100

Size 6
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 48 l/min


H5994

ATEX units
For explosive areas

Part II Technical data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II3G: Type of protection Ex nA II T5X according to EN 60079-0:2006 / EN 60079-15:2005

II3D: Type of protection Ex tD A22 IP 65 TX according to EN 61241-0:2006 / EN 61241-1:2004

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information RE 07010-X-B1	**RE 29564-XN-100-B0**
Part II	Technical data sheet RE 29564-XN-100-B2	
Part III	Product-specific instructions RE 29564-XN-100-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" RE 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 2 and 22
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-03-02-0-05
  subplates available in FE/ZN version (see page 10)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in Eurocard format or in modular design (separate order), see page 6
- Valve is adjusted and tested
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2EM	6	–	2X	/		B	11	XN	ET		K17		V	–	100

Electrically actuated 2-stage servo valve in 4/3 directional design with mechanical feedback for **external** control electronics

Size 6 **= 6**

Component series 20 to 29 **= 2X**
(20 to 29: unchanged installation and connection dimensions)

Rated flow [1)]

2 l/min	**= 2**
5 l/min	**= 5**
10 l/min	**= 10**
15 l/min	**= 15**
20 l/min	**= 20**
25 l/min	**= 25**

Characteristic curves, see page 8 (observe tolerance field of flow signal function)

Valve for **external** control electronics **= 11**
coil no. 11 (30 mA/85 Ω per coil) [2)]

XN = explosion protection "type nA"
For details see information on the explosion protection, page 6

ET = internal pilot oil supply and return[3)]

Inlet pressure range [4)]
210 = 10 to 210 bar
315 = 10 to 315 bar

K17 = **electrical connection via connector**
Order mating connector separately, see page 7

Spool overlap [5)]
E = 0 … 0.5 % negative
D = 0 … 0.5 % positive
C = 3 … 5 % positive

Seal material
V = FKM seals, suitable for mineral oil (HL, HLP) according to DIN 51524

100 = special number [6)]

Included in the delivery:
Valve operating instructions with declaration of conformity in part III

1) **Rated flow**
The rated flow refers to a 100% command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10% must be taken into account (see flow signal function page 8).

2) **External control electronics**
The actuating signal must be formed by a current controlled output stage. Control electronics (servo amplifier) see page 6.

3) **Pilot oil**
The valve is only delivered with internal pilot oil supply and return.

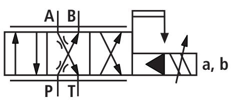
4) **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible.
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range of 10 ... 210 bar and/or 10 ...315 bar.

5) **Spool overlap**
The spool overlap is specified in % of the control spool stroke.

6) **Special number "100"**
Without actuation (de-energized condition), channels P → B and A → T are open for 10% of the nominal quantity.

4

Symbol



Function, section

4WS2EM 6-2X/...XN...-100

Valves of this type are electrically actuated, 2-stage directional servo-valves with porting pattern according to ISO 4401-03-02-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a bushing (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

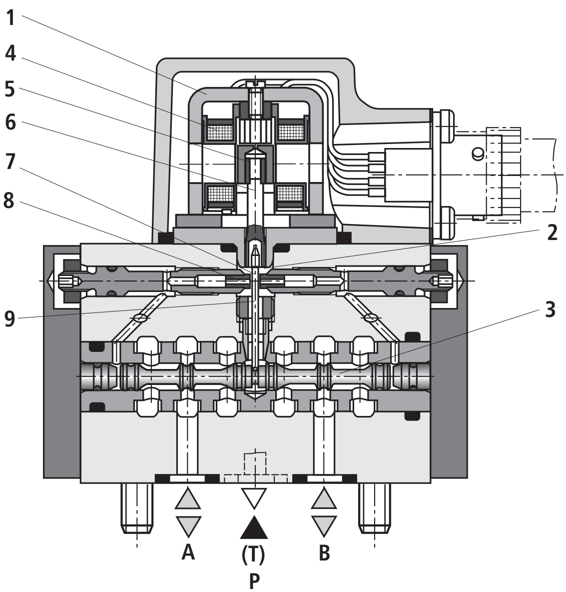
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

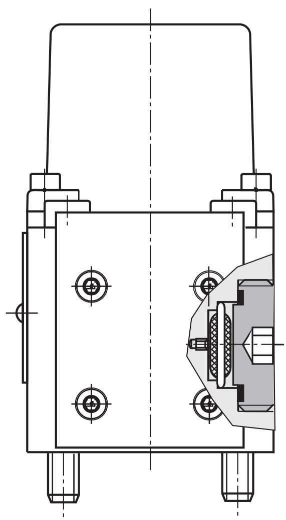
The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 6-2X/...XN...-100





Technical data

general

Porting pattern			ISO 4401-03-02-0-05
Installation position			Any (Ensure that upon system start-up, the valve is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +80
Ambient temperature range		°C	–30 … +80
Weight		kg	1.1

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Operating pressure	Ports P, A, B	bar	10 … 210 or 10 … 315
Return flow pressure	Port T	bar	Pressure peaks < 100, static < 10
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524, ignition temperature > 150 °C
Hydraulic fluid temperature range		°C	-15 ... +80; preferably +40 ... +50
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)			Class 18/16/13 1)
Zero flow $q_{V,L}$ 2) with spool overlap E measured without dither signal		l/min	$\sqrt{p_P / 70\ \text{bar}} \cdot (0.4\ \text{l/min} + 0.02 \cdot q_{V\ rated})$ 3); 4)
Rated flows $q_{v\ rated}$ 3), tolerance ±10 % with valve pressure differential Δ_p = 70 bar		l/min	2; 5; 10; 15; 20; 25
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170
Feedback system			Mechanical
Hysteresis (dither-optimized)		%	≤ 1.5
Range of inversion (dither-optimized)		%	≤ 0.2
Response sensitivity (dither-optimized)		%	≤ 0.2
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P 4)	≥ 50
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5
Zero shift upon change of:			
	Hydraulic fluid temperature	% / 20 °C	≤ 1
	Ambient temperature	% / 20 °C	≤ 1
	Operating pressure 80 … 120 % of p_P 4)	% / 100 bar	≤ 2
	Return flow pressure 0 … 10 % of p_P 4)	% / bar	≤ 1

1) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see www.boschrexroth.com/filter

2) $q_{V,L}$ = Zero flow in l/min
3) $q_{v\ rated}$ = Rated flow in l/min
4) p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100% rated current	Connection in series	H	1.0
	Connection in parallel	H	0.25
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC		II 3 G; II 3 D
Type of protection according to EN 60079-0:2006 / EN 60079-15:2005		Ex nA II T5X
Type of protection according to EN 61241-0:2006 / EN 61241-1:2004		Ex tD A22 IP 65 TX
Maximum surface temperature	°C	100
Ambient temperature range	°C	–30 … +80
Hydraulic fluid temperature range	°C	–15 … +80
Max. admissible operating voltage of the servo amplifier	V	32 (DC)
Conditions for use in zone 2 and 22		The valve may only be used in explosive zones of device group II, category 3, with "low" risk of mechanical hazards according to the harmonized standards EN 60079-0:2006, section 26.4.2 and EN 61241-0:2006, section 23.4.2.1. If used in zones with a "high" risk of mechanical load according to these standards , the user must take measures with a "low" risk of mechanical load.

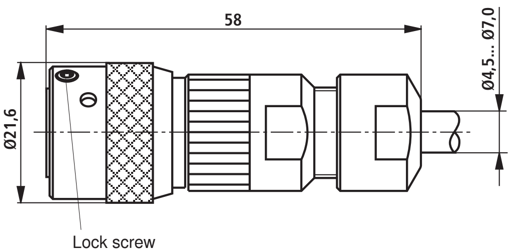
External control electronics

Servo amplifier (separate order)	Eurocard format	Analog	Type VT-SR2-1X/.60 according to technical data sheet RE 29980
	Modular design	Analog	Type VT 11021 according to technical data sheet RE 29743
The coils of the valve may only be connected to these amplifiers in parallel!			

⚠ **WARNING – Risk of explosion**
– The external servo amplifier must be operated outside the explosive area!

Mating connector

The servo valve may only be supplied through this mating connector. Separate order, material no. **R901043330**



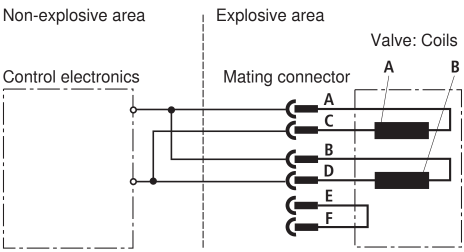
Connection:

Contact bushings with connection cross-section for litz wires 0.4 … 0.75 mm^2 are supplied unpacked.

The connection of the litz wires to the contact bushings is possible by crimping or soldering.

A list of the required tools for crimping connection is available in the assembly instructions which are supplied with the mating connector.

Electrical connection (example of parallel connection)



The coils are connected in parallel in the mating connector or at the amplifier (see figure).

In case of serial connection, contacts B and C must be connected.

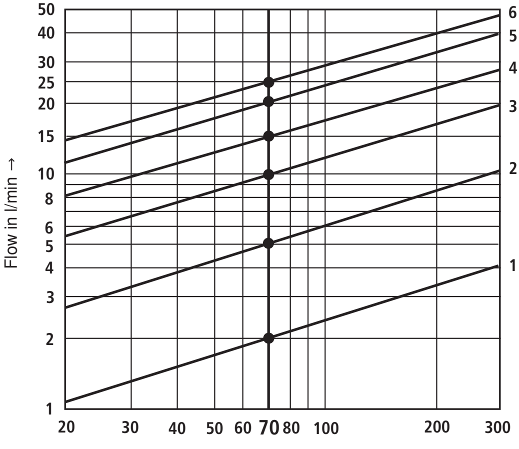
The E-F bridge can be used for the electrical determination of the correct connection of the plug-in connector and/or for the identification of cable break.

The electrical actuation from A (+) to D (–) causes flow direction from P → A and B → T. The reverse electrical actuation causes flow direction from P → B and A → T.

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

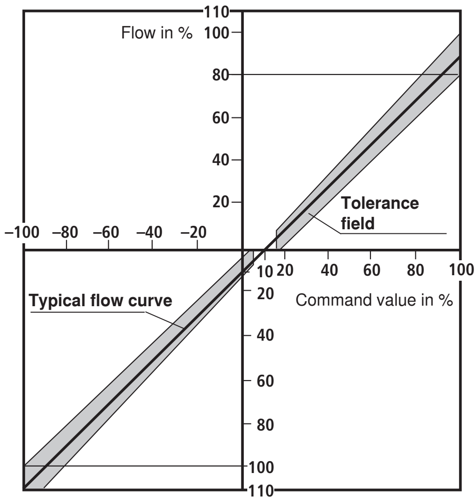
Note:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
2	2 l/min	1
5	5 l/min	2
10	10 l/min	3
15	15 l/min	4
20	20 l/min	5
25	25 l/min	6

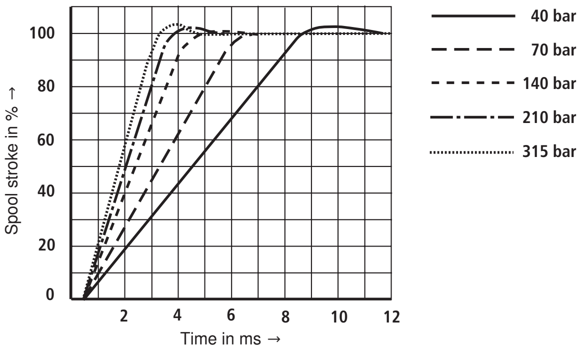
Δ_p = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of flow/signal function
at constant valve pressure difference Δ_p

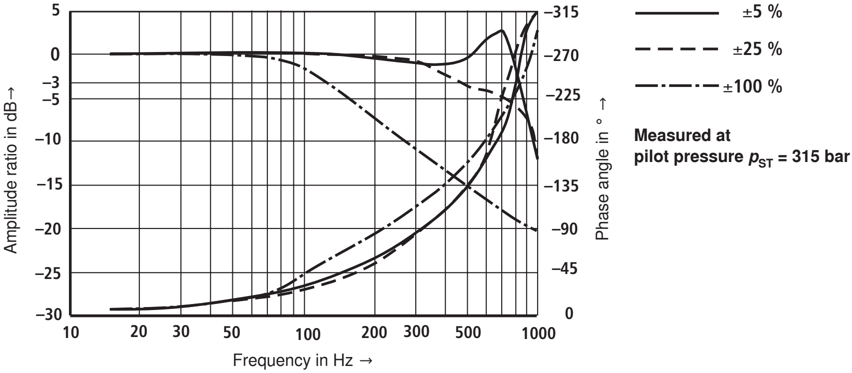


Characteristic curves (measured with HLP 32, ϑ_{oil} = 40°C ±5°C)

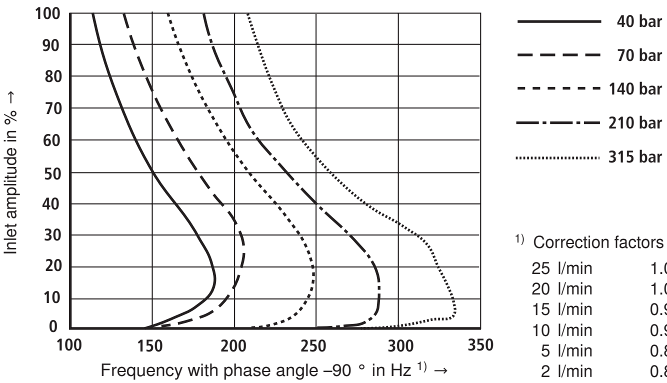
Transition function with pressure rating 315 bar, step response without flow



Frequency response with pressure rating 315 bar, stroke frequency without flow



Dependency of the frequency f at –90 ° on the operating pressure p and the inlet amplitude



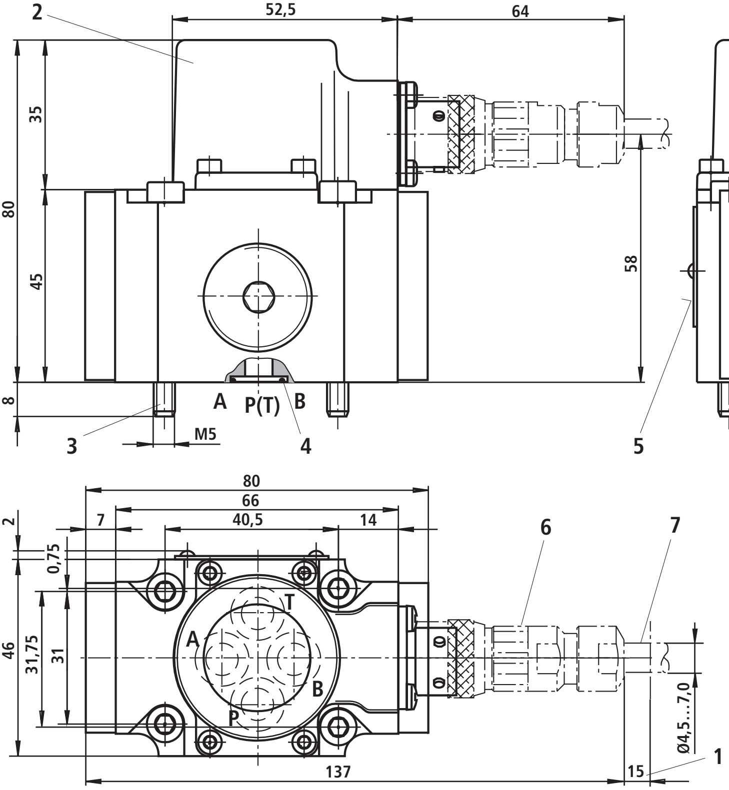
The output signal corresponds to the spool stroke with flow and without load pressure

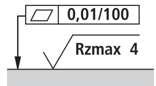
[1] Correction factors at $q_{V\ rated}$:

25 l/min	1.00
20 l/min	1.00
15 l/min	0.95
10 l/min	0.90
5 l/min	0.85
2 l/min	0.80

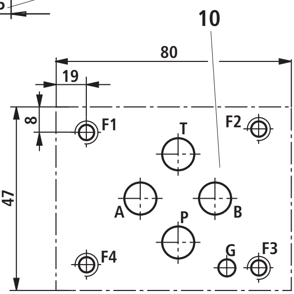
4

Unit dimensions (dimensions in mm)





Required surface quality of the valve mounting face



1 Required space for the removal of mating connectors, additionally observe the bending radius of the connection line

2 Cap

3 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws ISO 4762-M5x50-10.9-flZn-240h-L (Friction coefficient 0.09 – 0.14 according to VDA 235-101)
(included in the delivery)

4 Identical seal rings for ports P, A, B and T

5 Name plate

6 Mating connector (order separately, see page 7)

7 Connection line, further information on page 7

8 Filter

9 Plug screw

10 Machined valve mounting face, porting pattern according to ISO 4401-03-02-0-05
Deviating from the standard:
– Locating pin not available (G)

Subplates
G341/01 FE/ZN (G1/4)
G342/01 FE/ZN (G3/8)
G502/01 FE/ZN (G1/2)
with dimensions as in the technical data sheet RE 45052
(must be ordered separately)

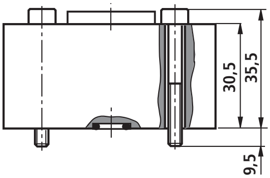
Note:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-03-02-0-05 (dimensions in mm)

Symbol



Ordering code and more information

- Material number: **R900936049**
- Weight: 0.6 kg
- Identical seal rings for ports P, A, B and T
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M5x40-10.9-flZn-240h-L
  (Friction coefficient 0.09 - 0.14 according to VDA 235-101) (included in the delivery)

Note

Before the assembly, observe the information in the product-specific instructions RE 29564-XN-100-B3, section 3.2.

Notes

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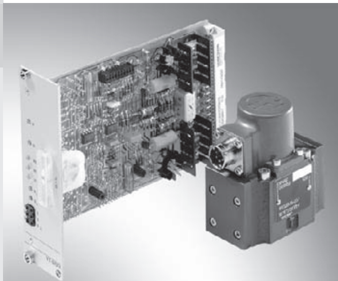
4/3 directional servo-valve with mechanical position feedback

RE 29564-XN-102-B2/05.10
Replaces: 02.09

Type 4WS2EM 6...XN...-102

Size 6
Component series 2X
Maximum operating pressure 315 bar
Maximum flow 48 l/min



H5994

ATEX units
For explosive areas

Part II Technical data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II3G: Type of protection Ex nA II T5X according to EN 60079-0:2006 / EN 60079-15:2005

II3D: Type of protection Ex tD A22 IP 65 TX according to EN 61241-0:2006 / EN 61241-1:2004

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information RE 07010-X-B1	**RE 29564-XN-102-B0**
Part II	Technical data sheet RE 29564-XN-102-B2	
Part III	Product-specific instructions RE 29564-XN-102-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" RE 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 2 and 22
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-03-02-0-05
  subplates available in FE/ZN version (see page 10)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in Eurocard format or in modular design (separate order), see page 6
- Valve is adjusted and tested
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2EM	6	–	2X	/		B	11	XN	ET		K17		V	–	102

Electrically actuated 2-stage servo valve in 4/3 directional design with mechanical feedback for **external** control electronics

Size 6 **= 6**

Component series 20 to 29 **= 2X**
(20 to 29: unchanged installation and connection dimensions)

Rated flow 1)

2 l/min	**= 2**
5 l/min	**= 5**
10 l/min	**= 10**
15 l/min	**= 15**
20 l/min	**= 20**
25 l/min	**= 25**

Characteristic curves, see page 8
(observe tolerance field of flow signal function)

Valve for **external** control electronics **= 11**
coil no. 11 (30 mA/85 Ω per coil) 2)

XN = explosion protection "type nA"
For details see information on the explosion protection, page 6

ET = internal pilot oil supply and return 3)

Inlet pressure range 4)

210 = 10 to 210 bar
315 = 10 to 315 bar

K17 = **electrical connection via connector**
Order mating connector separately, see page 7

Spool overlap 5)

E = 0 … 0.5 % negative
D = 0 … 0.5 % positive
C = 3 … 5 % positive

Seal material

V = FKM seals, suitable for mineral oil (HL, HLP) according to DIN 51524

102 = special number 6)

Included in the delivery:
Valve operating instructions with declaration of conformity in part III

1) **Rated flow**
The rated flow refers to a 100% command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10% must be taken into account (see flow signal function page 8).

2) **External control electronics**
The actuating signal must be formed by a current controlled output stage. Control electronics (servo amplifier) see page 6.

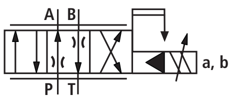
3) **Pilot oil**
The valve is only delivered with internal pilot oil supply and return.

4) **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible.
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range of 10 ... 210 bar and/or 10 ...315 bar.

5) **Spool overlap**
The spool overlap is specified in % of the control spool stroke.

6) **Special number "102"**
Without actuation (de-energized condition), channels P → A and B → T are open for 10% of the nominal quantity.

Symbol



Function, section

4WS2EM 6-2X/...XN...-102

Valves of this type are electrically actuated, 2-stage directional servo-valves with porting pattern according to ISO 4401-03-02-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a bushing (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

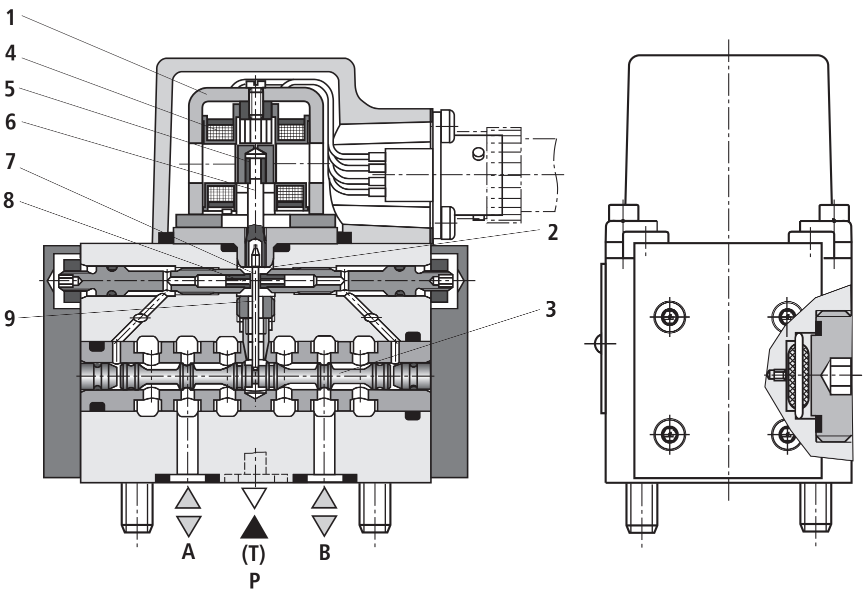
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 6-2X/...XN...-102



Technical data

general

Porting pattern			ISO 4401-03-02-0-05
Installation position			Any (Ensure that upon system start-up, the valve is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +80
Ambient temperature range		°C	–30 … +80
Weight		kg	1.1

hydraulic (measured with HLP 32, ϑ_{oil} = 40°C ±5°C)

Operating pressure	Ports P, A, B	bar	10 … 210 or 10 … 315
Return flow pressure	Port T	bar	Pressure peaks < 100, static < 10
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524, ignition temperature > 150 °C
Hydraulic fluid temperature range		°C	-15 ... +80; preferably +40 ... +50
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45
Maximum admissible degree of contamination of the hydraulic fluid cleanliness class according to ISO 4406 (c)			Class 18/16/13[1]
Zero flow $q_{V,L}$ [2] with spool overlap E measured without dither signal		l/min	$\sqrt{p_P / 70\ \text{bar}} \cdot (0.4\ \text{l/min} + 0.02 \cdot q_{V\ rated})$ [3); 4)]
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δ_p = 70 bar		l/min	2; 5; 10; 15; 20; 25
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170
Feedback system			Mechanical
Hysteresis (dither-optimized)		%	≤ 1.5
Range of inversion (dither-optimized)		%	≤ 0.2
Response sensitivity (dither-optimized)		%	≤ 0.2
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 50
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5
Zero shift upon change of:			
	Hydraulic fluid temperature	% / 20 °C	≤ 1
	Ambient temperature	% / 20 °C	≤ 1
	Operating pressure 80 … 120 % of p_P [4]	% / 100 bar	≤ 2
	Return flow pressure 0 … 10 % of p_P [4]	% / bar	≤ 1

1) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see www.boschrexroth.com/filter

2) $q_{V,L}$ = Zero flow in l/min
3) $q_{v\ rated}$ = Rated flow in l/min
4) p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100% rated current	Connection in series	H	1.0
	Connection in parallel	H	0.25
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC		II 3 G; II 3 D
Type of protection according to EN 60079-0:2006 / EN 60079-15:2005		Ex nA II T5X
Type of protection according to EN 61241-0:2006 / EN 61241-1:2004		Ex tD A22 IP 65 TX
Maximum surface temperature	°C	100
Ambient temperature range	°C	–30 … +80
Hydraulic fluid temperature range	°C	–15 … +80
Max. admissible operating voltage of the servo amplifier	V	32 (DC)
Conditions for use in zone 2 and 22		The valve may only be used in explosive zones of device group II, category 3, with "low" risk of mechanical hazards according to the harmonized standards EN 60079-0:2006, section 26.4.2 and EN 61241-0:2006, section 23.4.2.1. If used in zones with a "high" risk of mechanical load according to these standards , the user must take measures with a "low" risk of mechanical load.

External control electronics

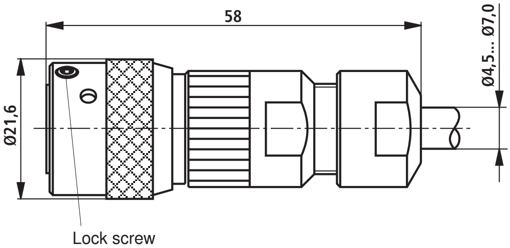
Servo amplifier (separate order)	Eurocard format	Analog	Type VT-SR2-1X/.60 according to technical data sheet RE 29980
	Modular design	Analog	Type VT 11021 according to technical data sheet RE 29743
The coils of the valve may only be connected to these amplifiers in parallel!			

⚠ **WARNING – Risk of explosion**

– The external servo amplifier must be operated outside the explosive area!

Mating connector

The servo valve may only be supplied through this mating connector. Separate order, material no. **R901043330**



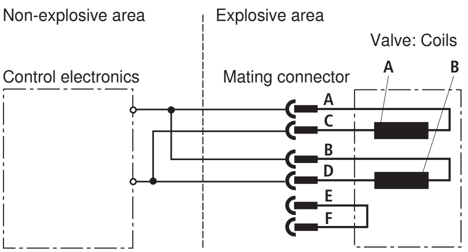
Connection:

Contact bushings with connection cross-section for litz wires 0.4 … 0.75 mm² are supplied unpacked.

The connection of the litz wires to the contact bushings is possible by crimping or soldering.

A list of the required tools for crimping connection is available in the assembly instructions which are supplied with the mating connector.

Electrical connection (example of parallel connection)



The coils are connected in parallel in the mating connector or at the amplifier (see figure).

In case of serial connection, contacts B and C must be connected.

The E-F bridge can be used for the electrical determination of the correct connection of the plug-in connector and/or for the identification of cable break.

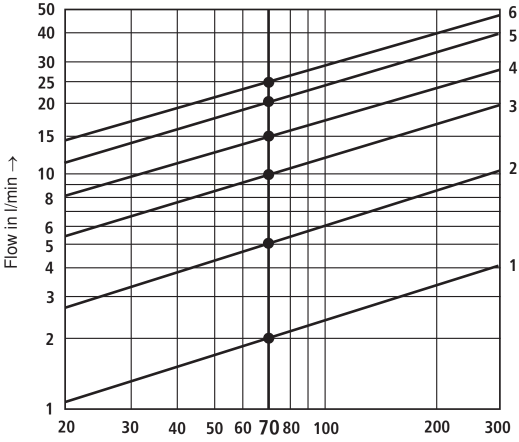
The electrical actuation from A (+) to D (–) causes flow direction from P → A and B → T. The reverse electrical actuation causes flow direction from P → B and A → T.

4

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

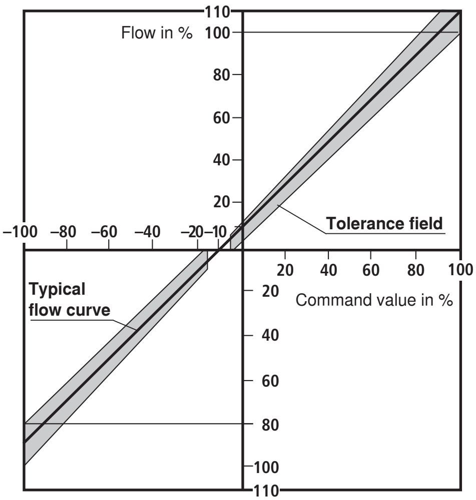
Note:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
2	2 l/min	1
5	5 l/min	2
10	10 l/min	3
15	15 l/min	4
20	20 l/min	5
25	25 l/min	6

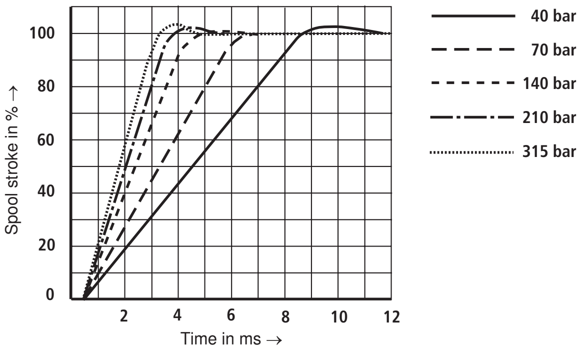
Δ_p = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of flow/signal function
at constant valve pressure difference Δ_p

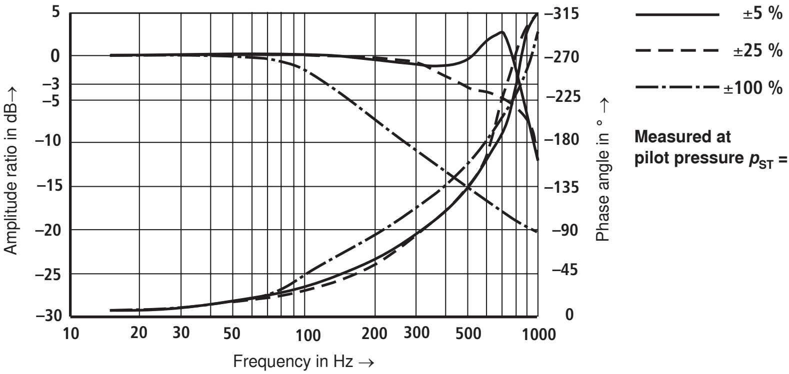


Characteristic curves (measured with HLP 32, ϑ_{oil} = 40°C ±5°C)

Transition function with pressure rating 315 bar, step response without flow

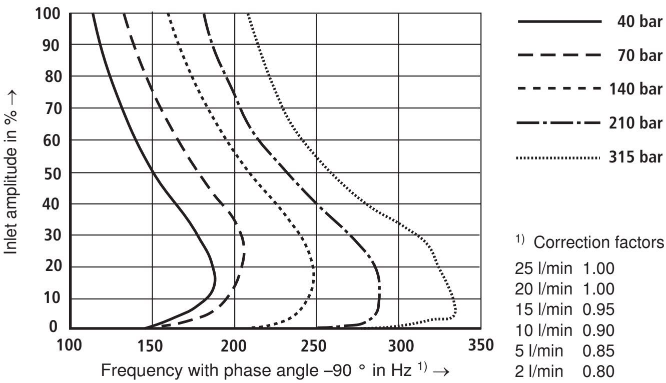


Frequency response with pressure rating 315 bar, stroke frequency without flow



Measured at pilot pressure p_{ST} = 315 bar

Dependency of the frequency f at –90 ° on the operating pressure p and the inlet amplitude



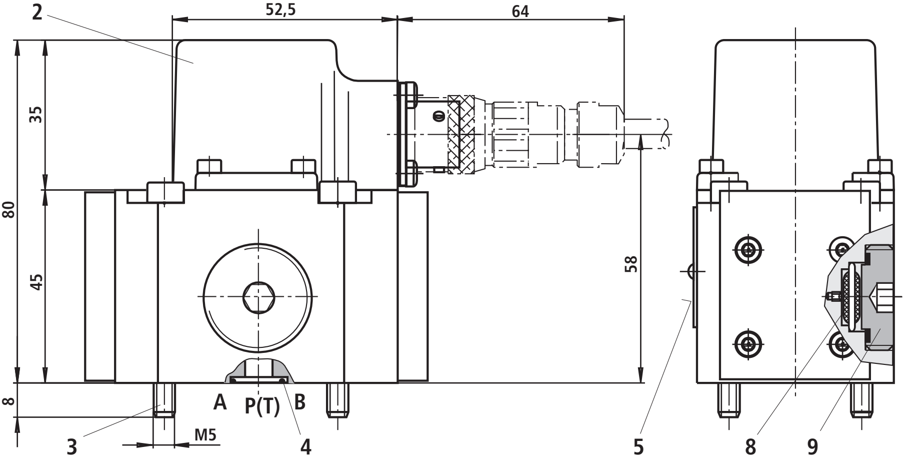
The output signal corresponds to the spool stroke with flow and without load pressure

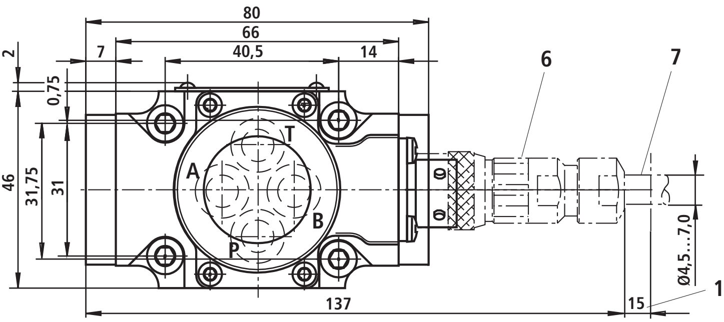
1) Correction factors at $q_{V\ rated}$:

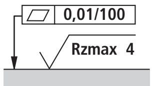
25 l/min	1.00
20 l/min	1.00
15 l/min	0.95
10 l/min	0.90
5 l/min	0.85
2 l/min	0.80

4

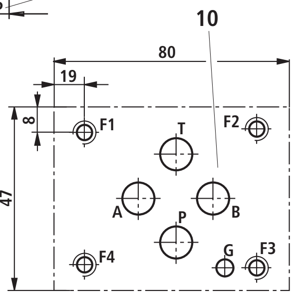
Unit dimensions (dimensions in mm)







Required surface quality of the valve mounting face



- **1** Required space for the removal of mating connectors, additionally observe the bending radius of the connection line
- **2** Cap
- **3** Valve mounting screws
  For reasons of stability, exclusively the following valve mounting screws may be used:
  4 hexagon socket head cap screws ISO 4762-M5x50-10.9-flZn-240h-L (Friction coefficient 0.09 – 0.14 according to VDA 235-101)
  (included in the delivery)
- **4** Identical seal rings for ports P, A, B and T
- **5** Name plate
- **6** Mating connector (order separately, see page 7)
- **7** Connection line, further information on page 7
- **8** Filter
- **9** Plug screw
- **10** Machined valve mounting face, porting pattern according to ISO 4401-03-02-0-05
  Deviating from the standard:
  – Locating pin not available (G)

Subplates
G341/01 FE/ZN (G1/4)
G342/01 FE/ZN (G3/8)
G502/01 FE/ZN (G1/2)
with dimensions as in the technical data sheet RE 45052
(must be ordered separately)

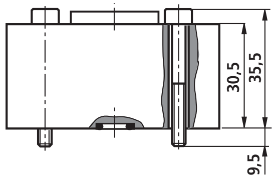
Note:

Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-03-02-0-05 (dimensions in mm)

Symbol



Ordering code and more information

- Material number: **R900936049**
- Weight: 0.6 kg
- Identical seal rings for ports P, A, B and T
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M5x40-10.9-flZn-240h-L
  (Friction coefficient 0.09 - 0.14 according to VDA 235-101) (included in the delivery)

Note

Before the assembly, observe the information in the product-specific instructions RE 29564-XN-102-B3, section 3.2.

Notes

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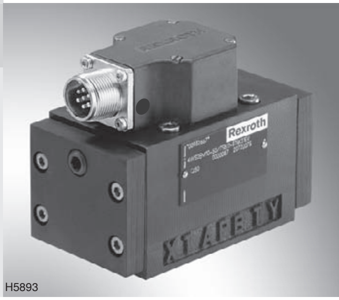
4/3 directional servo-valve with mechanical position feedback

RE 29583-XH-B2/10.11
Replaces: 07.11

Type 4WS2EM 10...XH

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min



H5893

ATEX units
For explosive areas

Part II Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II 1G: Type of protection Ex ia IIC T4 Ga according to EN 60079-0:2009 / EN 60079-11:2007

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XH-B0**
Part II	Data sheet 29583-XH-B2	
Part III	Product-specific instructions 29583-XH-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 0
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting, porting pattern according to ISO 4401-05-05-0-05 with ports X and Y suplates available in FE/ZN version (see page 12)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in modular design, additional safety barrier (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed, thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10	–	5X	/		B	11	XH			K31		V

Electrically operated 2-stage servo valve in 4/3 directional design for **external** control electronics

Mechanical feedback **= M**

Size **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

Rated flow 1)

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics coil no. 11 (30 mA/85 Ω per coil) 2) **= 11**

XH = Explosion protection "type ia"
For details see information on the explosion protection, page 6

Pilot oil supply and return 3)

– = Supply external, return external
E = Supply internal, return external
T = Supply external, return internal
ET = Supply internal, return internal
(ET = Standard version)

Inlet pressure range to the 1st stage 4)

210 = 10 … 210 bar
315 = 10 … 315 bar

K31 = **Electrical connection via connector**
Order mating connector separately, see page 7

Spool overlap 5)

E = 0 … 0.5 % negative
D = 0 … 0.5 % positive
C = 3 … 5 % positive

Seal material

V = FKM seals
suitable for mineral oil (HL, HLP) according to DIN 51524

Included in the delivery:
- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

1) **Rated flow**

The rated flow refers to a 100% command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10% must be taken into account (see flow signal function page 8).

2) **External control electronics**

The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal.
Control electronics (servo amplifier) see page 6.

3) **Pilot oil**

Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.

The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.
Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

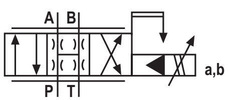
4) **Inlet pressure range**

Care should be taken that the system pressure is as constant as possible.
Pilot pressure range: 10 … 210 bar or 10 … 315 bar
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

5) **Spool overlap**

The spool overlap is specified in % of the control spool stroke.

Symbol



4

Function, section

4WS2EM 10…XH

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a bushing (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

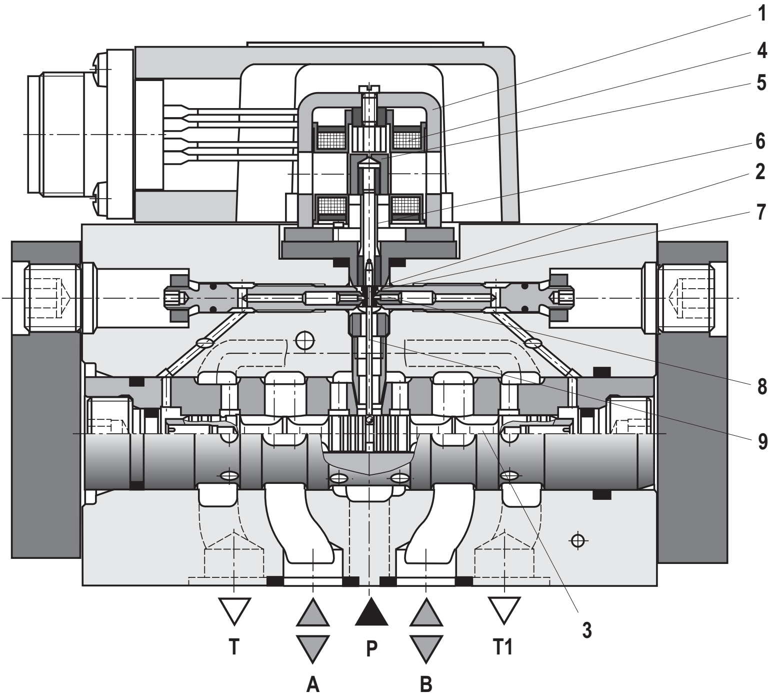
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XH



Technical data

general

Porting pattern			ISO 4401-05-05-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +70
Ambient temperature range		°C	–20 … +60
Weight		kg	3.56

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	up to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks < 100 permitted							
	Pilot oil return external	bar	up to 315							
	Port Y	bar	Pressure peaks <100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	-15 ... +60; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]							
Zero flow $q_{V,L}$ [2] with spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 0.7 \frac{l}{min}$	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 0.9 \frac{l}{min}$	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1.2 \frac{l}{min}$			$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1.5 \frac{l}{min}$		$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1.7 \frac{l}{min}$
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1.5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
Hydraulic fluid temperature		% / 20 K	≤ 1							
Ambient temperature		% / 20 K	≤ 1							
Operating pressure 80 … 120 % of p_P [4]		% / 100 bar	≤ 2							
Return flow pressure 0 … 10 % of p_P [4]		% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters, see www.boschrexroth.com/filter

[2] $q_{V,L}$ = Zero flow in l/min
[3] $q_{v\ rated}$ = Rated flow in l/min
[4] p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100% rated current	Connection in parallel	H	0.25
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC			II 1G
Type of protection according to EN 60079-0:2009 / EN 60079-11:2007			Ex ia IIC T4 Ga
Ambient temperature range		°C	–20 … +60
Hydraulic fluid temperature range		°C	–15 … +60
Electric supply of the valve only from certified, intrinsically safe electrical circuits with the following maximum values	U_{max}	V	9.3
	I_{max}	mA	390
	P_{max}	mW	907
Conditions for use in zone 0			The valve cap consists of die-cast aluminum. For the use as device of category 1 in zone 0, the valve cap must be protected so that even with rarely occurring malfunctions, no ignitable sparks from friction, impact or grinding can be produced. **Important:** The ignition temperature of the hydraulic fluid used must at least be 150 °C.
Necessary clearance area for burst protection			The specified clearance area for the burst protection (see page 12) must remain free so that in case of error, overpressure can leak through the blanking plug from the valve cap.

External control electronics

Servo amplifier [1] in modular design	Analog	Type VT 11021 according to data sheet 29743
Recommended safety barrier [1]	Single-channel	Company Stahl, type 9001/02-093-390-101

⚠ WARNING – Risk of explosion

– The servo amplifier and the safety barrier must be operated outside the explosive area!

[1] order separately

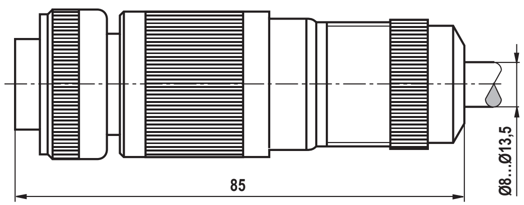
Mating connector

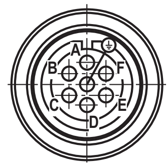
Mating connector according to EN 175201-804

Metal version

Separate order under the Material no. **R900223890**

Connection:
Solder contacts with connection cross-section for litz wires 0.5 … 1.5 mm²



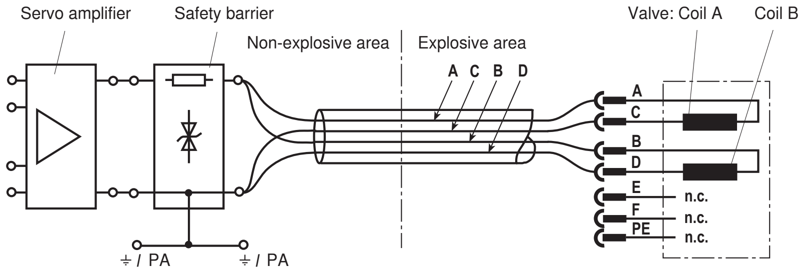


Electrical connection

The coils may **only be connected in parallel**.

The electrical control with plus (+) at A and B and minus (–) at C and D results in the flow direction P → A and B → T.
The reverse electrical control causes flow direction from P → B and A → T.

Pins E, F and PE at the connector are not connected.



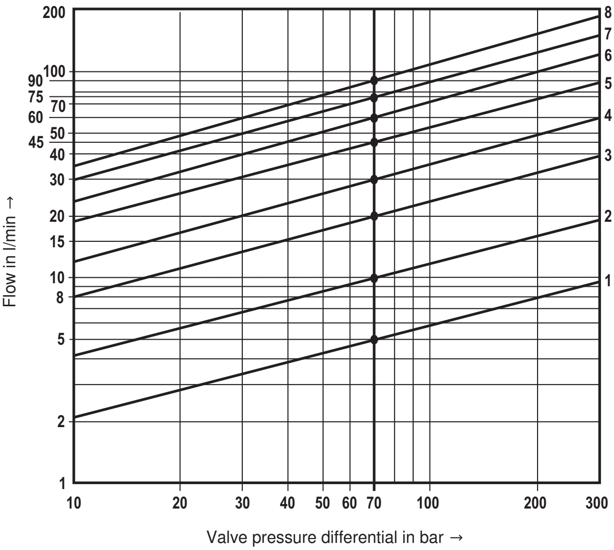
Important

For intrinsically safe electric circuits, only cables and lines approved of for that purpose may be used.

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

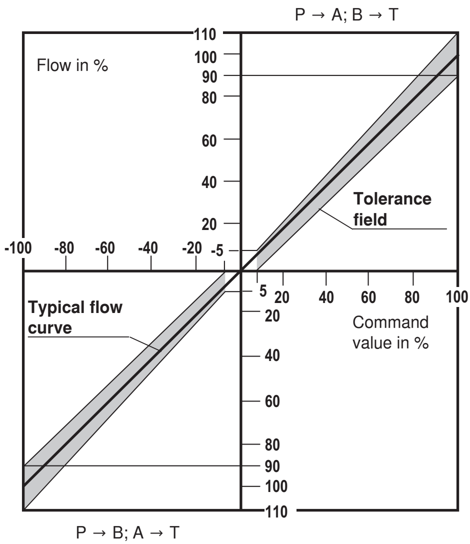
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

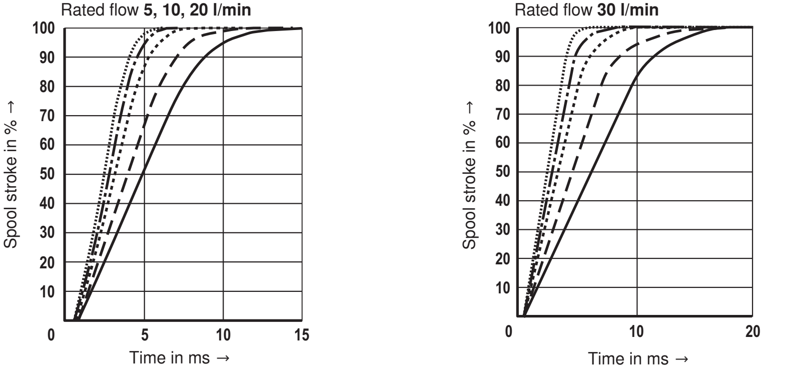
Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of the flow/signal function at constant valve pressure differential Δp



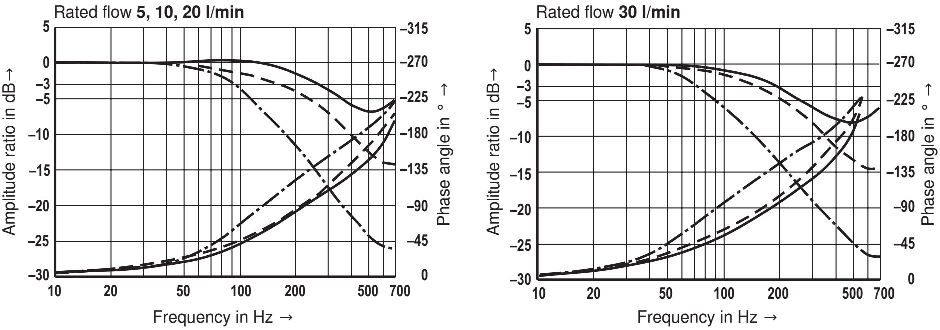
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40°C ±5°C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])



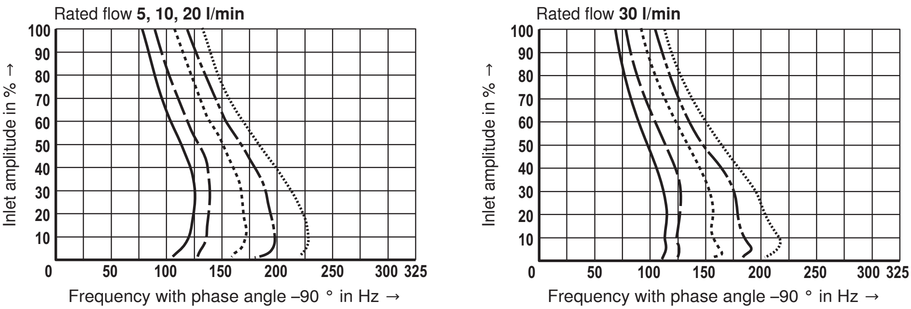
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])



±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])



40 bar — 70 bar — 140 bar — 210 bar — 315 bar

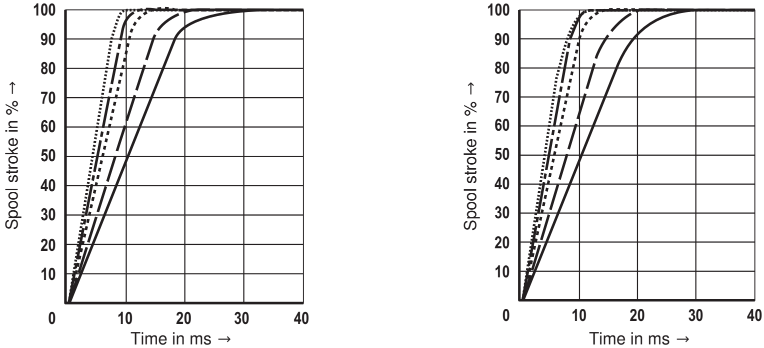
[1)] For information on the safety barrier see page 6 and 7

4

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])

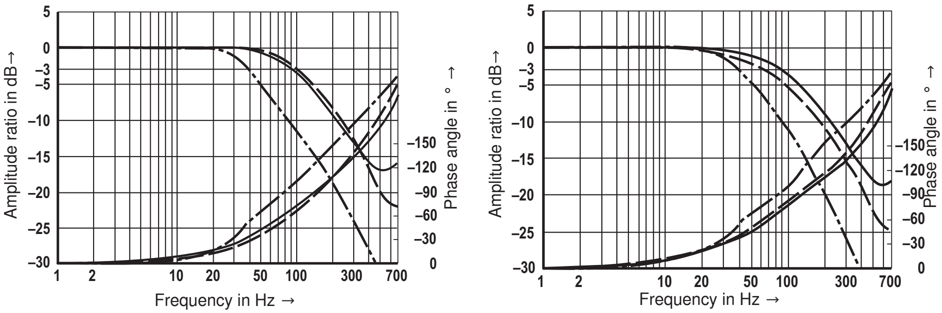
Rated flow **45 l/min** Rated flow **60 l/min**



40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])

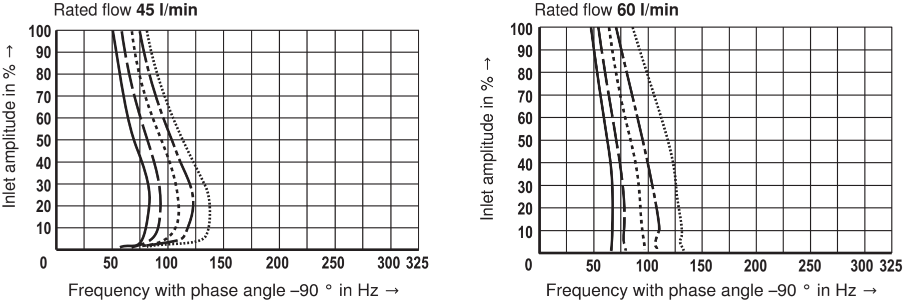
Rated flow **45 l/min** Rated flow **60 l/min**



±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])

Rated flow **45 l/min** Rated flow **60 l/min**

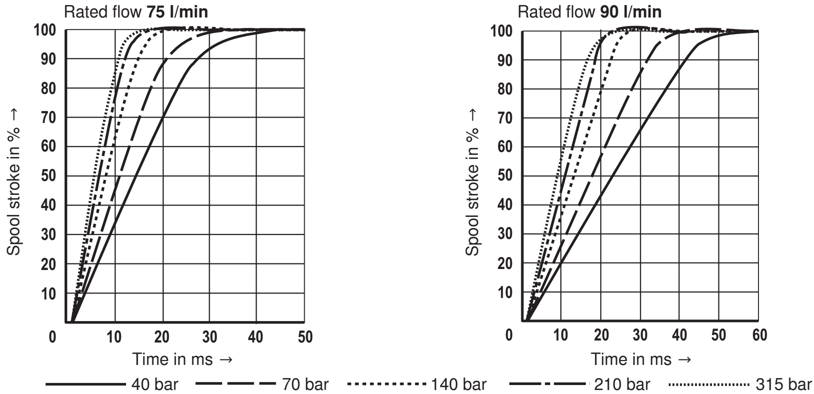


40 bar — 70 bar — 140 bar — 210 bar — 315 bar

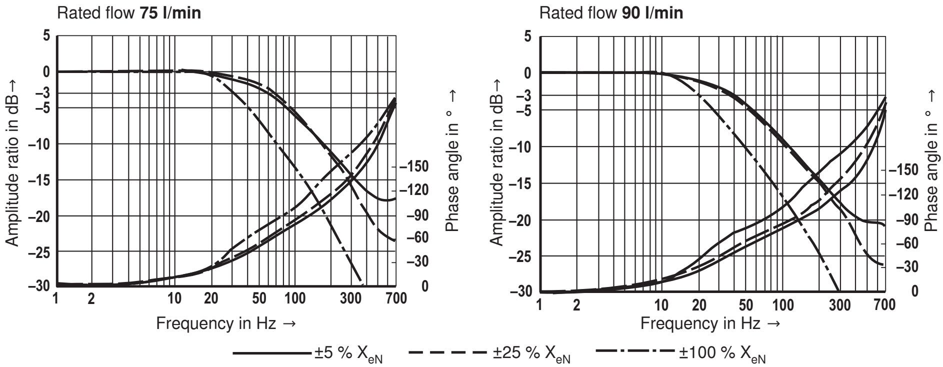
[1)] For information on the safety barrier see page 6 and 7

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

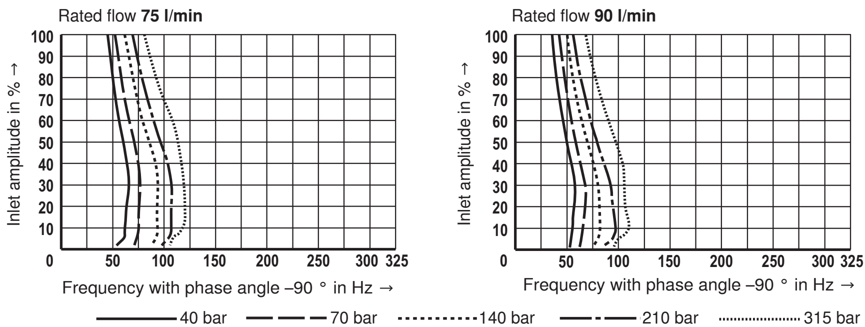
Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])



Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])



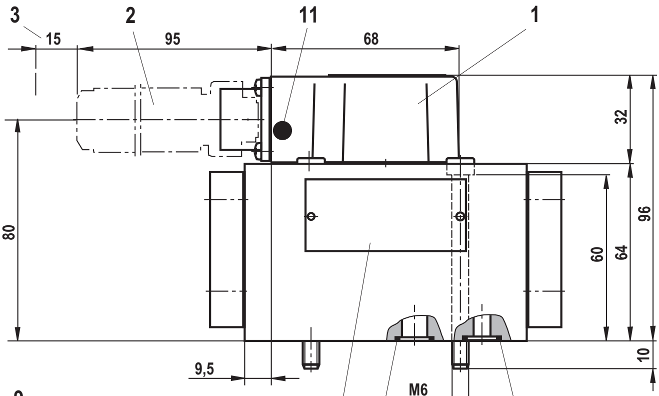
Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])

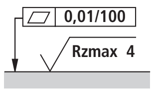


[1)] For information on the safety barrier see page 6 and 7

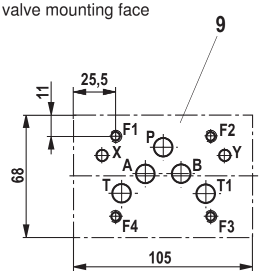
4

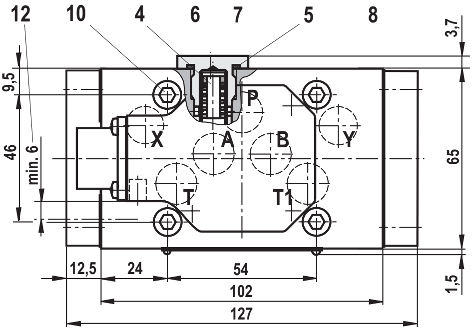
Unit dimensions (dimensions in mm)





Required surface quality of the valve mounting face





1 Cap
2 Mating connector (separate order, see page 7)
3 Space required for removing the mating connector, additionally observe the bending radius of the connection line
4 Exchangeable filter element with seals Material no.: **R961001950**
5 Profile seal for filter screw M16 x 1.5, part of item 4
6 Name plate
7 Identical seal rings for ports P, A, B, T and T1
8 Identical seal rings for ports X and Y Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.
9 Processed valve mounting face Porting pattern according to ISO 4401-05-05-0-05 Port T1 is optional and is recommended for reducing the pressure differential from B → T with rated flows > 45 l/min.
10 Valve mounting screws For reasons of stability, exclusively the following valve mounting screws may be used: **4 hexagon socket head cap screws ISO 4762-M6x70-10.9-flZn-240h-L (Friction coefficient 0.09 – 0.14 according to VDA 235-101)** (included in the delivery)
11 Burst protection
12 Clearance area for burst protection

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions like in data sheet 45054 (must be ordered separately)

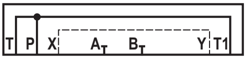
Important:

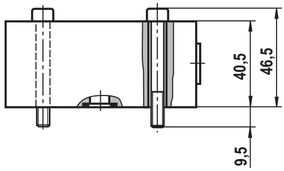
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101) (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XH-B3, section 3.2.

Notes

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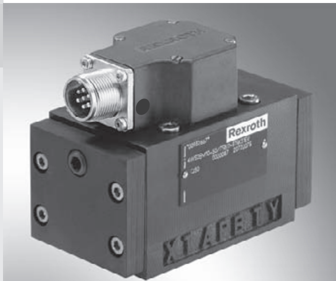
Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

4/3 directional servo-valve with mechanical position feedback

RE 29583-XH-100-B2/12.11
Replaces: 07.11

Type 4WS2EM 10...XH...-100



H5893

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II 1G: Type of protection Ex ia IIC T4 Ga according to EN 60079-0:2009 / EN 60079-11:2007

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XH-100-B0**
Part II	Data sheet 29583-XH-100-B2	
Part III	Product-specific instructions 29583-XH-100-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 0
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting, porting pattern according to ISO 4401-05-05-0-05 with ports X and Y suplates available in FE/ZN version (see page 12)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in modular design, additional safety barrier (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed, thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10 – 5X /	B	11	XH			K31		V – 100

Electrically operated 2-stage servo valve in 4/3 directional design for **external** control electronics

Mechanical feedback **= M**

Size **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

Rated flow [1)]

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics
Coil no. 11 (30 mA/85 Ω per coil) [2)] **= 11**

XH = Explosion protection "type ia"
For details see information on the explosion protection, page 6

Pilot oil supply and return [3)]

– =	Supply external, return external
E =	Supply internal, return external
T =	Supply external, return internal
ET =	Supply internal, return internal (ET = Standard version)

Inlet pressure range to the 1st stage [4)]

210 =	10 to 210 bar
315 =	10 to 315 bar

K31 = Electrical connection via connector
Order mating connector separately, see page 7

Spool overlap [5)]

E =	0 … 0.5 % negative
D =	0 … 0.5 % positive
C =	3 … 5 % positive

Seal material
V = FKM seals
Suitable formineral oil (HL, HLP) according to DIN 51524

100 = Special number [6)]

Included in the delivery:
- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

1) **Rated flow**
The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10 % must be taken into account (see flow signal function page 8).

2) **External control electronics**
The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal.
Control electronics (servo amplifier) see page 6.

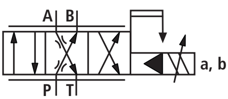
3) **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.
The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.
Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

4) **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible.
Pilot pressure range: 10 … 210 bar or 10 … 315 bar
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

5) **Spool overlap**
The spool overlap is specified in % of the control spool stroke.

6) **Special number "100"**
Without actuation (de-energized condition), channels P → B and A → T are open for 10 % of the nominal quantity.

Symbol



4

Function, section

4WS2EM 10…XH…-100

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a bushing (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

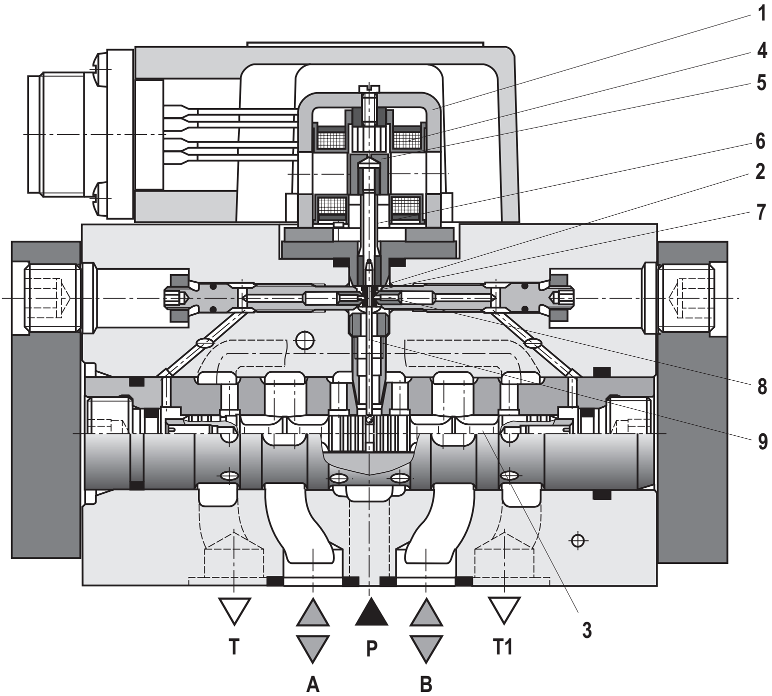
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XH…-100



Technical data

general

Porting pattern			ISO 4401-05-05-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥ 10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +70
Ambient temperature range		°C	–20 … +60
Weight		kg	3.56

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	up to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks < 100 permitted							
	Pilot oil return external	bar	up to 315							
	Port Y	bar	Pressure peaks < 100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	–15 ... +60; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]							
Zero flow $q_{V,L}$ [2] with spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P{}^{4)}}{70\ \text{bar}}} \cdot 0.7 \frac{\text{l}}{\text{min}}$	$\sqrt{\frac{p_P{}^{4)}}{70\ \text{bar}}} \cdot 0.9 \frac{\text{l}}{\text{min}}$	$\sqrt{\frac{p_P{}^{4)}}{70\ \text{bar}}} \cdot 1.2 \frac{\text{l}}{\text{min}}$			$\sqrt{\frac{p_P{}^{4)}}{70\ \text{bar}}} \cdot 1.5 \frac{\text{l}}{\text{min}}$		$\sqrt{\frac{p_P{}^{4)}}{70\ \text{bar}}} \cdot 1.7 \frac{\text{l}}{\text{min}}$
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1.5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
Hydraulic fluid temperature		% / 20 K	≤ 1							
Ambient temperature		% / 20 K	≤ 1							
Operating pressure 80 … 120 % of p_P [4]		% / 100 bar	≤ 2							
Return flow pressure 0 … 10 % of p_P [4]		% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see www.boschrexroth.com/filter

[2] $q_{V,L}$ = Zero flow in l/min
[3] $q_{v\ rated}$ = Rated flow in l/min
[4] p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100 % rated current	Connection in parallel	H	0.25
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC			II 1G
Type of protection according to EN 60079-0:2009 / EN 60079-11:2007			Ex ia IIC T4 Ga
Ambient temperature range		°C	–20 … +60
Hydraulic fluid temperature range		°C	–15 … +60
Electric supply of the valve only from certified, intrinsically safe electrical circuits with the following maximum values	U_{max}	V	9.3
	I_{max}	mA	390
	P_{max}	mW	907
Conditions for use in zone 0			The valve cap consists of die-cast aluminum. For the use as device of category 1 in zone 0, the valve cap must be protected so that even with rarely occurring malfunctions, no ignitable sparks from friction, impact or grinding can be produced. **Important:** The ignition temperature of the hydraulic fluid used must at least be 150 °C.
Necessary clearance area for burst protection			The specified clearance area for the burst protection (see page 12) must remain free so that in case of error, overpressure can leak through the blanking plug from the valve cap.

External control electronics

Servo amplifier [1] in modular design	Analog	Type VT 11021 according to data sheet 29743
Recommended safety barrier [1]	Single-channel	Company Stahl, type 9001/02-093-390-101

⚠ WARNING – Risk of explosion

– The servo amplifier and the safety barrier must be operated outside the explosive area!

[1] Order separately

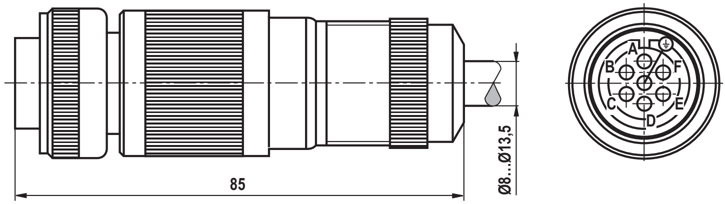
Mating connector

Mating connector according to EN 175201-804

Metal version

Separate order under the Material no. **R900223890**

Connection:
Solder contacts with connection cross-section for litz wires 0.5 … 1.5 mm²

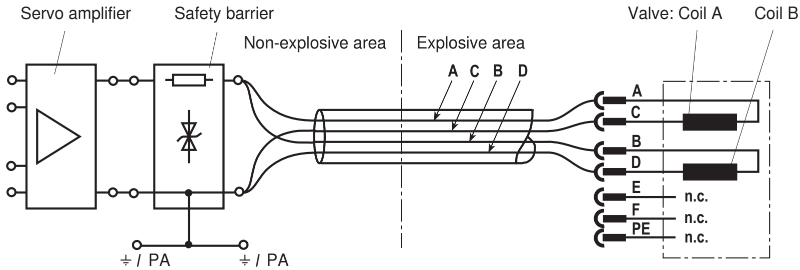


Electrical connection

The coils may **only be connected in parallel**.

The electrical control with plus (+) at A and B and minus (–) at C and D results in the flow direction P → A and B → T.
The reverse electrical control causes flow direction from P → B and A → T.

Pins E, F and PE at the connector are not connected.



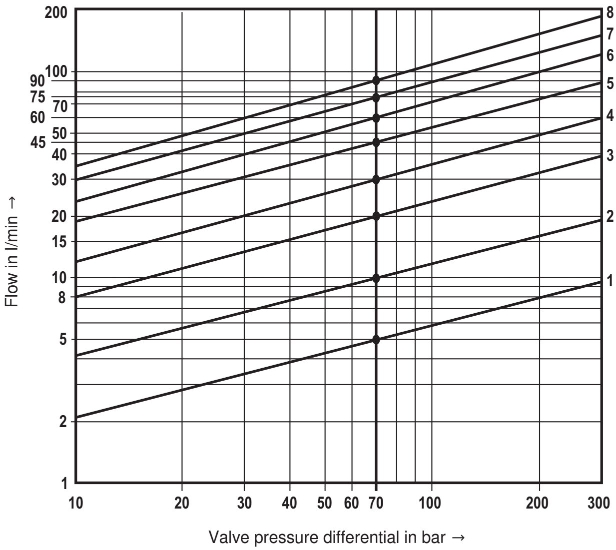
Important

For intrinsically safe electric circuits, only cables and lines approved of for that purpose may be used.

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

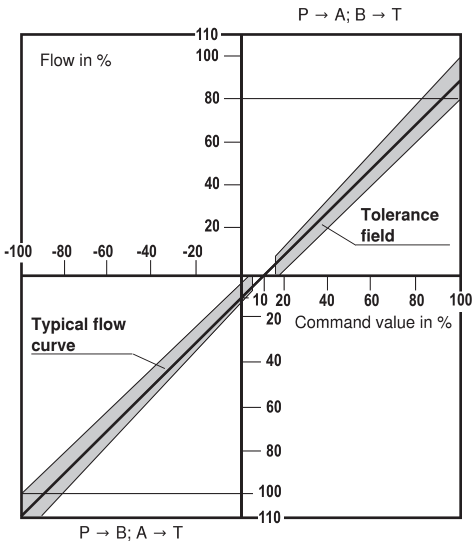
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δ*p* = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

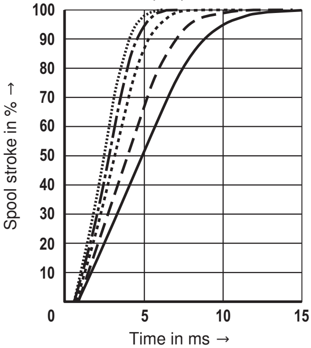
Tolerance field of the flow/signal function at constant valve pressure differential Δ*p*



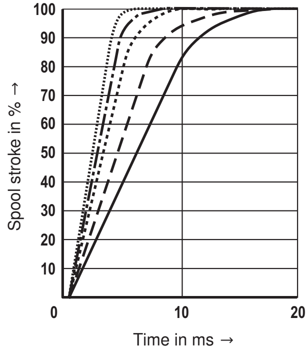
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1])

Rated flow **5, 10, 20 l/min**



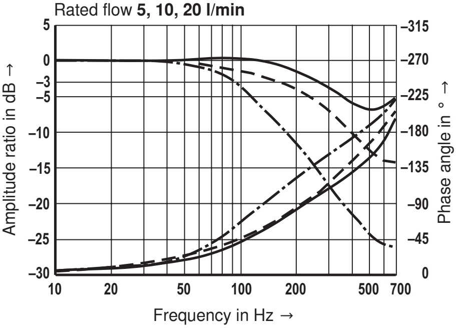
Rated flow **30 l/min**



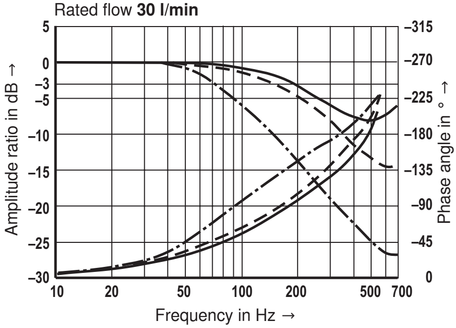
40 bar 70 bar 140 bar 210 bar 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1])

Rated flow **5, 10, 20 l/min**



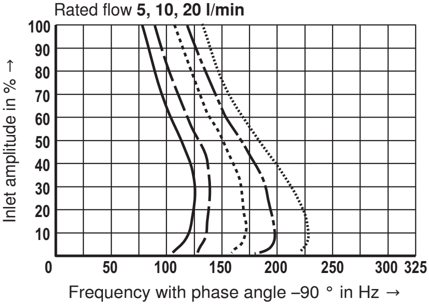
Rated flow **30 l/min**



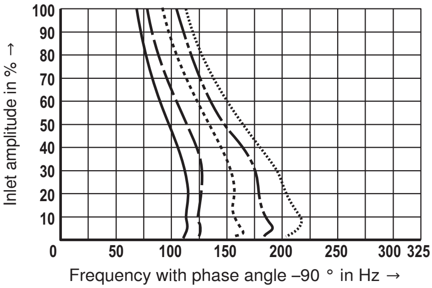
±5 % X_{eN} ±25 % X_{eN} ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1])

Rated flow **5, 10, 20 l/min**



Rated flow **30 l/min**



40 bar 70 bar 140 bar 210 bar 315 bar

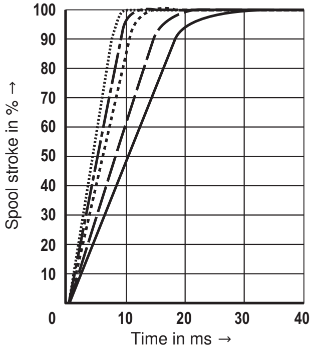
[1] For information on the safety barrier see page 6 and 7

4

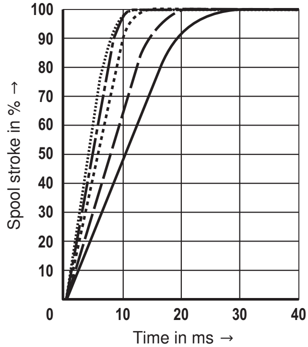
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])

Rated flow **45 l/min**



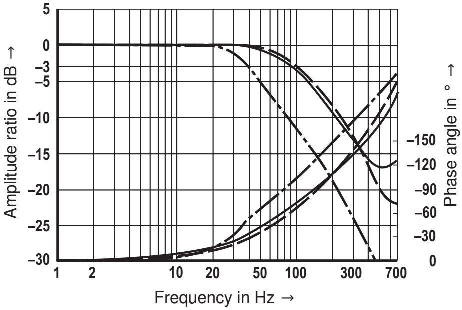
Rated flow **60 l/min**



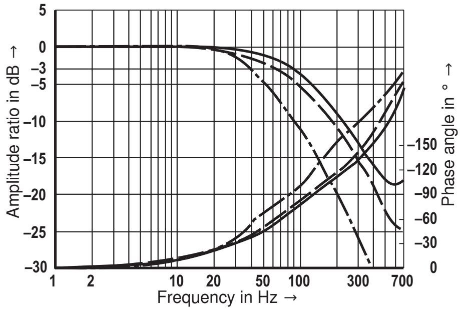
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])

Rated flow **45 l/min**



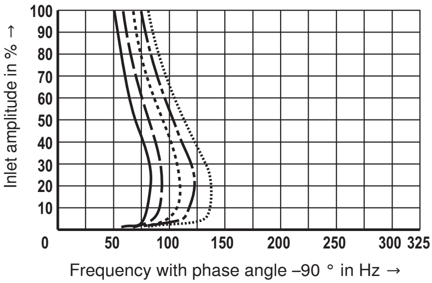
Rated flow **60 l/min**



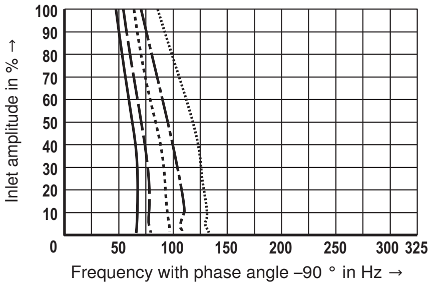
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])

Rated flow **45 l/min**



Rated flow **60 l/min**



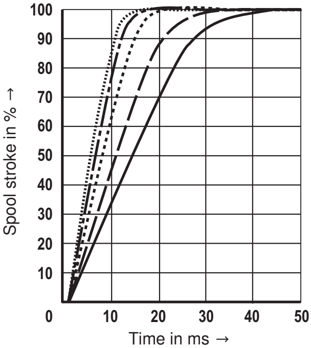
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

[1)] For information on the safety barrier see page 6 and 7

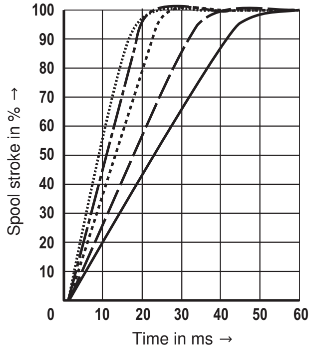
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])

Rated flow **75 l/min**



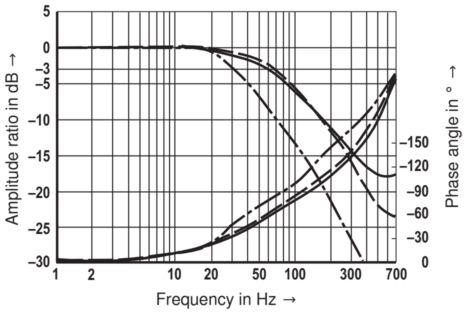
Rated flow **90 l/min**



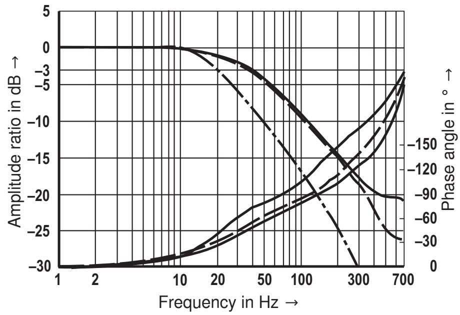
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])

Rated flow **75 l/min**



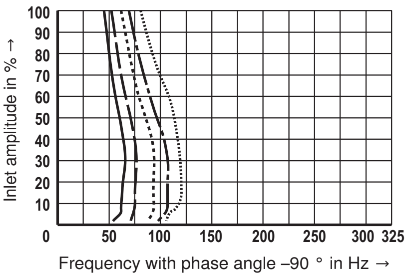
Rated flow **90 l/min**



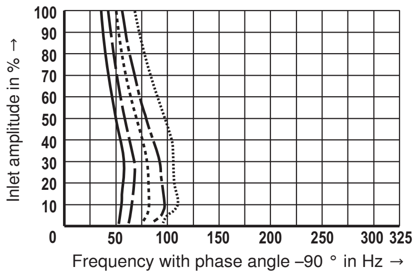
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])

Rated flow **75 l/min**



Rated flow **90 l/min**

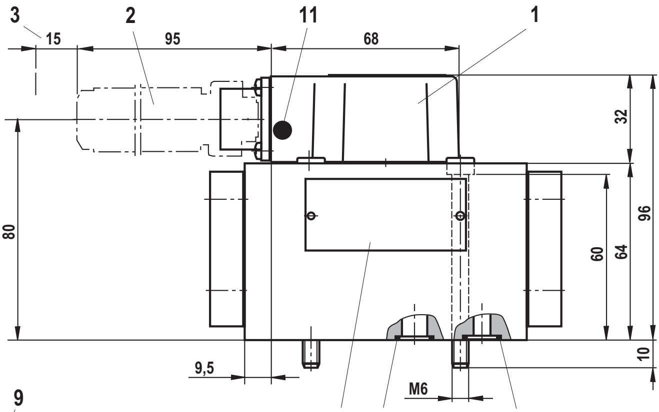


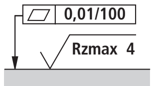
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

[1)] For information on the safety barrier see page 6 and 7

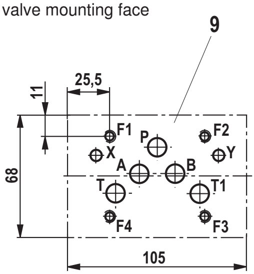
4

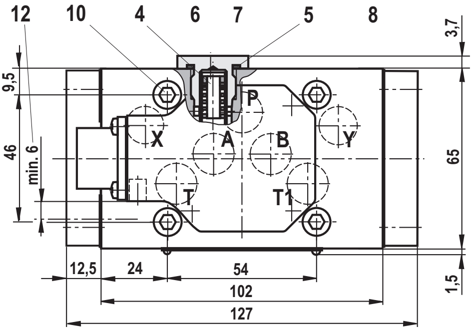
Unit dimensions (dimensions in mm)





Required surface quality of the valve mounting face





1 Cap

2 Mating connector
(separate order, see page 7)

3 Space required for removing the mating connector, additionally observe the bending radius of the connection line

4 Exchangeable filter element with seals
Material no.: **R961001950**

5 Profile seal for filter screw M16 x 1.5, part of item 4

6 Name plate

7 Identical seal rings for ports P, A, B, T and T1

8 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

9 Processed valve mounting face
Porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure differential from B → T with rated flows > 45 l/min.

10 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M6x70-10.9-flZn-240h-L
(Friction coefficient 0.09 – 0.14 according to VDA 235-101) (included in the delivery)

11 Burst protection

12 Clearance area for burst protection

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions like in data sheet 45054 (must be ordered separately)

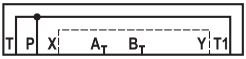
Important:

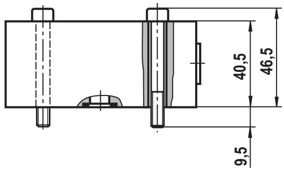
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XH-100-B3, section 3.2.

Notes

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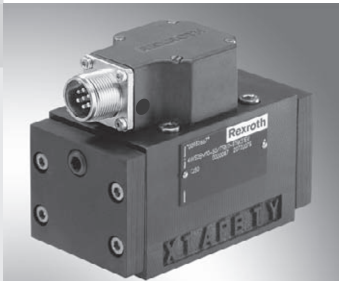
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional servo-valve with mechanical position feedback

RE 29583-XH-102-B2/12.11
Replaces: 07.11

Type 4WS2EM 10...XH...-102

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min



H5893

ATEX units
For explosive areas

Part II   Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II 1G: Type of protection Ex ia IIC T4 Ga according to EN 60079-0:2009 / EN 60079-11:2007

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XH-102-B0**
Part II	Data sheet 29583-XH-102-B2	
Part III	Product-specific instructions 29583-XH-102-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 0
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting, porting pattern according to ISO 4401-05-05-0-05 with ports X and Y suplates available in FE/ZN version (see page 12)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in modular design, additional safety barrier (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed, thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10	–	5X	/		B	11	XH			K31		V	–	102

Electrically operated 2-stage servo valve in 4/3 directional design for **external** control electronics

Mechanical feedback	**= M**
Size	**= 10**
Component series 50 to 59 (50 to 59: unchanged installation and connection dimensions)	**= 5X**

Rated flow [1)]

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics
Coil no. 11 (30 mA/85 Ω per coil) [2)] **= 11**

XH = Explosion protection "type ia"
For details see information on the explosion protection, page 6

Pilot oil supply and return [3)]

– =	Supply external, return external
E =	Supply internal, return external
T =	Supply external, return internal
ET =	Supply internal, return internal (ET = Standard version)

Inlet pressure range to the 1st stage [4)]

210 =	10 to 210 bar
315 =	10 to 315 bar

K31 = **Electrical connection via connector**
Order mating connector separately, see page 7

Spool overlap [5)]

E =	0 … 0.5 % negative
D =	0 … 0.5 % positive
C =	3 … 5 % positive

Seal material
V = FKM seals
Suitable for mineral oil (HL, HLP) according to DIN 51524

102 = Special number [6)]

Included in the delivery:

- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

[1)] **Rated flow**

The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10 % must be taken into account (see flow signal function page 8).

[2)] **External control electronics**

The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal.
Control electronics (servo amplifier) see page 6.

[3)] **Pilot oil**

Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.

The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.
Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

[4)] **Inlet pressure range**

Care should be taken that the system pressure is as constant as possible.
Pilot pressure range: 10 … 210 bar or 10 … 315 bar

With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

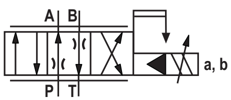
[5)] **Spool overlap**

The spool overlap is specified in % of the control spool stroke.

[6)] **Special number "102"**

Without actuation (de-energized condition), channels P → A and B → T are open for 10 % of the nominal quantity.

Symbol



4

Function, section

4WS2EM 10…XH…-102

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a bushing (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

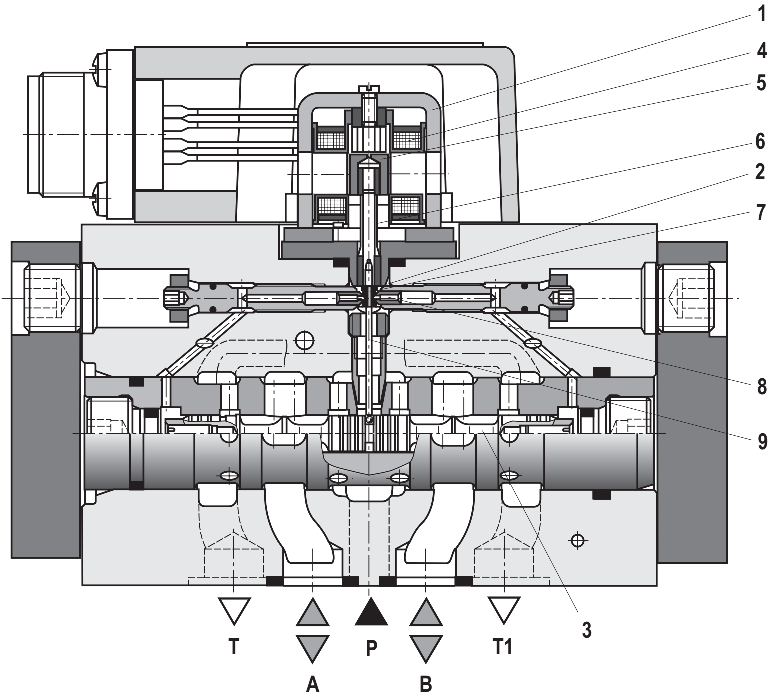
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XH…-102



Technical data

general

Porting pattern			ISO 4401-05-05-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +70
Ambient temperature range		°C	–20 … +60
Weight		kg	3.56

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	up to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks < 100 permitted							
	Pilot oil return external	bar	up to 315							
	Port Y	bar	Pressure peaks < 100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	–15 ... +60; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]							
Zero flow $q_{V,L}$ [2] with spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P^{4)}}{70\ bar}} \cdot 0.7 \frac{l}{min}$	$\sqrt{\frac{p_P^{4)}}{70\ bar}} \cdot 0.9 \frac{l}{min}$	$\sqrt{\frac{p_P^{4)}}{70\ bar}} \cdot 1.2 \frac{l}{min}$			$\sqrt{\frac{p_P^{4)}}{70\ bar}} \cdot 1.5 \frac{l}{min}$		$\sqrt{\frac{p_P^{4)}}{70\ bar}} \cdot 1.7 \frac{l}{min}$
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1.5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
Hydraulic fluid temperature		% / 20 K	≤ 1							
Ambient temperature		% / 20 K	≤ 1							
Operating pressure 80 … 120 % of p_P [4]		% / 100 bar	≤ 2							
Return flow pressure 0 … 10 % of p_P [4]		% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see www.boschrexroth.com/filter

[2] $q_{V,L}$ = Zero flow in l/min

[3] $q_{v\ rated}$ = Rated flow in l/min

[4] p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100 % rated current	Connection in parallel	H	0.25
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC			II 1G
Type of protection according to EN 60079-0:2009 / EN 60079-11:2007			Ex ia IIC T4 Ga
Ambient temperature range		°C	–20 … +60
Hydraulic fluid temperature range		°C	–15 … +60
Electric supply of the valve only from certified, intrinsically safe electrical circuits with the following maximum values	U_{max}	V	9.3
	I_{max}	mA	390
	P_{max}	mW	907
Conditions for use in zone 0			The valve cap consists of die-cast aluminum. For the use as device of category 1 in zone 0, the valve cap must be protected so that even with rarely occurring malfunctions, no ignitable sparks from friction, impact or grinding can be produced. **Important:** The ignition temperature of the hydraulic fluid used must at least be 150 °C.
Necessary clearance area for burst protection			The specified clearance area for the burst protection (see page 12) must remain free so that in case of error, overpressure can leak through the blanking plug from the valve cap.

External control electronics

Servo amplifier [1] in modular design	Analog	Type VT 11021 according to data sheet 29743
Recommended safety barrier [1]	Single-channel	Company Stahl, type 9001/02-093-390-101

⚠ WARNING – Risk of explosion
– The servo amplifier and the safety barrier must be operated outside the explosive area!

[1] Order separately

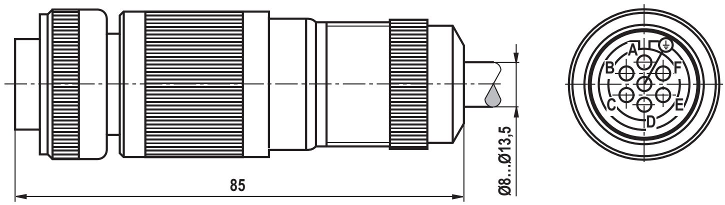
Mating connector

Mating connector according to EN 175201-804

Metal version

Separate order under the Material no. **R900223890**

Connection:
Solder contacts with connection cross-section for litz wires 0.5 … 1.5 mm^2

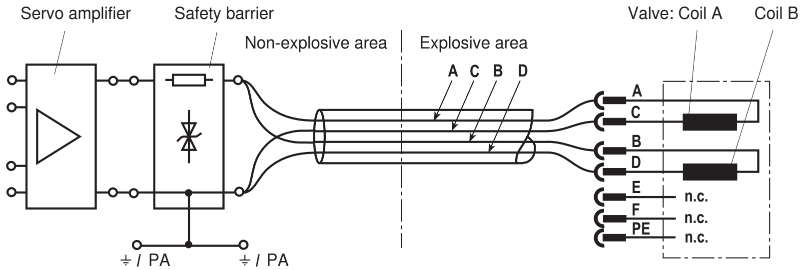


Electrical connection

The coils may **only be connected in parallel**.

The electrical control with plus (+) at A and B and minus (–) at C and D results in the flow direction P → A and B → T.
The reverse electrical control causes flow direction from P → B and A → T.

Pins E, F and PE at the connector are not connected.



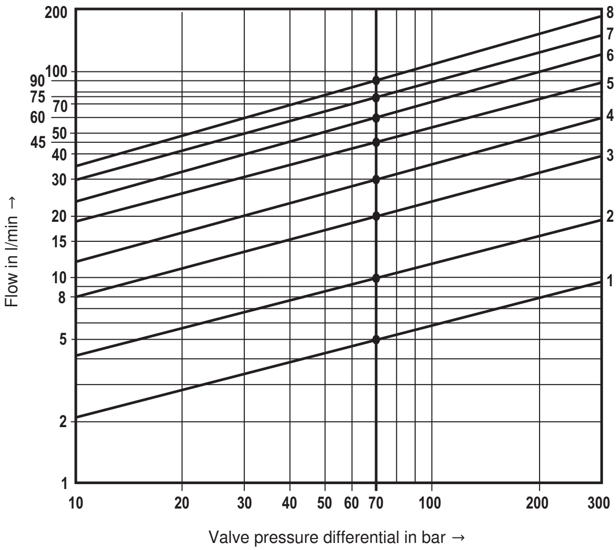
Important
For intrinsically safe electric circuits, only cables and lines approved of for that purpose may be used.

4

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

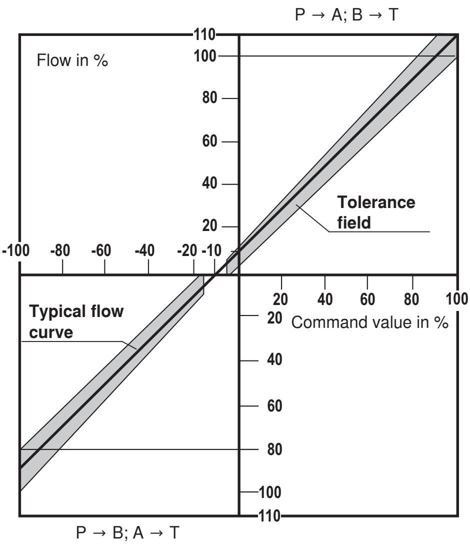
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

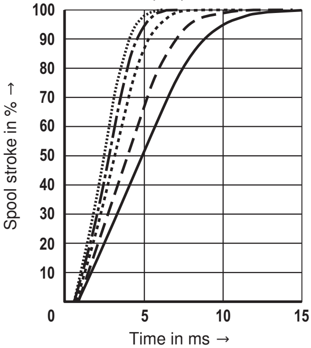
Tolerance field of the flow/signal function at constant valve pressure differential Δp



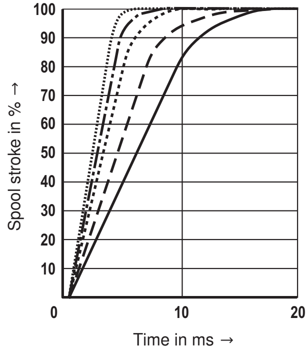
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])

Rated flow **5, 10, 20 l/min**



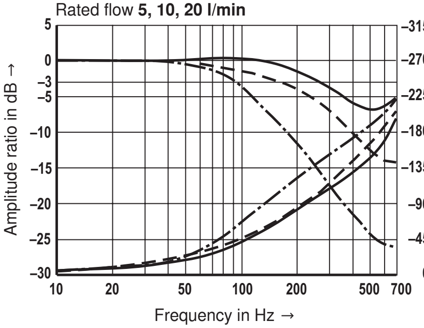
Rated flow **30 l/min**



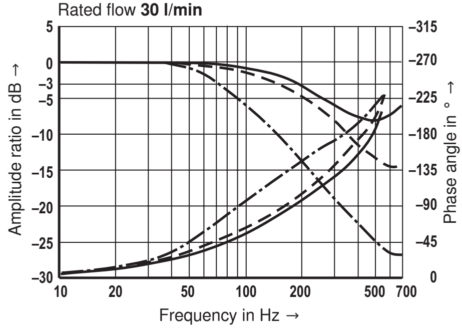
40 bar – – – 70 bar ········· 140 bar —·— 210 bar ········ 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])

Rated flow **5, 10, 20 l/min**



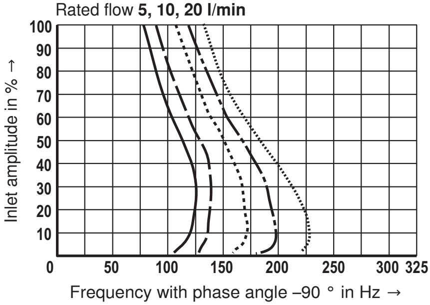
Rated flow **30 l/min**



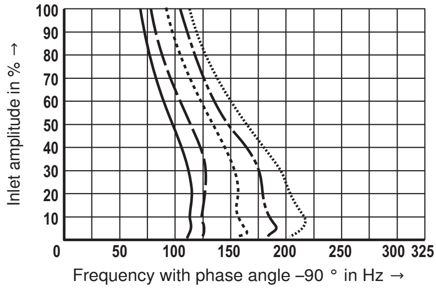
±5 % X_{eN} – – – ±25 % X_{eN} —·— ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])

Rated flow **5, 10, 20 l/min**



Rated flow **30 l/min**



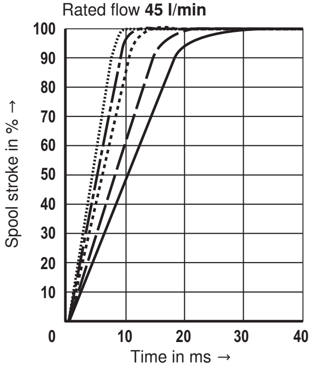
40 bar – – – 70 bar ········· 140 bar —·— 210 bar ········ 315 bar

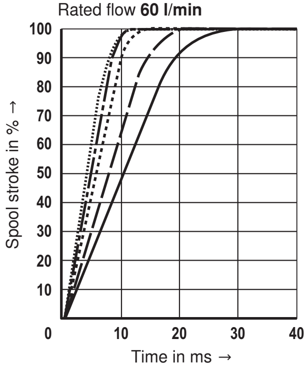
[1)] For information on the safety barrier see page 6 and 7

4

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

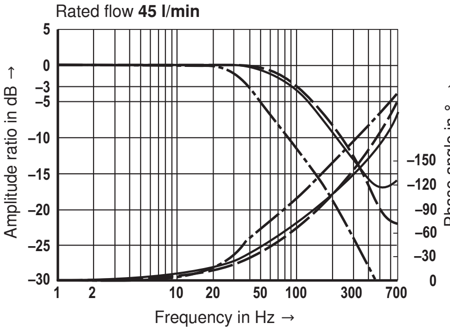
Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])

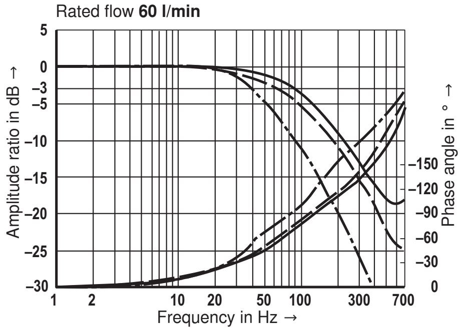




40 bar — 70 bar — 140 bar — 210 bar — 315 bar

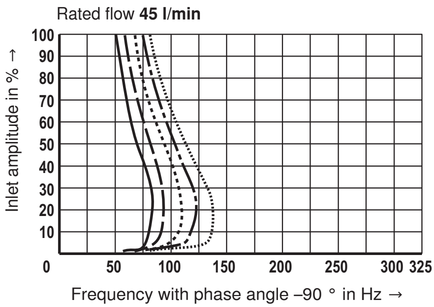
Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])

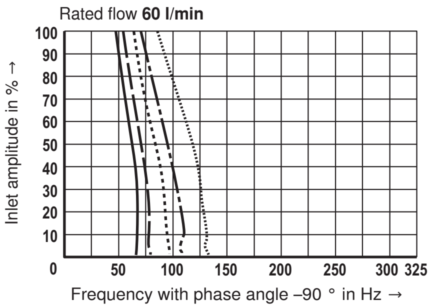




±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])





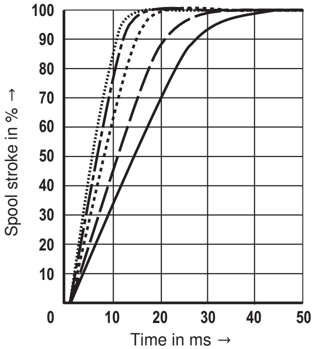
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

[1)] For information on the safety barrier see page 6 and 7

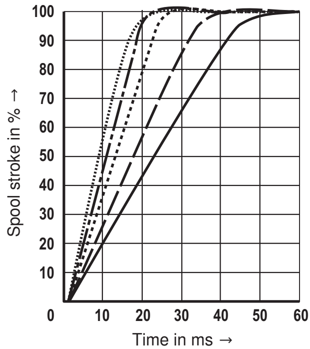
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1])

Rated flow **75 l/min**



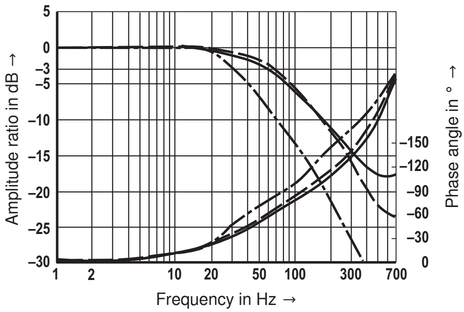
Rated flow **90 l/min**



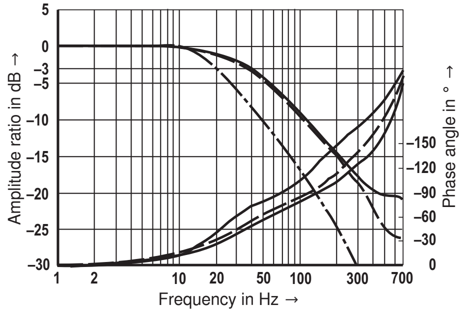
40 bar, 70 bar, 140 bar, 210 bar, 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1])

Rated flow **75 l/min**



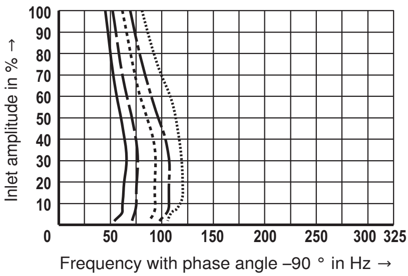
Rated flow **90 l/min**



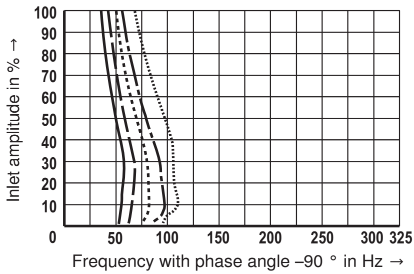
±5 % X_{eN}, ±25 % X_{eN}, ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1])

Rated flow **75 l/min**



Rated flow **90 l/min**

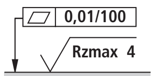


40 bar, 70 bar, 140 bar, 210 bar, 315 bar

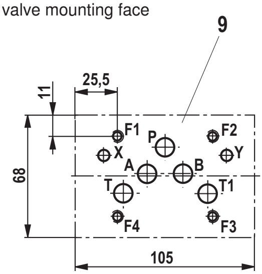
[1] For information on the safety barrier see page 6 and 7

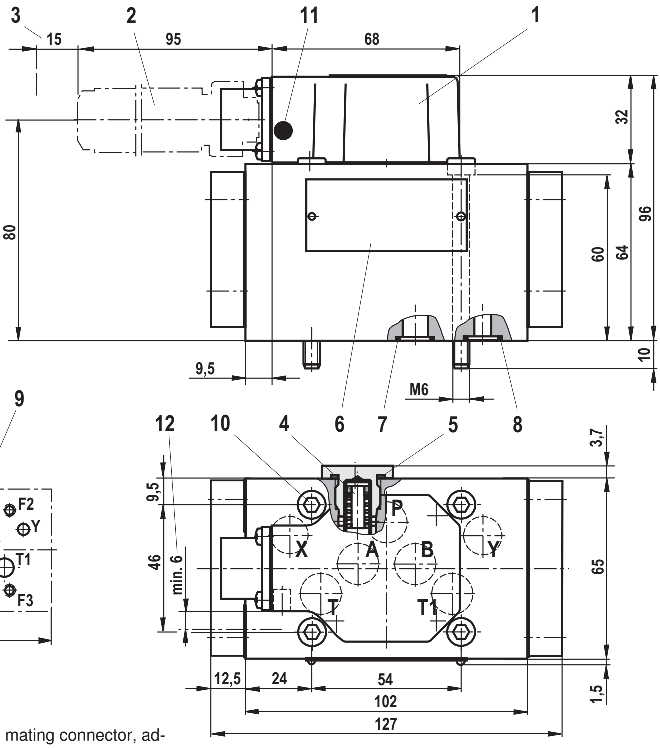
4

Unit dimensions (dimensions in mm)



Required surface quality of the valve mounting face





1 Cap

2 Mating connector (separate order, see page 7)

3 Space required for removing the mating connector, additionally observe the bending radius of the connection line

4 Exchangeable filter element with seals
Material no.: **R961001950**

5 Profile seal for filter screw M16 x 1.5, part of item 4

6 Name plate

7 Identical seal rings for ports P, A, B, T and T1

8 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

9 Processed valve mounting face
Porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure differential from B → T with rated flows > 45 l/min.

10 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M6x70-10.9-flZn-240h-L
(Friction coefficient 0.09 – 0.14 according to
VDA 235-101) (included in the delivery)

11 Burst protection

12 Clearance area for burst protection

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions like in data sheet 45054 (must be ordered separately)

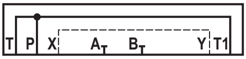
Important:

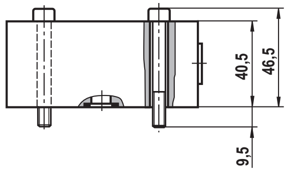
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XH-102-B3, section 3.2.

Notes

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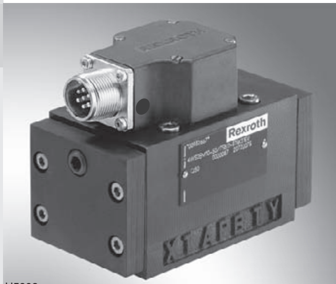
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

3/3 directional servo-valve with mechanical position feedback

RE 29583-XH-104-B2/12.11
Replaces: 07.11

Type 4WS2EM 10...XH...-104



H5893

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II 1G: Type of protection Ex ia IIC T4 Ga according to EN 60079-0:2009 / EN 60079-11:2007

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XH-104-B0**
Part II	Data sheet 29583-XH-104-B2	
Part III	Product-specific instructions 29583-XH-104-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 0
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting, porting pattern according to ISO 4401-05-05-0-05 with ports X and Y suplates available in FE/ZN version (see page 12)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Wear-free spool feedback element
- Control:
  External control electronics in modular design, additional safety barrier (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed, thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10 – 5X /		B	11	XH			K31		V – 104

Electrically operated 2-stage servo valve in 3/3 directional design for **external** control electronics

Mechanical feedback **= M**

Size **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

Rated flow 1)

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics
Coil no. 11 (30 mA/85 Ω per coil) 2) **= 11**

XH = Explosion protection "type ia"
For details see information on the explosion protection, page 6

Pilot oil supply and return 3)

– =	Supply external, return external
E =	Supply internal, return external
T =	Supply external, return internal
ET =	Supply internal, return internal (ET = Standard version)

Inlet pressure range to the 1st stage 4)

210 =	10 to 210 bar
315 =	10 to 315 bar

K31 = **Electrical connection via connector**
Order mating connector separately, see page 7

Spool overlap 5)

E =	0 … 0.5 % negative
D =	0 … 0.5 % positive
C =	3 … 5 % positive

Seal material
V = FKM seals
Suitable for mineral oil (HL, HLP) according to DIN 51524

104 = Special number 6)

Included in the delivery:
- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

1) **Rated flow**
The rated flow refers to a 100 % command value signal at 35 bar valve pressure differential per control edge. The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10 % must be taken into account (see flow signal function page 8).

2) **External control electronics**
The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal.
Control electronics (servo amplifier) see page 6.

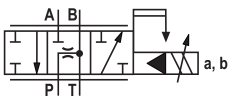
3) **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.
The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.
Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

4) **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible. Pilot pressure range: 10 … 210 bar or 10 … 315 bar
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

5) **Spool overlap**
The spool overlap is specified in % of the control spool stroke.

6) **Special number "104"**
Without command value actuation (0 mA), channel B is set to half the operating pressure. In the control area, channel A is always blocked.

Symbol



4

Function, section

4WS2EM 10…XH…-104

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a bushing (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

Special number 104 is a 3/3 directional servo-valve so that depending on the input signal either P to B or B to T is connected. In the control area, channel A is always blocked.

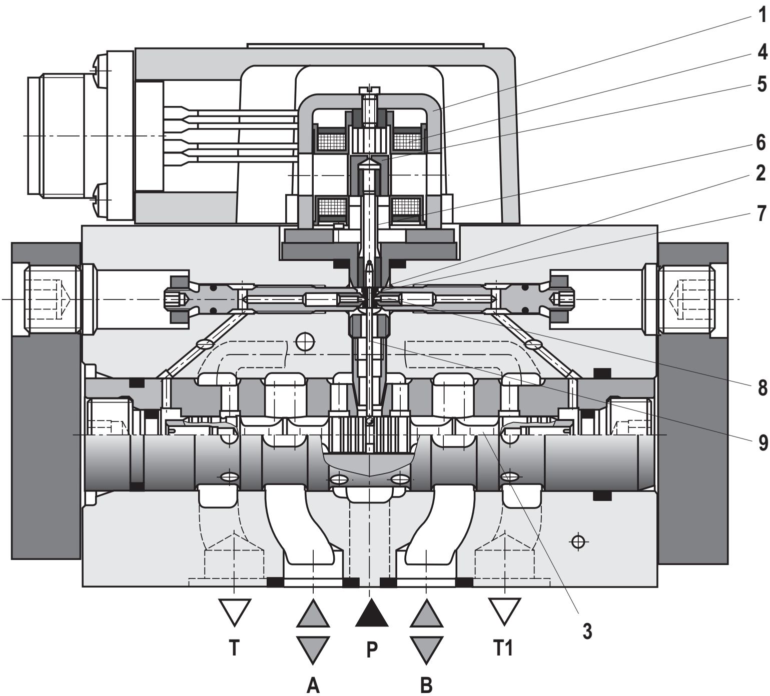
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XH…-104



Technical data

general

Porting pattern			ISO 4401-05-05-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +70
Ambient temperature range		°C	–20 … +60
Weight		kg	3.56

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	up to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks < 100 permitted							
	Pilot oil return external	bar	up to 315							
	Port Y	bar	Pressure peaks < 100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	–15 ... +60; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]							
Zero flow $q_{V,L}$ [2] with spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 0.6 \frac{l}{min}$	$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 0.7 \frac{l}{min}$	$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 0.9 \frac{l}{min}$			$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 1.1 \frac{l}{min}$		$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 1.3 \frac{l}{min}$
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δp = 35 bar/edge		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1.5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 15					≥ 30		≥ 40
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
Hydraulic fluid temperature		% / 20 K	≤ 1							
Ambient temperature		% / 20 K	≤ 1							
Operating pressure 80 … 120 % of p_P [4]		% / 100 bar	≤ 2							
Return flow pressure 0 … 10 % of p_P [4]		% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of the filters see www.boschrexroth.com/filter

[2] $q_{V,L}$ = Zero flow in l/min
[3] $q_{v\ rated}$ = Rated flow in l/min
[4] p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100 % rated current	Connection in parallel	H	0.25
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC			II 1G
Type of protection according to EN 60079-0:2009 / EN 60079-11:2007			Ex ia IIC T4 Ga
Ambient temperature range		°C	–20 … +60
Hydraulic fluid temperature range		°C	–15 … +60
Electric supply of the valve only from certified, intrinsically safe electrical circuits with the following maximum values	U_{max}	V	9.3
	I_{max}	mA	390
	P_{max}	mW	907
Conditions for use in zone 0			The valve cap consists of die-cast aluminum. For the use as device of category 1 in zone 0, the valve cap must be protected so that even with rarely occurring malfunctions, no ignitable sparks from friction, impact or grinding can be produced. **Important:** The ignition temperature of the hydraulic fluid used must at least be 150 °C.
Necessary clearance area for burst protection			The specified clearance area for the burst protection (see page 12) must remain free so that in case of error, overpressure can leak through the blanking plug from the valve cap.

External control electronics

Servo amplifier [1] in modular design	Analog	Type VT 11021 according to data sheet 29743
Recommended safety barrier [1]	Single-channel	Company Stahl, type 9001/02-093-390-101

⚠ WARNING – Risk of explosion
– The servo amplifier and the safety barrier must be operated outside the explosive area!

[1] Order separately

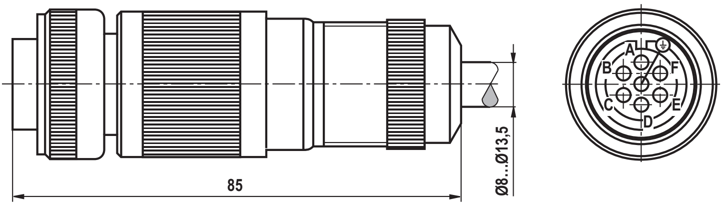
Mating connector

Mating connector according to EN 175201-804

Metal version

Separate order under the Material no. **R900223890**

Connection:
Solder contacts with connection cross-section for litz wires 0.5 … 1.5 mm^2

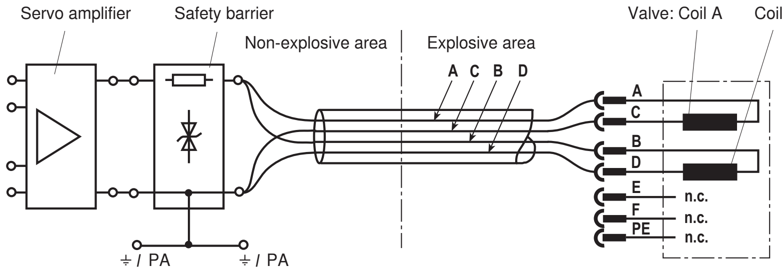


Electrical connection

The coils may **only be connected in parallel**.

The electrical control with plus (+) at A and B and minus (–) at C and D results in the flow direction B → T.
Reverse electrical control results in the flow direction P → B.

Pins E, F and PE at the connector are not connected.



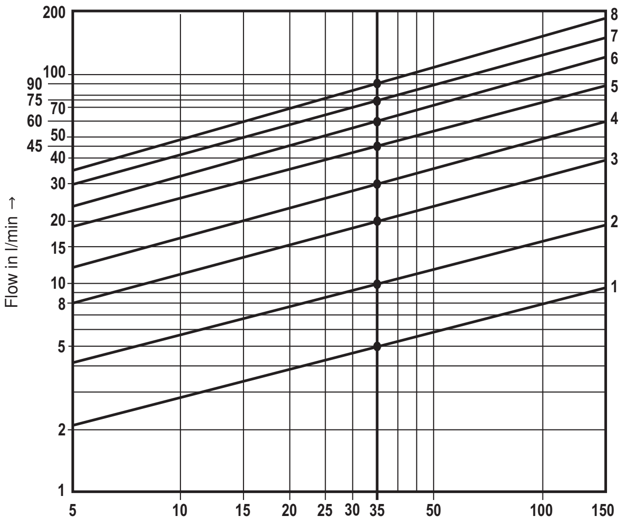
Important

For intrinsically safe electric circuits, only cables and lines approved of for that purpose may be used.

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

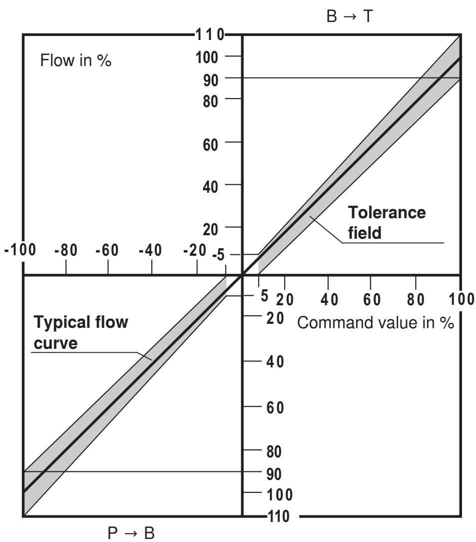
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

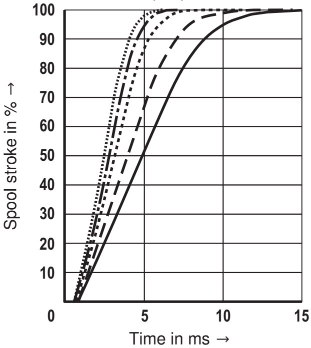
Tolerance field of the flow/signal function at constant valve pressure differential Δp



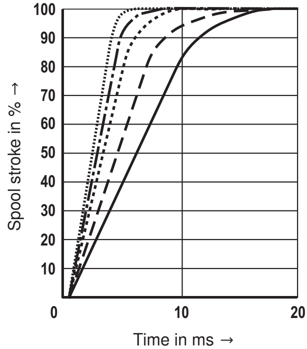
Characteristic curves (measured with HLP 32, $\vartheta_{\mathbf{oil}}$ = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])

Rated flow **5, 10, 20 l/min**



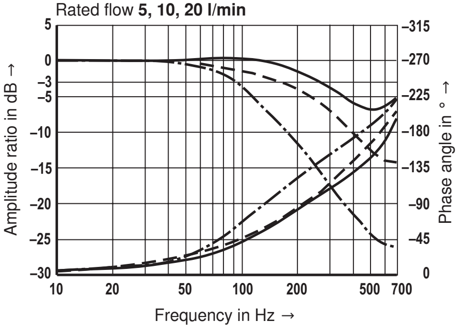
Rated flow **30 l/min**



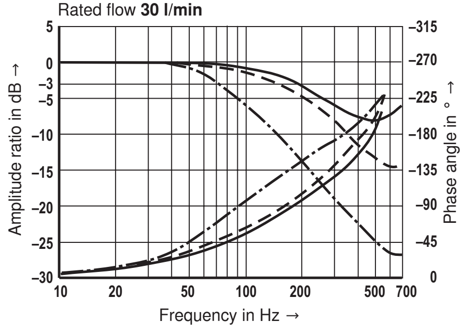
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])

Rated flow **5, 10, 20 l/min**



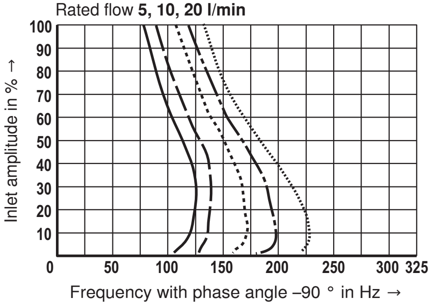
Rated flow **30 l/min**



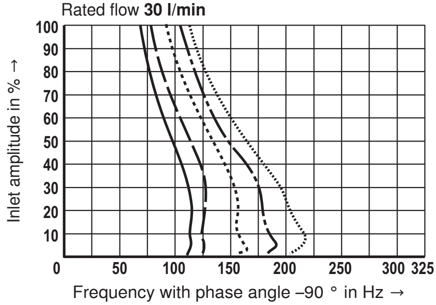
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])

Rated flow **5, 10, 20 l/min**



Rated flow **30 l/min**



40 bar — 70 bar — 140 bar — 210 bar — 315 bar

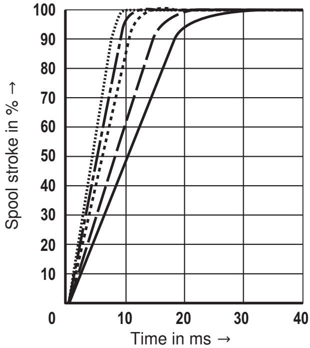
[1)] For information on the safety barrier see page 6 and 7

4

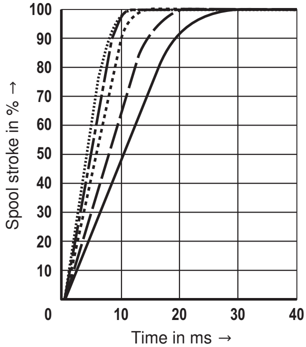
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1)])

Rated flow **45 l/min**



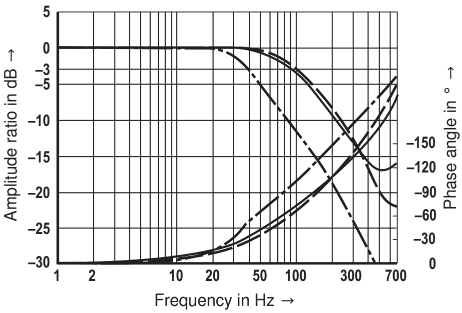
Rated flow **60 l/min**



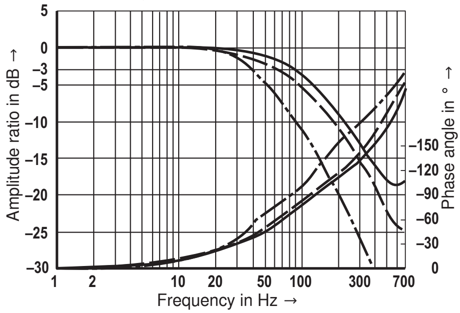
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1)])

Rated flow **45 l/min**



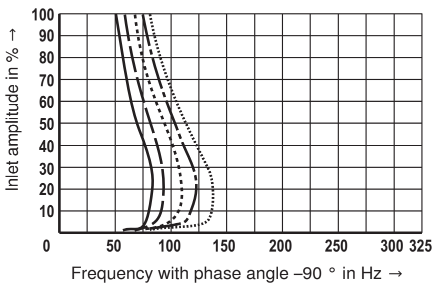
Rated flow **60 l/min**



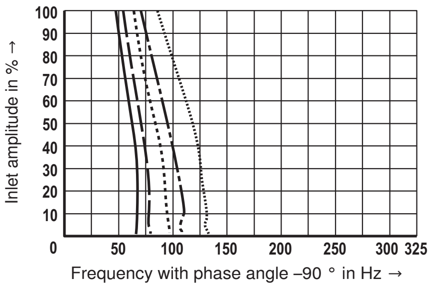
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1)])

Rated flow **45 l/min**



Rated flow **60 l/min**

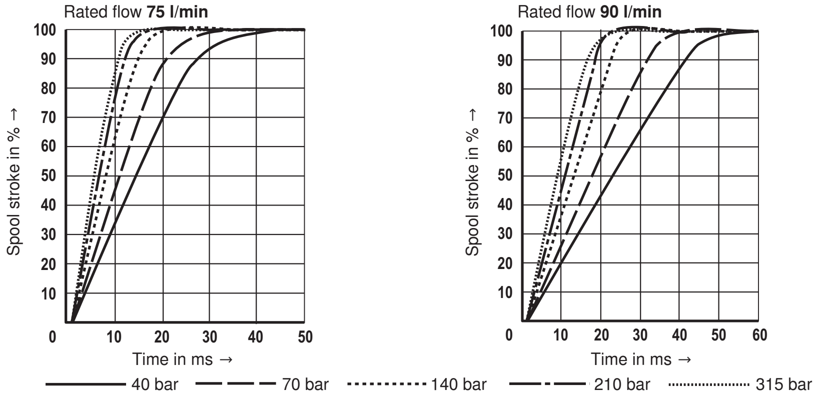


40 bar — 70 bar — 140 bar — 210 bar — 315 bar

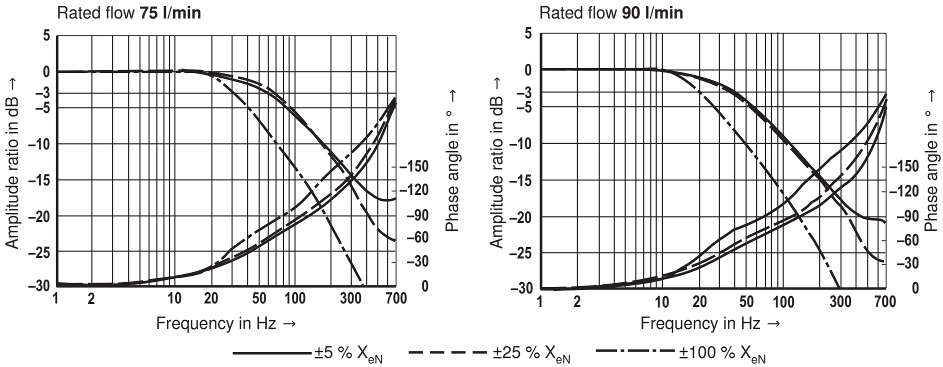
[1)] For information on the safety barrier see page 6 and 7

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

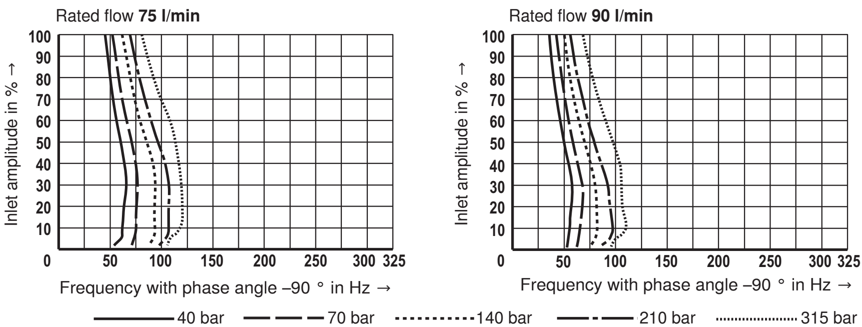
Transition function with pressure rating 315 bar, step response without flow (measured with safety barrier [1])



Frequency response with pressure rating 315 bar, stroke frequency without flow (measured with safety barrier [1])

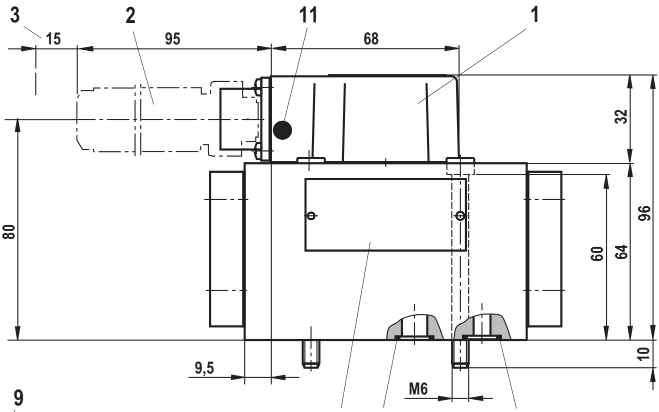


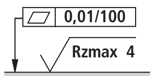
Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude
(measured with safety barrier [1])



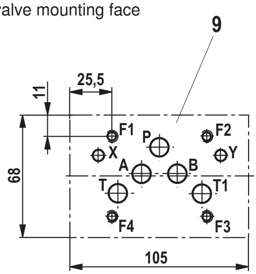
[1] For information on the safety barrier see page 6 and 7

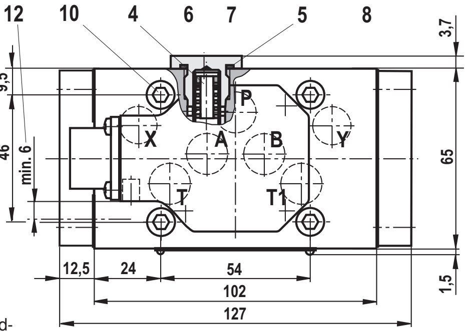
Unit dimensions (dimensions in mm)





Required surface quality of the valve mounting face





1. **1** Cap
2. **2** Mating connector (separate order, see page 7)
3. **3** Space required for removing the mating connector, additionally observe the bending radius of the connection line
4. **4** Exchangeable filter element with seals
   Material no.: **R961001950**
5. **5** Profile seal for filter screw M16 x 1.5, part of item 4
6. **6** Name plate
7. **7** Identical seal rings for ports P, A, B, T and T1
8. **8** Identical seal rings for ports X and Y
   Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.
9. **9** Processed valve mounting face
   Porting pattern according to ISO 4401-05-05-0-05
   Port T1 is optional and is recommended for reducing the pressure differential from B → T with rated flows > 45 l/min.
10. **10** Valve mounting screws
    For reasons of stability, exclusively the following valve mounting screws may be used:
    4 hexagon socket head cap screws
    ISO 4762-M6x70-10.9-flZn-240h-L
    (Friction coefficient 0.09 – 0.14 according to VDA 235-101)(included in the delivery)
11. **11** Burst protection
12. **12** Clearance area for burst protection

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions like in data sheet 45054 (must be ordered separately)

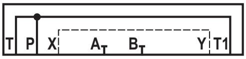
Important:

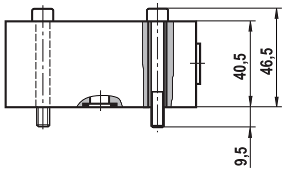
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XH-104-B3, section 3.2.

Notes

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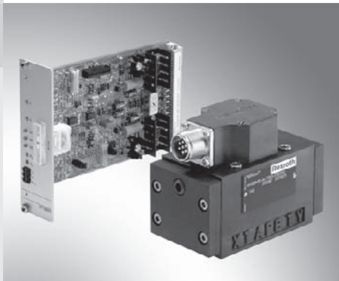
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional servo-valve with mechanical position feedback

RE 29583-XN-B2/09.10
Replaces: 03.07

Type 4WS2EM 10...XN

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min



H5893

ATEX units
For explosive areas

Part II Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II3G: Type of protection Ex nA II T5X according to EN 60079-0:2006 / EN 60079-15:2005

II3D: Type of protection Ex tD A22 IP 65 TX according to EN 61241-0:2006 / EN 61241-1:2004

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XN-B0**
Part II	Data sheet 29583-XN-B2	
Part III	Product-specific instructions 29583-XN-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 2 and 22
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-05-05-0-05 with ports X and Y suplates available in FE/ZN version (see page 11)
- Dry control motor, no contamination of the solenoid gap by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in Eurocard format or in modular design (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed; thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seals, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10 –	5X /		B	11	XN			K31		V

Electrically actuated 2-stage servo valve in 4/3 directional design for **external** control electronics

Mechanical feedback **= M**

Size **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

Rated flow [1)]

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics coil no. 11 (30 mA/85 Ω per coil) [2)] **= 11**

XN = Explosion protection "type nA"
For details see information on the explosion protection, page 6

Pilot oil supply and return [3)]

– =	Supply external, return external
E =	Supply internal, return external
T =	Supply external, return internal
ET =	Supply internal, return internal (ET = Standard version)

Inlet pressure range to the 1st stage [4)]

210 =	10 to 210 bar
315 =	10 to 315 bar

Electrical connection
K31 = with connector
Mating connector – separate order, see page 6

Spool overlap [5)]

E =	0 … 0.5 % negative
D =	0 … 0.5 % positive
C =	3 … 5 % positive

Seal material
V = FKM seals
suitable for mineral oil (HL, HLP) according to DIN 51524

Included in the delivery:
- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

1) **Rated flow**
The rated flow refers to a 100% command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10% must be taken into account (see flow signal function page 7).

2) **External control electronics**
The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal.
Control electronics (servo amplifier) see page 6.

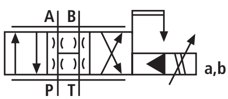
3) **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.
The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.
Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

4) **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible. Pilot pressure range: 10 … 210 bar or 10 … 315 bar
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

5) **Spool overlap**
The spool overlap is specified in % of the control spool stroke.

4

Symbol



Function, section

4WS2EM 10-5X/...XN

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

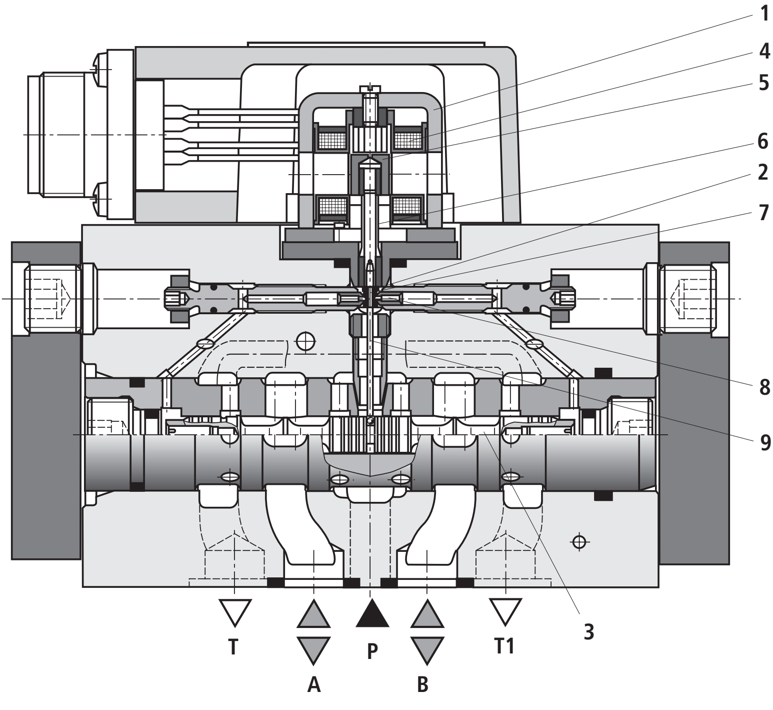
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XN



Technical data

general

Porting pattern			ISO 4401-05-05-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +80
Ambient temperature range		°C	–30 … +80
Weight		kg	3.56

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks <100 permitted							
	Pilot oil return external	bar	to 315							
	Port Y	bar	Pressure peaks <100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	-15 ... +80; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]							
Zero flow $q_{V,L}$ [2] with spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 0{,}7 \frac{l}{min.}$	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 0{,}9 \frac{l}{min.}$	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1{,}2 \frac{l}{min.}$			$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1.5 \frac{l}{min.}$		$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1.7 \frac{l}{min.}$
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1,5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
Hydraulic fluid temperature		% / 20 K	≤ 1							
Ambient temperature		% / 20 K	≤ 1							
Operating pressure 80 … 120 % of p_P [4]		% / 100 bar	≤ 2							
Return flow pressure 0 … 10 % of p_P [4]		% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of filters, see www.boschrexroth.com/filter

[2] $q_{V,L}$ = Zero flow in l/min

[3] $q_{v\ rated}$ = Rated flow in l/min

[4] p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100% rated current	Connection in series	H	1.0
	Connection in parallel	H	0.25
In case of actuating using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC		II 3 G; II 3 D
Type of protection according to EN 60079-0:2006 / EN 60079-15:2005		Ex nA II T5X
Type of protection according to EN 61241-0:2006 / EN 61241-1:2004		Ex tD A22 IP 65 TX
Maximum surface temperature	°C	100
Ambient temperature range	°C	–30 … +80
Hydraulic fluid temperature range	°C	–15 … +80
Max. admissible operating voltage of the servo amplifier	V	32 (DC)

External control electronics

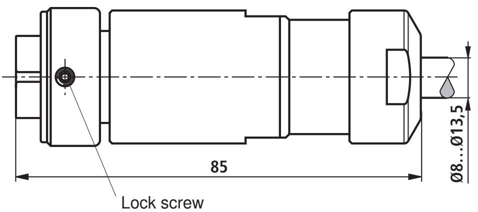
Servo amplifier (separate order)	Eurocard format	analog	Type VT-SR2-1X/.60 according to data sheet 29980
	Modular design	analog	Type VT 11021 according to data sheet 29743
The coils of the valve may only be connected in parallel to these amplifiers!			

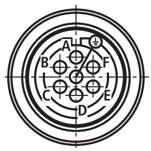
⚠ WARNING – Risk of explosion

– The external servo amplifier must be operated outside the explosive area!

Mating connector

The servo valve may only be supplied through this mating connector.





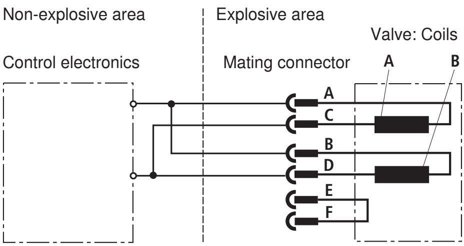
Electrical connection acc. to EN 175201-804

Metal version

Separate order under the material no. **R901044595**

Connection:
Contact sockets with soldered joints for litz wires 0.5 … 1.5 mm²

Electrical connection (example of parallel connection)



The coils are connected in parallel in the mating connector or at the amplifier (see figure).

In case of serial connection, contacts B and C must be connected.

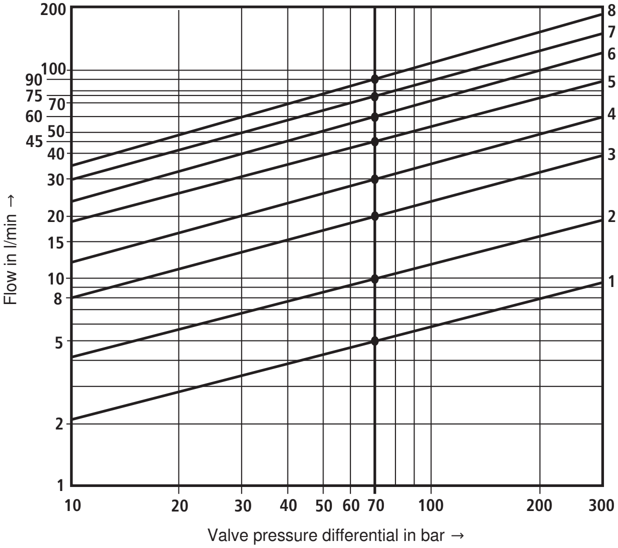
The E-F bridge can be used for the electrical determination of the correct connection of the plug-in connector and/or for the identification of cable break.

The electrical actuation from A (+) to D (–) causes flow direction from P → A and B → T. The reverse electrical actuation causes flow direction from P → B and A → T.

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

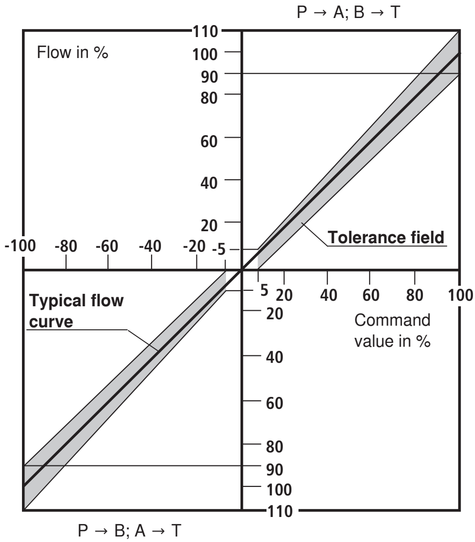
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

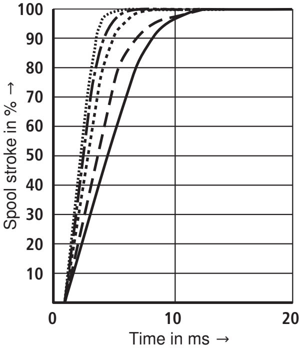
Tolerance field of the flow/signal function at constant valve pressure differential Δp



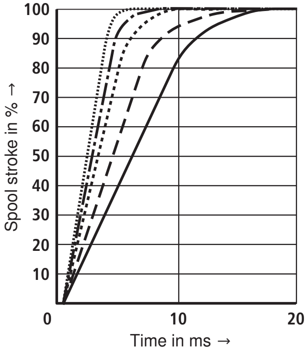
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **5, 10, 20 l/min**



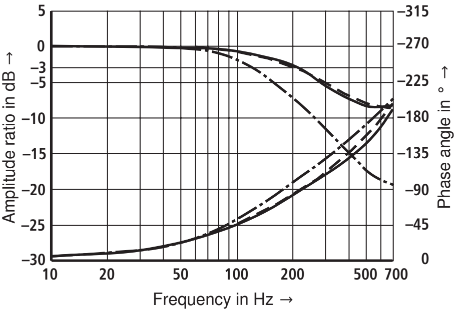
Rated flow **30 l/min**



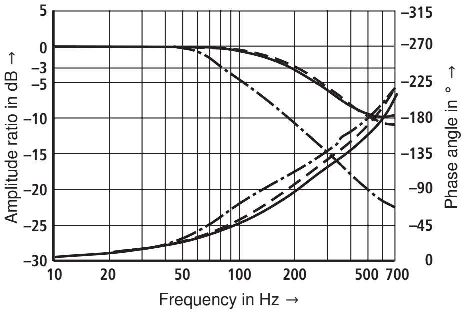
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **5, 10, 20 l/min**



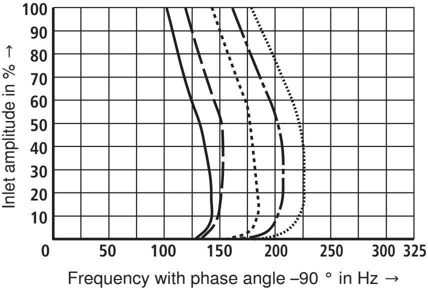
Rated flow **30 l/min**



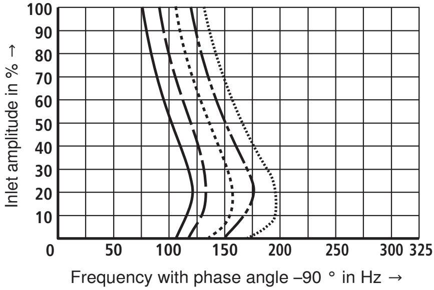
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **5, 10, 20 l/min**



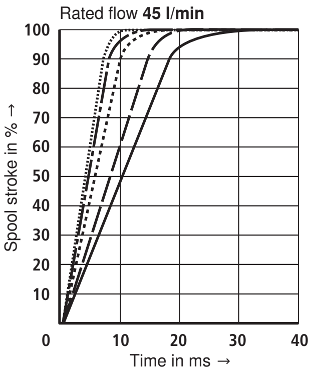
Rated flow **30 l/min**

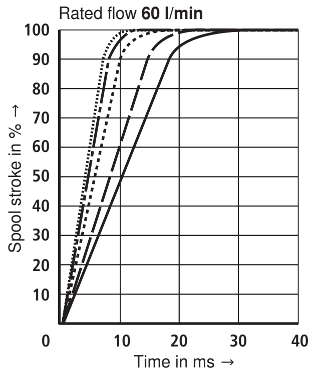


40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

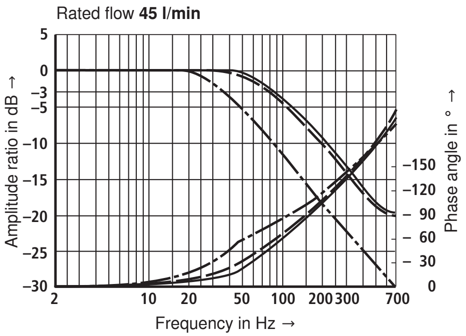
Transition function with pressure rating 315 bar, step response without flow

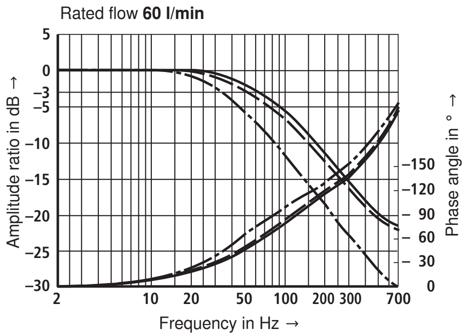




40 bar — 70 bar — 140 bar — 210 bar — 315 bar

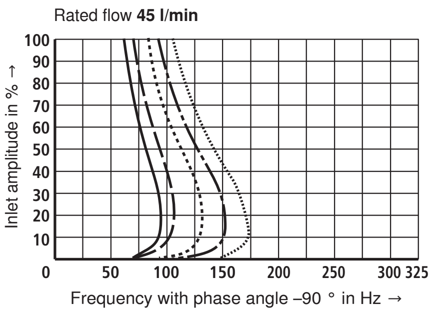
Frequency response with pressure rating 315 bar, stroke frequency without flow

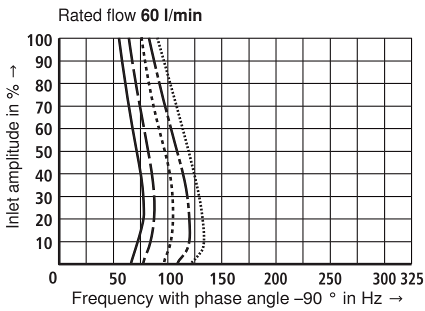




±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude





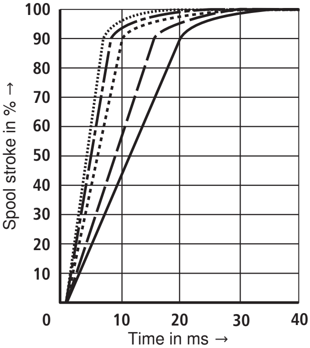
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

4

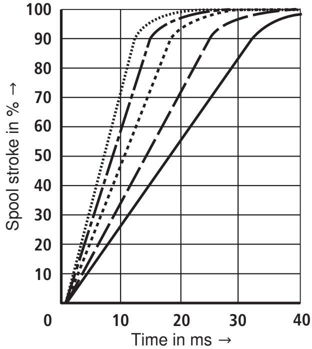
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **75 l/min**



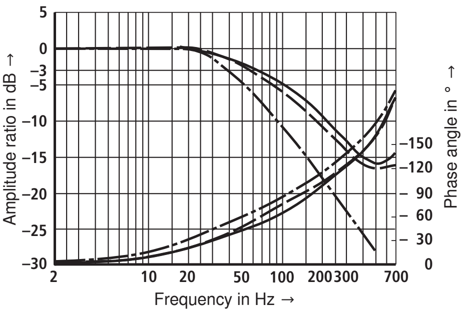
Rated flow **90 l/min**



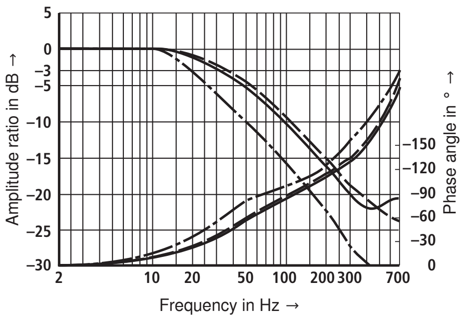
40 bar 70 bar 140 bar 210 bar 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **75 l/min**



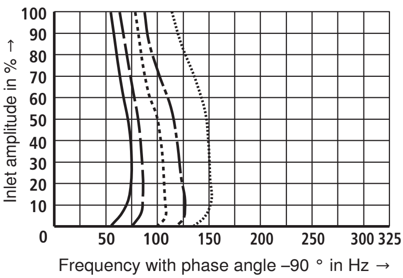
Rated flow **90 l/min**



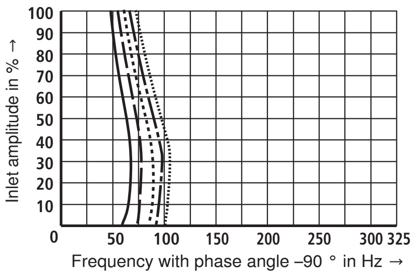
±5 % X_{eN} ±25 % X_{eN} ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **75 l/min**

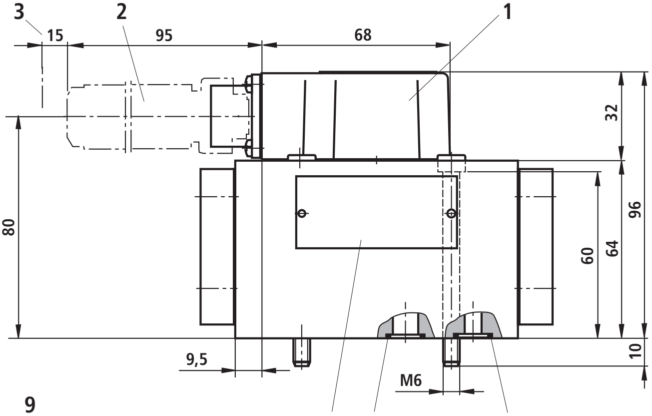


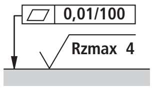
Rated flow **90 l/min**



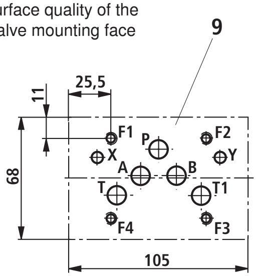
40 bar 70 bar 140 bar 210 bar 315 bar

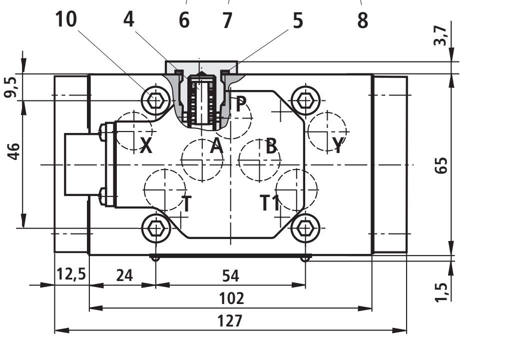
Unit dimensions (dimensions in mm)





Required
surface quality of the
valve mounting face





1 Cap

2 Mating connector
(separate order, see page 6)

3 Space required for removing the mating connector, additionally observe the bending radius of the connection line

4 Exchangeable filter element
material no.: **R900306843**

5 Profile seal for filter screw M16 x 1.5
material no.: **R900012503** (FKM seal)

6 Name plate

7 Identical seal rings for ports P, A, B, T and T1

8 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

9 Processed valve mounting face
Porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

10 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M6x70-10.9-flZn-240h-L
(Friction coefficient 0.09 – 0.14 according to VDA 235-101) (included in the delivery)

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions as in the data sheet 45054 (must be ordered separately)

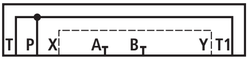
Important:

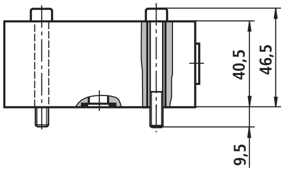
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to
  VDA 235-101) (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XN-B3, section 3.2.

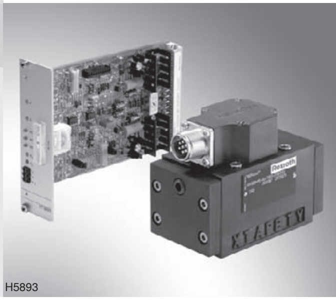
Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional servo-valve with mechanical position feedback

RE 29583-XN-100-B2/10.10
Replaces: 04.07

Type 4WS2EM 10...XN...-100

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min



H5893

ATEX units
For explosive areas

Part II Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II3G: Type of protection Ex nA II T5X according to EN 60079-0:2006 / EN 60079-15:2005

II3D: Type of protection Ex tD A22 IP 65 TX according to EN 61241-0:2006 / EN 61241-1:2004

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XN-100-B0**
Part II	Data sheet 29583-XN-100-B2	
Part III	Product-specific instructions 29583-XN-100-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 2 and 22
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-05-05-0-05 with ports X and Y suplates available in FE/ZN version (see page 11)
- Dry control motor, no contamination of the solenoid gap by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in Eurocard format or in modular design (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed; thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seals, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10 – 5X /		B	11	XN			K31		V – 100

Electrically actuated 2-stage servo valve in 4/3 directional design for **external** control electronics

Mechanical feedback **= M**

Size **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

Rated flow [1)]

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics
coil no. 11 (30 mA/85 Ω per coil) [2)] **= 11**

XN = Explosion protection "type nA"
For details see information on the explosion protection, page 6

Pilot oil supply and return [3)]

– =	Supply external, return external
E =	Supply internal, return external
T =	Supply external, return internal
ET =	Supply internal, return internal (ET = Standard version)

Inlet pressure range to the 1st stage [4)]

210 =	10 to 210 bar
315 =	10 to 315 bar

Electrical connection
K31 = with connector
Mating connector – separate order, see page 6

Spool overlap [5)]

E =	0 … 0.5 % negative
D =	0 … 0.5 % positive
C =	3 … 5 % positive

Seal material
V = FKM seals
suitable for mineral oil (HL, HLP) according to DIN 51524

100 = Special number [6)]

Included in the delivery:
- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

[1)] **Rated flow**
The rated flow refers to a 100% command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10% must be taken into account (see flow signal function page 7).

[2)] **External control electronics**
The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal.
Control electronics (servo amplifier) see page 6.

[3)] **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.
The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.

Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

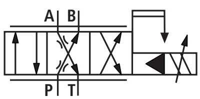
[4)] **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible. Pilot pressure range: 10 … 210 bar or 10 … 315 bar
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

[5)] **Spool overlap**
The spool overlap is specified in % of the control spool stroke.

[6)] **Special number "100"**
Without actuation (de-energized condition), channels P → B and A → T are open for 10 % of the nominal quantity.

4

Symbol



Function, section

4WS2EM 10-5X/...XN...-100

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

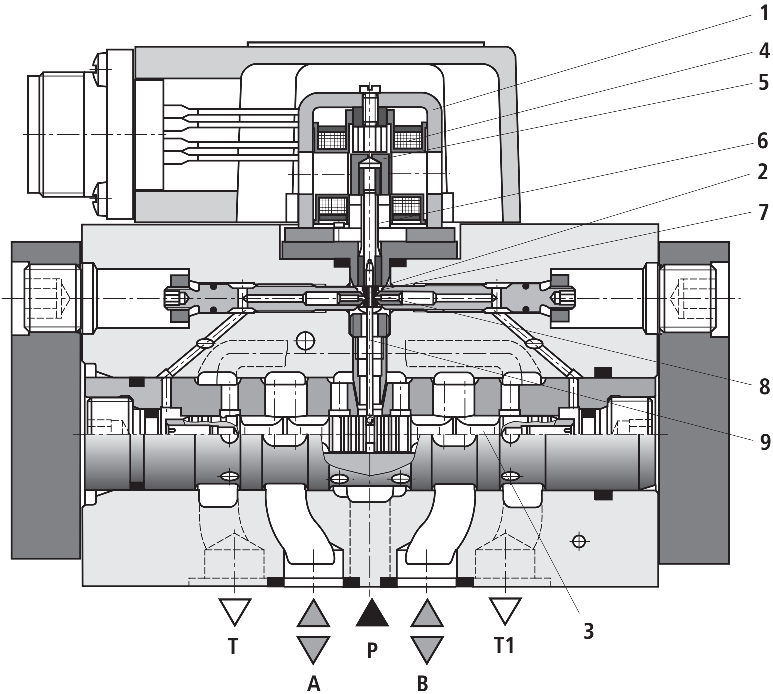
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XN...-100



Technical data

general

Porting pattern			ISO 4401-05-05-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +80
Ambient temperature range		°C	–30 … +80
Weight		kg	3.56

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks <100 permitted							
	Pilot oil return external	bar	to 315							
	Port Y	bar	Pressure peaks <100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	-15 ... +80; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 1)							
Zero flow $q_{V,L}$ 2) with spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P\ ^{4)}}{70\ \text{bar}}} \cdot 0{,}7 \frac{\text{l}}{\text{min.}}$	$\sqrt{\frac{p_P\ ^{4)}}{70\ \text{bar}}} \cdot 0{,}9 \frac{\text{l}}{\text{min.}}$	$\sqrt{\frac{p_P\ ^{4)}}{70\ \text{bar}}} \cdot 1{,}2 \frac{\text{l}}{\text{min.}}$			$\sqrt{\frac{p_P\ ^{4)}}{70\ \text{bar}}} \cdot 1.5 \frac{\text{l}}{\text{min.}}$		$\sqrt{\frac{p_P\ ^{4)}}{70\ \text{bar}}} \cdot 1.7 \frac{\text{l}}{\text{min.}}$
Rated flows $q_{v\ rated}$ 3), tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1,5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P 4)	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
Hydraulic fluid temperature		% / 20 K	≤ 1							
Ambient temperature		% / 20 K	≤ 1							
Operating pressure 80 … 120 % of p_P 4)		% / 100 bar	≤ 2							
Return flow pressure 0 … 10 % of p_P 4)		% / bar	≤ 1							

1) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of filters, see www.boschrexroth.com/filter

2) $q_{V,L}$ = Zero flow in l/min
3) $q_{v\ rated}$ = Rated flow in l/min
4) p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100% rated current	Connection in series	H	1.0
	Connection in parallel	H	0.25
In case of actuating using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC		II 3 G; II 3 D
Type of protection according to EN 60079-0:2006 / EN 60079-15:2005		Ex nA II T5X
Type of protection according to EN 61241-0:2006 / EN 61241-1:2004		Ex tD A22 IP 65 TX
Maximum surface temperature	°C	100
Ambient temperature range	°C	–30 … +80
Hydraulic fluid temperature range	°C	–15 … +80
Max. admissible operating voltage of the servo amplifier	V	32 (DC)

External control electronics

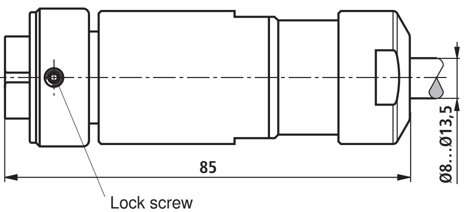
Servo amplifier (separate order)	Eurocard format	analog	Type VT-SR2-1X/.60 according to data sheet 29980
	Modular design	analog	Type VT 11021 according to data sheet 29743
The coils of the valve may only be connected in parallel to these amplifiers!			

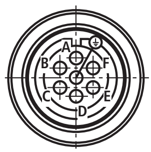
⚠ WARNING – Risk of explosion

– The external servo amplifier must be operated outside the explosive area!

Mating connector

The servo valve may only be supplied through this mating connector.





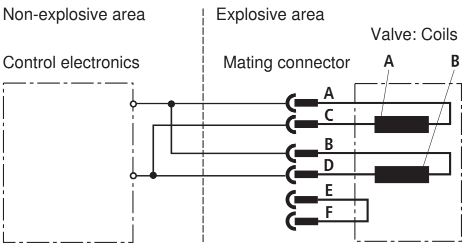
Electrical connection acc. to EN 175201-804

Metal version

Separate order under the material no. **R901044595**

Connection:
Contact sockets with soldered joints for litz wires 0.5 … 1.5 mm²

Electrical connection (example of parallel connection)



The coils are connected in parallel in the mating connector or at the amplifier (see figure).

In case of serial connection, contacts B and C must be connected.

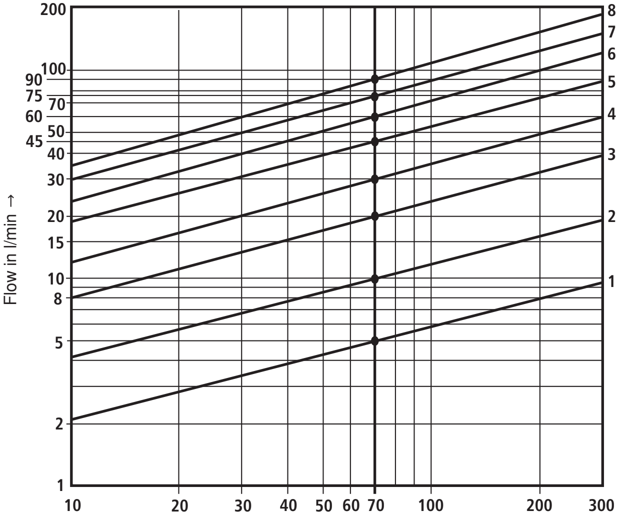
The E-F bridge can be used for the electrical determination of the correct connection of the plug-in connector and/or for the identification of cable break.

The electrical actuation from A (+) to D (–) causes flow direction from P → A and B → T. The reverse electrical actuation causes flow direction from P → B and A → T.

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

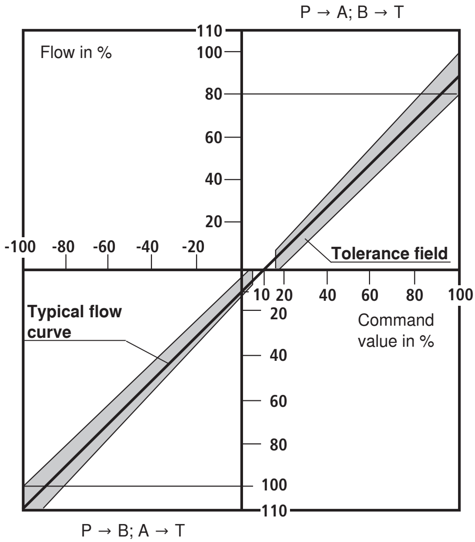
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of the flow/signal function at constant valve pressure differential Δp

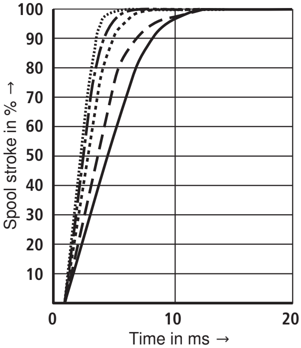


4

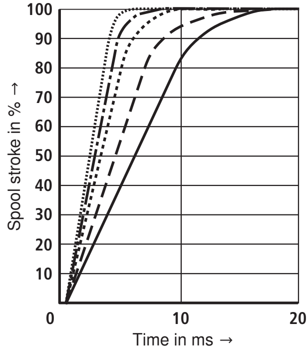
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **5, 10, 20 l/min**



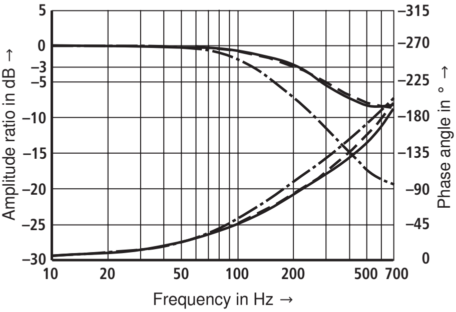
Rated flow **30 l/min**



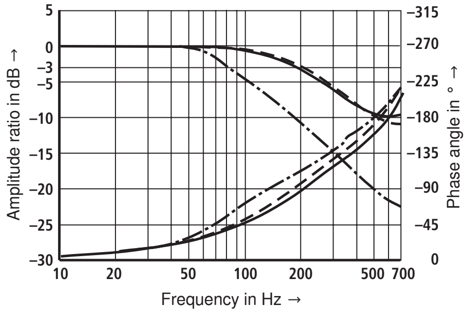
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **5, 10, 20 l/min**



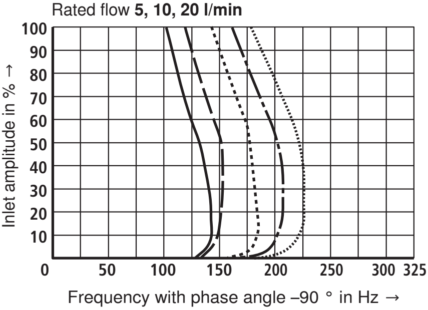
Rated flow **30 l/min**



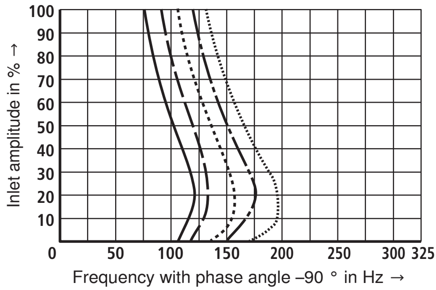
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **5, 10, 20 l/min**



Rated flow **30 l/min**

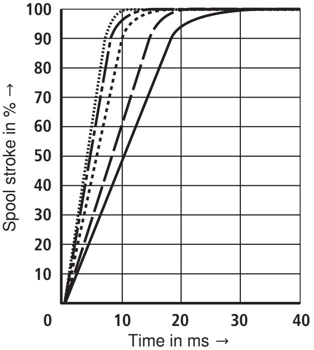


40 bar — 70 bar — 140 bar — 210 bar — 315 bar

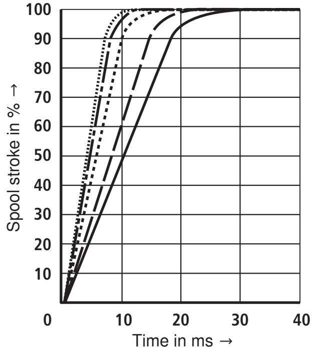
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **45 l/min**



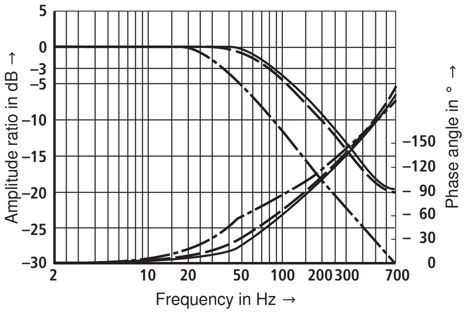
Rated flow **60 l/min**



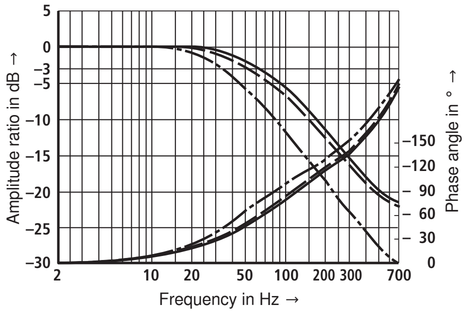
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **45 l/min**



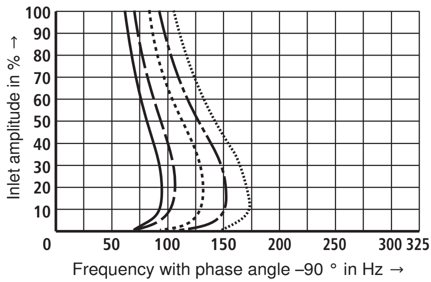
Rated flow **60 l/min**



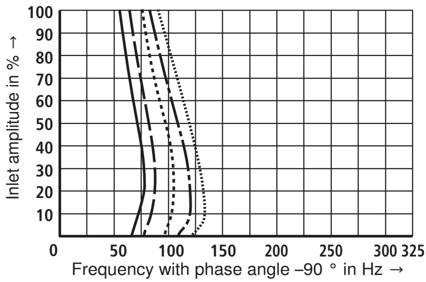
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **45 l/min**



Rated flow **60 l/min**



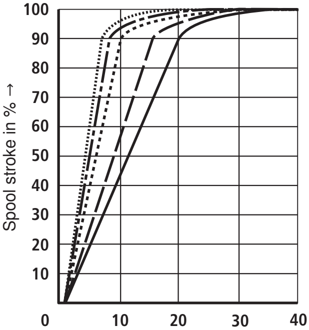
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

4

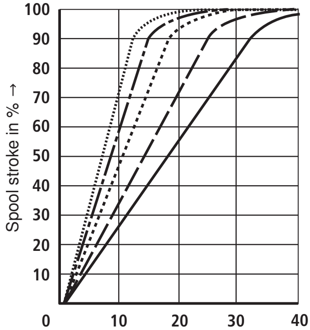
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **75 l/min**



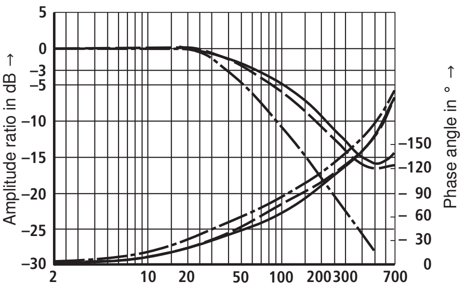
Rated flow **90 l/min**



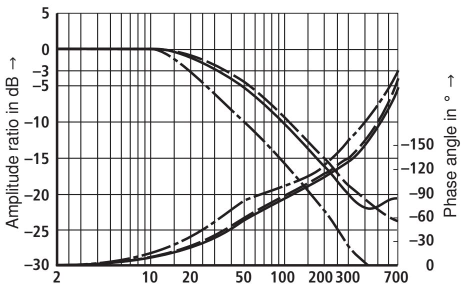
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **75 l/min**



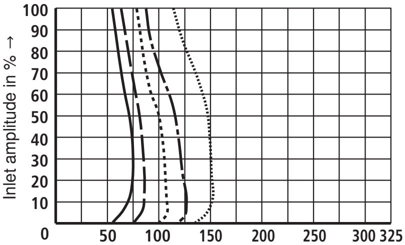
Rated flow **90 l/min**



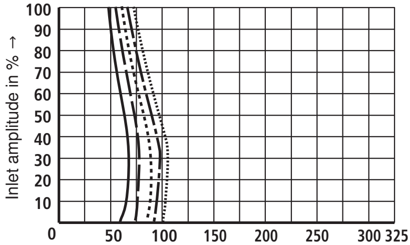
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **75 l/min**

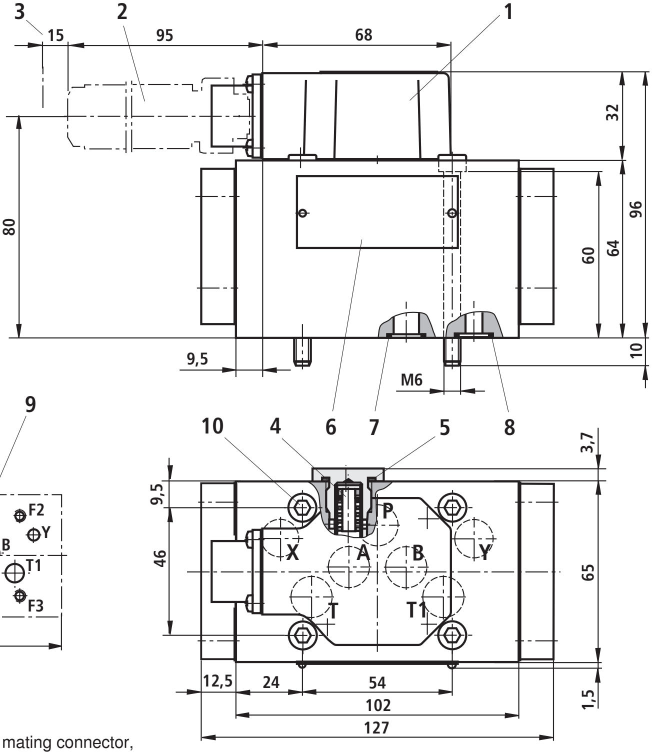


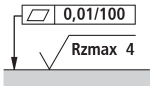
Rated flow **90 l/min**



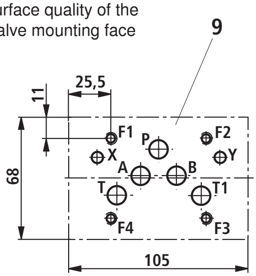
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Unit dimensions (dimensions in mm)





Required
surface quality of the
valve mounting face



1 Cap

2 Mating connector
(separate order, see page 6)

3 Space required for removing the mating connector, additionally observe the bending radius of the connection line

4 Exchangeable filter element
material no.: **R900306843**

5 Profile seal for filter screw M16 x 1.5
material no.: **R900012503** (FKM seal)

6 Name plate

7 Identical seal rings for ports P, A, B, T and T1

8 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

9 Processed valve mounting face
Porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

10 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M6x70-10.9-flZn-240h-L
(Friction coefficient 0.09 – 0.14 according to VDA 235-101) (included in the delivery)

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions as in the data sheet 45054 (must be ordered separately)

Important:

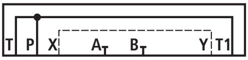
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

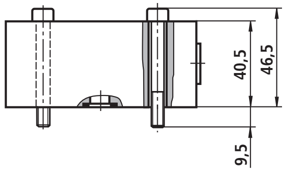
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

4

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws ISO 4762-M6x50-10.9-flZn-240h-L (friction coefficient 0.09 - 0.14 according to VDA 235-101) (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XN-100-B3, section 3.2.

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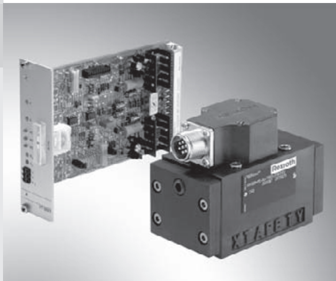
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional servo-valve with mechanical position feedback

RE 29583-XN-102-B2/10.10
Replaces: 04.07

Type 4WS2EM 10...XN...-102



H5893

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min

ATEX units
For explosive areas

Part II Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II3G: Type of protection Ex nA II T5X according to EN 60079-0:2006 / EN 60079-15:2005

II3D: Type of protection Ex tD A22 IP 65 TX according to EN 61241-0:2006 / EN 61241-1:2004

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XN-102-B0**
Part II	Data sheet 29583-XN-102-B2	
Part III	Product-specific instructions 29583-XN-102-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 2 and 22
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-05-05-0-05 with ports X and Y suplates available in FE/ZN version (see page 11)
- Dry control motor, no contamination of the solenoid gap by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in Eurocard format or in modular design (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed; thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seals, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10	–	5X	/		B	11	XN			K31		V	–	102

Electrically actuated 2-stage servo valve in 4/3 directional design for **external** control electronics

Mechanical feedback **= M**

Size **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

Rated flow 1)

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics coil no. 11 (30 mA/85 Ω per coil) 2) **= 11**

XN = Explosion protection "type nA"
For details see information on the explosion protection, page 6

Pilot oil supply and return 3)

– =	Supply external, return external
E =	Supply internal, return external
T =	Supply external, return internal
ET =	Supply internal, return internal (ET = Standard version)

Inlet pressure range to the 1st stage 4)

210 =	10 to 210 bar
315 =	10 to 315 bar

Electrical connection

K31 = with connector
Mating connector – separate order, see page 6

Spool overlap 5)

E =	0 … 0.5 % negative
D =	0 … 0.5 % positive
C =	3 … 5 % positive

Seal material

V = FKM seals
suitable for mineral oil (HL, HLP) according to DIN 51524

102 = Special number 6)

Included in the delivery:

- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

1) **Rated flow**

The rated flow refers to a 100% command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10% must be taken into account (see flow signal function page 7).

2) **External control electronics**

The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal.
Control electronics (servo amplifier) see page 6.

3) **Pilot oil**

Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.

The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.

Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

4) **Inlet pressure range**

Care should be taken that the system pressure is as constant as possible. Pilot pressure range: 10 … 210 bar or 10 … 315 bar

With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

5) **Spool overlap**

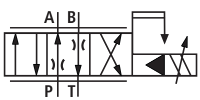
The spool overlap is specified in % of the control spool stroke.

6) **Special number "102"**

Without actuation (de-energized condition), channels P → A and B → T are open for 10 % of the nominal quantity.

4

Symbol



Function, section

4WS2EM 10-5X/...XN...-102

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

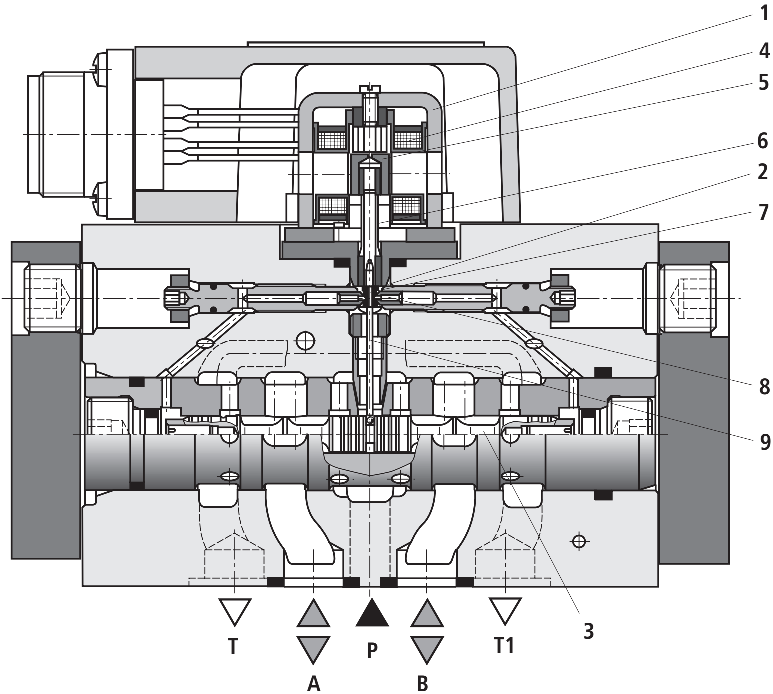
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XN...-102



Technical data

general

Porting pattern			ISO 4401-05-05-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +80
Ambient temperature range		°C	–30 … +80
Weight		kg	3.56

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks <100 permitted							
	Pilot oil return external	bar	to 315							
	Port Y	bar	Pressure peaks <100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	-15 ... +80; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]							
Zero flow $q_{V,L}$ [2] with spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P\,^{4)}}{70\ bar}}\cdot 0{,}7\frac{l}{min.}$	$\sqrt{\frac{p_P\,^{4)}}{70\ bar}}\cdot 0{,}9\frac{l}{min.}$	$\sqrt{\frac{p_P\,^{4)}}{70\ bar}}\cdot 1{,}2\frac{l}{min.}$			$\sqrt{\frac{p_P\,^{4)}}{70\ bar}}\cdot 1.5\frac{l}{min.}$		$\sqrt{\frac{p_P\,^{4)}}{70\ bar}}\cdot 1.7\frac{l}{min.}$
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1,5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
Hydraulic fluid temperature		% / 20 K	≤ 1							
Ambient temperature		% / 20 K	≤ 1							
Operating pressure 80 … 120 % of p_P [4]		% / 100 bar	≤ 2							
Return flow pressure 0 … 10 % of p_P [4]		% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of filters, see www.boschrexroth.com/filter

[2] $q_{V,L}$ = Zero flow in l/min
[3] $q_{v\ rated}$ = Rated flow in l/min
[4] p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100% rated current	Connection in series	H	1.0
	Connection in parallel	H	0.25
In case of actuating using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC		II 3 G; II 3 D
Type of protection according to EN 60079-0:2006 / EN 60079-15:2005		Ex nA II T5X
Type of protection according to EN 61241-0:2006 / EN 61241-1:2004		Ex tD A22 IP 65 TX
Maximum surface temperature	°C	100
Ambient temperature range	°C	–30 … +80
Hydraulic fluid temperature range	°C	–15 … +80
Max. admissible operating voltage of the servo amplifier	V	32 (DC)

External control electronics

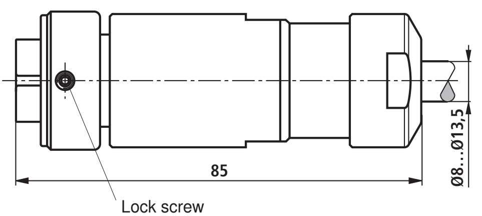
Servo amplifier (separate order)	Eurocard format	analog	Type VT-SR2-1X/.60 according to data sheet 29980
	Modular design	analog	Type VT 11021 according to data sheet 29743
The coils of the valve may only be connected in parallel to these amplifiers!			

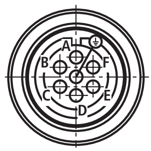
⚠ WARNING – Risk of explosion

– The external servo amplifier must be operated outside the explosive area!

Mating connector

The servo valve may only be supplied through this mating connector.





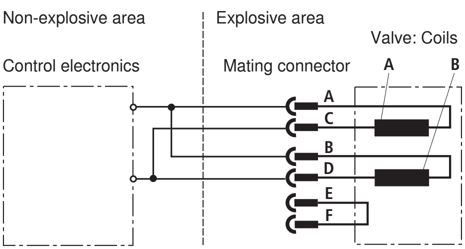
Electrical connection acc. to EN 175201-804

Metal version

Separate order under the material no. **R901044595**

Connection:
Contact sockets with soldered joints for litz wires 0.5 … 1.5 mm²

Electrical connection (example of parallel connection)



The coils are connected in parallel in the mating connector or at the amplifier (see figure).

In case of serial connection, contacts B and C must be connected.

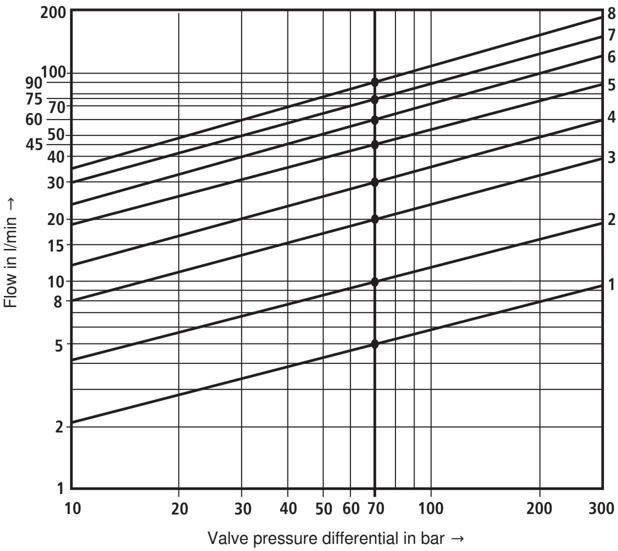
The E-F bridge can be used for the electrical determination of the correct connection of the plug-in connector and/or for the identification of cable break.

The electrical actuation from A (+) to D (–) causes flow direction from P → A and B → T. The reverse electrical actuation causes flow direction from P → B and A → T.

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

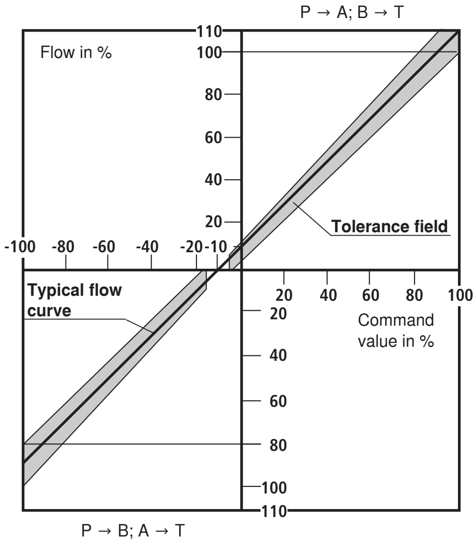
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

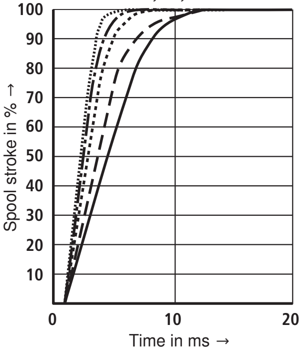
Tolerance field of the flow/signal function at constant valve pressure differential Δp



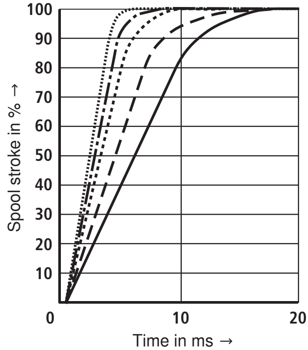
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **5, 10, 20 l/min**



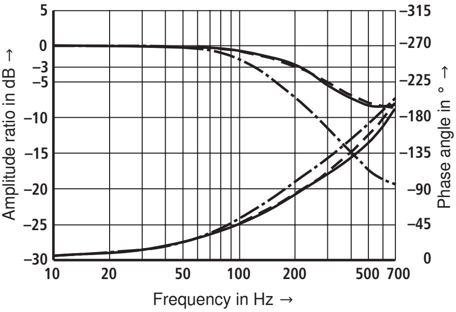
Rated flow **30 l/min**



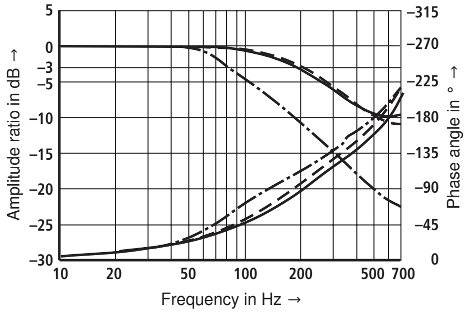
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **5, 10, 20 l/min**



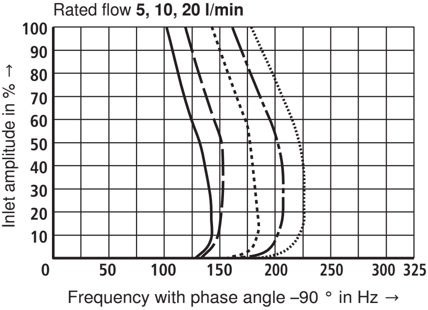
Rated flow **30 l/min**



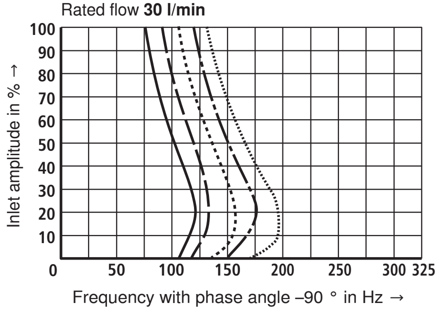
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **5, 10, 20 l/min**



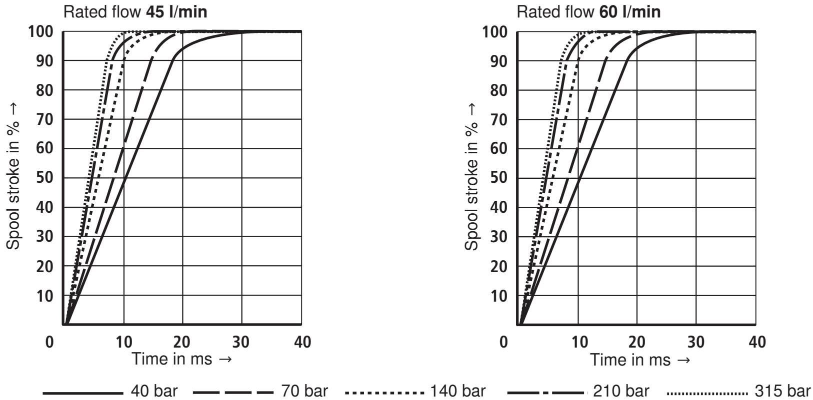
Rated flow **30 l/min**



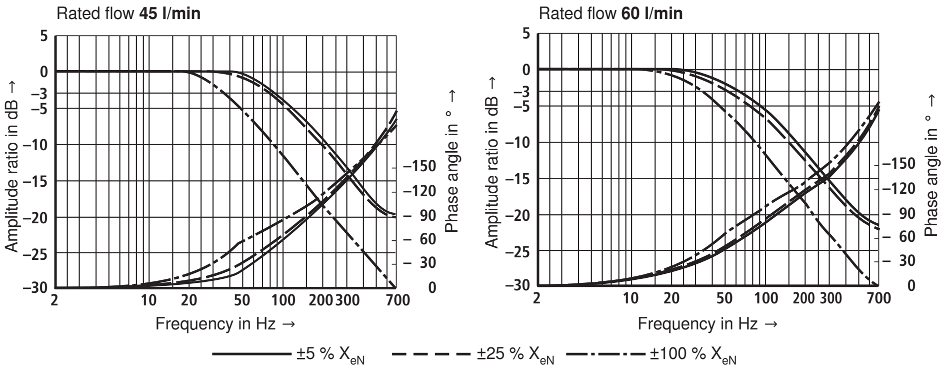
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

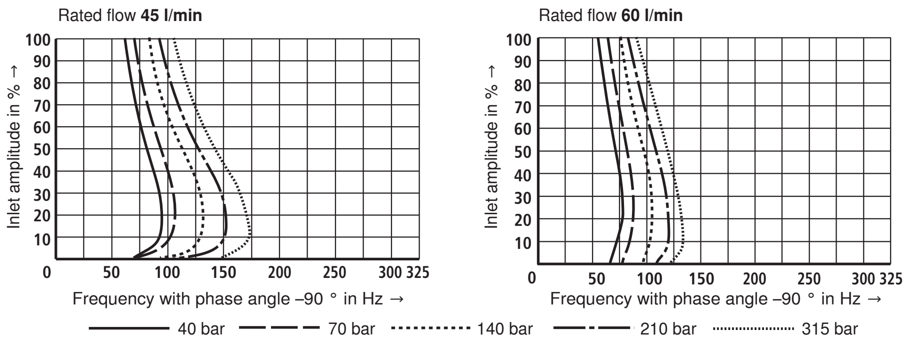
Transition function with pressure rating 315 bar, step response without flow



Frequency response with pressure rating 315 bar, stroke frequency without flow



Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

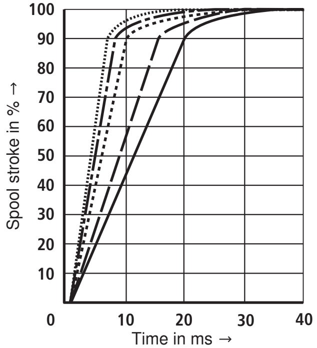


4

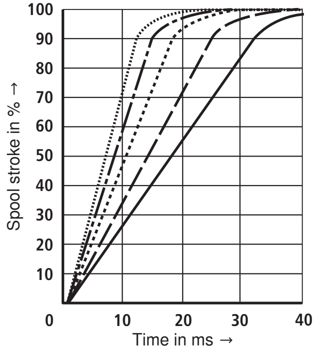
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **75 l/min**



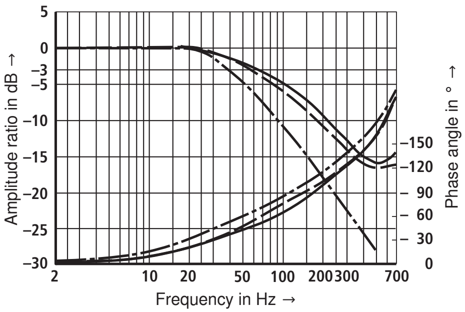
Rated flow **90 l/min**



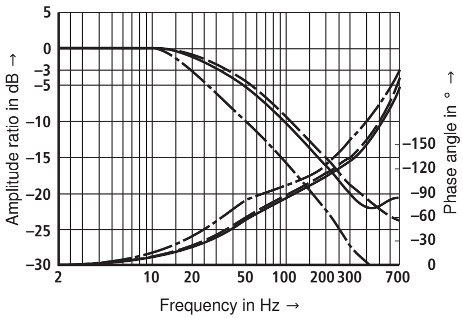
——— 40 bar — — — 70 bar ·········· 140 bar —·— 210 bar ·················· 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **75 l/min**



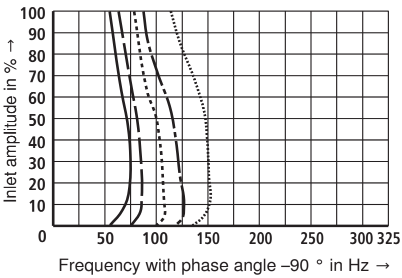
Rated flow **90 l/min**



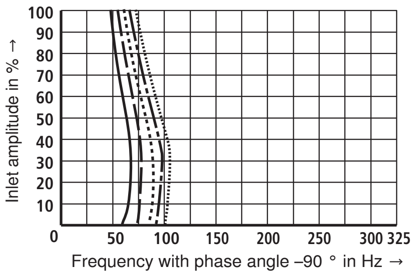
——— ±5 % X_{eN} — — — ±25 % X_{eN} —·—·— ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **75 l/min**

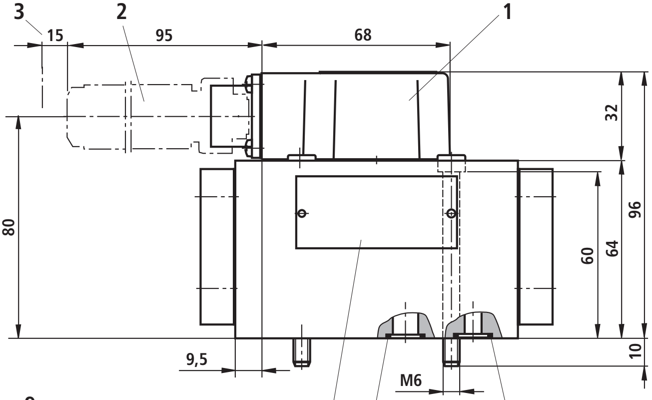


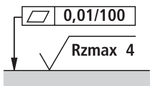
Rated flow **90 l/min**



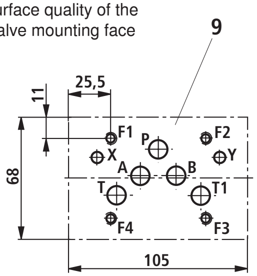
——— 40 bar — — — 70 bar ·········· 140 bar —·— 210 bar ·················· 315 bar

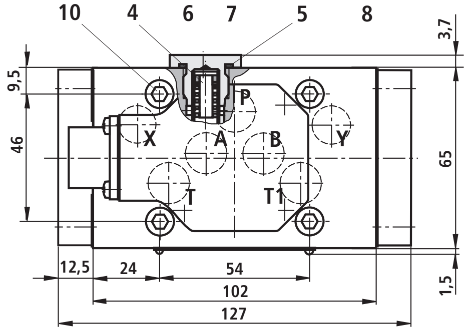
Unit dimensions (dimensions in mm)





Required
surface quality of the
valve mounting face





1 Cap
2 Mating connector
(separate order, see page 6)
3 Space required for removing the mating connector, additionally observe the bending radius of the connection line
4 Exchangeable filter element
material no.: **R900306843**
5 Profile seal for filter screw M16 x 1.5
material no.: **R900012503** (FKM seal)
6 Name plate
7 Identical seal rings for ports P, A, B, T and T1
8 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.
9 Processed valve mounting face
Porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.
10 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M6x70-10.9-flZn-240h-L
(Friction coefficient 0.09 – 0.14 according to VDA 235-101) (included in the delivery)

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions as in the data sheet 45054 (must be ordered separately)

Important:

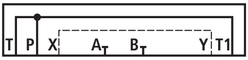
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

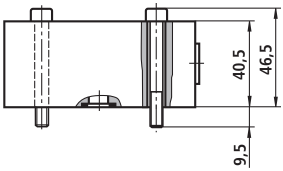
The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

4

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101) (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XN-102-B3, section 3.2.

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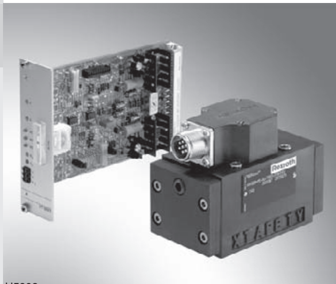
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional servo-valve with mechanical position feedback

RE 29583-XN-114-B2/10.10
Replaces: 04.07

Type 4WS2EM 10...XN...-114

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min



H5893

ATEX units
For explosive areas

Part II Data sheet

Information on explosion protection:

Range of application in accordance with the Explosion Protection Directive 94/9/EC

II3G: Type of protection Ex nA II T5X according to EN 60079-0:2006 / EN 60079-15:2005

II3D: Type of protection Ex tD A22 IP 65 TX according to EN 61241-0:2006 / EN 61241-1:2004

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XN-114-B0**
Part II	Data sheet 29583-XN-114-B2	
Part III	Product-specific instructions 29583-XN-114-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo-valve for proper use in explosive areas of zone 2 and 22
- Valve to control position, force, pressure or velocity
- 2-stage servo valve with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-05-05-0-05 with ports X and Y suplates available in FE/ZN version (see page 11)
- Dry control motor, no contamination of the solenoid gap by the hydraulic fluid
- Can also be used as 3-way version
- Wear-free spool feedback element
- Control:
  External control electronics in Eurocard format or in modular design (separate order), see page 6
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Spool with flow force compensation
- Control sleeve centrically fixed; thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seals, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10 – 5X /		B	11	XN			K31		V – 114

Electrically actuated 2-stage servo valve in 4/3 directional design for **external** control electronics

Mechanical feedback **= M**

Size **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: unchanged installation and connection dimensions)

Rated flow [1]

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics coil no. 11 (30 mA/85 Ω per coil) [2] **= 11**

XN = Explosion protection "type nA"
For details see information on the explosion protection, page 6

Pilot oil supply and return [3]

– =	Supply external, return external
E =	Supply internal, return external
T =	Supply external, return internal
ET =	Supply internal, return internal (ET = Standard version)

Inlet pressure range to the 1st stage [4]

210 =	10 to 210 bar
315 =	10 to 315 bar

Electrical connection

K31 = with connector
Mating connector – separate order, see page 6

Spool overlap [5]

E =	0 … 0.5 % negative
D =	0 … 0.5 % positive
C =	3 … 5 % positive

Seal material

V = FKM seals
suitable for mineral oil (HL, HLP) according to DIN 51524

114 = Special number [6]

Included in the delivery:

- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

[1] **Rated flow**
The rated flow refers to a 100% command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10% must be taken into account (see flow signal function page 7).

[2] **External control electronics**
The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal.
Control electronics (servo amplifier) see page 6.

[3] **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous.

The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.

Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

[4] **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible. Pilot pressure range: 10 … 210 bar or 10 … 315 bar

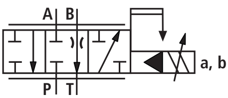
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

[5] **Spool overlap**
The spool overlap is specified in % of the control spool stroke.

[6] **Special number "114"**
Without actuation (de-energized condition), channel B → T is open for 10 % of the nominal quantity. In the control area, port A is always blocked.

4

Symbol



Function, section

4WS2EM 10-5X/...XN...-114

Valves of this type are electrically operated, 2-stage directional servo-valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

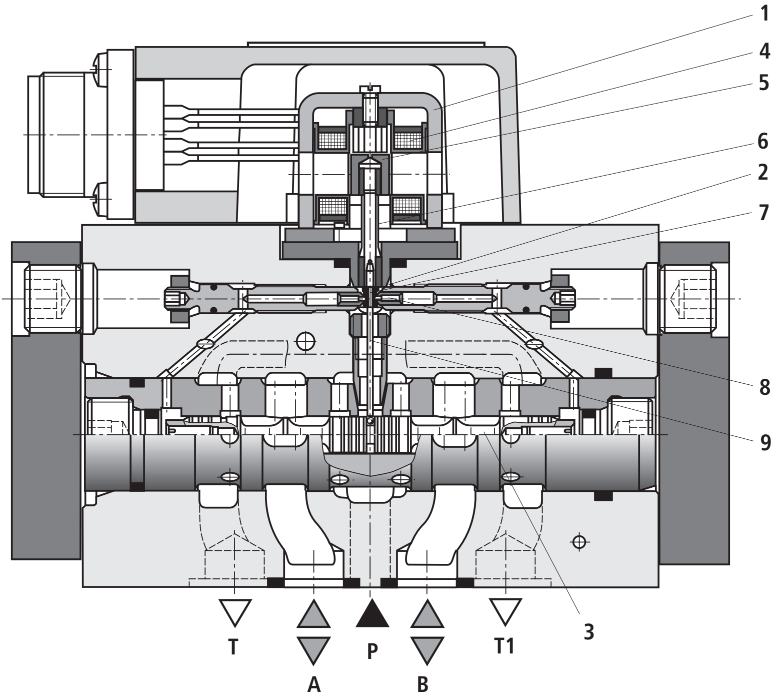
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XN...-114



Technical data

general

Porting pattern			ISO 4401-05-05-0-05
Installation position			Any (Ensure that upon system start-up, the pilot control is supplied with enough pressure (≥10 bar)!)
Surface protection	Valve body, cover, filter screw		Nitro-carburated
	Cap		Anodized
Storage temperature range		°C	–20 … +80
Ambient temperature range		°C	–30 … +80
Weight		kg	3.56

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315
	Main valve, ports P, A, B	bar	to 315
Return flow pressure	Port T		
	Pilot oil return internal	bar	Pressure peaks <100 permitted
	Pilot oil return external	bar	to 315
	Port Y	bar	Pressure peaks <100 permitted, static < 10
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 ignition temperature > 150 °C
Hydraulic fluid temperature range		°C	-15 ... +80; preferably +40 ... +50
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]

Zero flow $q_{V,L}$ [2] with spool overlap E measured without dither signal	l/min	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 0{,}7 \frac{l}{min.}$	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 0{,}9 \frac{l}{min.}$	$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1{,}2 \frac{l}{min.}$			$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1.5 \frac{l}{min.}$		$\sqrt{\frac{p_P{}^{4)}}{70\ bar}} \cdot 1.7 \frac{l}{min.}$
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)	l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke	%	120 … 170				120 … 150			
Feedback system		Mechanical							
Hysteresis (dither-optimized)	%	≤ 1,5							
Range of inversion (dither-optimized)	%	≤ 0.3							
Response sensitivity (dither-optimized)	%	≤ 0.2							
Pressure gain with 1 % spool stroke change (from the hydraulic zero point)	% of p_P [4]	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range	%	≤ 3, long-term ≤ 5							
Zero shift upon change of:									
Hydraulic fluid temperature	% / 20 K	≤ 1							
Ambient temperature	% / 20 K	≤ 1							
Operating pressure 80 … 120 % of p_P [4]	% / 100 bar	≤ 2							
Return flow pressure 0 … 10 % of p_P [4]	% / bar	≤ 1							

1) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components. For the selection of filters, see www.boschrexroth.com/filter

2) $q_{V,L}$ = Zero flow in l/min
3) $q_{v\ rated}$ = Rated flow in l/min
4) p_P = Operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529:1991+A1:2000			IP 65 with mating connector correctly mounted and locked
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100% rated current	Connection in series	H	1.0
	Connection in parallel	H	0.25
In case of actuating using non-Rexroth amplifiers, we recommend a superimposed dither signal			

Information on explosion protection

Range of application as per directive 94/9/EC		II 3 G; II 3 D
Type of protection according to EN 60079-0:2006 / EN 60079-15:2005		Ex nA II T5X
Type of protection according to EN 61241-0:2006 / EN 61241-1:2004		Ex tD A22 IP 65 TX
Maximum surface temperature	°C	100
Ambient temperature range	°C	–30 … +80
Hydraulic fluid temperature range	°C	–15 … +80
Max. admissible operating voltage of the servo amplifier	V	32 (DC)

External control electronics

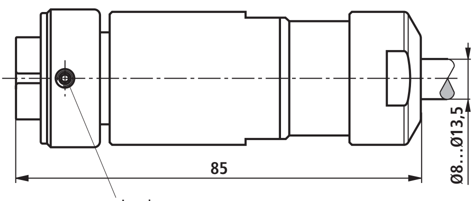
Servo amplifier (separate order)	Eurocard format	analog	Type VT-SR2-1X/.60 according to data sheet 29980
	Modular design	analog	Type VT 11021 according to data sheet 29743
The coils of the valve may only be connected in parallel to these amplifiers!			

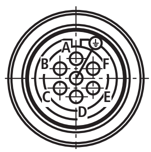
⚠ WARNING – Risk of explosion

– The external servo amplifier must be operated outside the explosive area!

Mating connector

The servo valve may only be supplied through this mating connector.





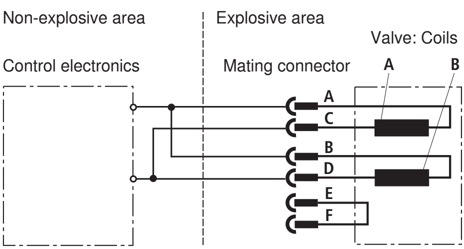
Electrical connection acc. to EN 175201-804

Metal version

Separate order under the material no. **R901044595**

Connection:
Contact sockets with soldered joints for litz wires 0.5 … 1.5 mm²

Electrical connection (example of parallel connection)



The coils are connected in parallel in the mating connector or at the amplifier (see figure).

In case of serial connection, contacts B and C must be connected.

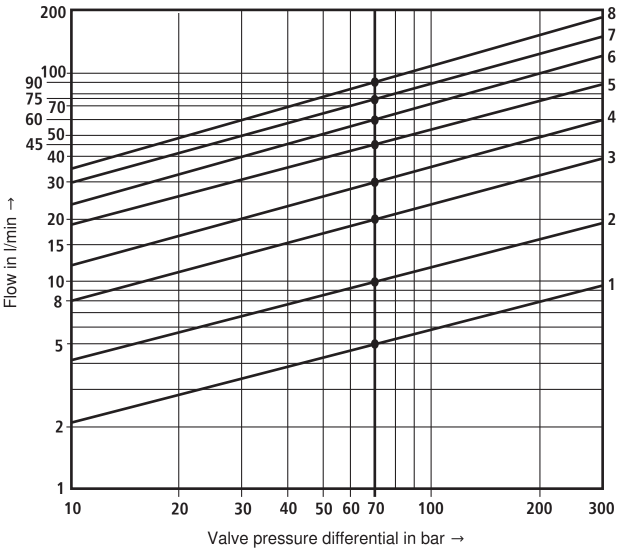
The E-F bridge can be used for the electrical determination of the correct connection of the plug-in connector and/or for the identification of cable break.

The electrical actuation from A (+) to D (–) causes flow direction from B → T. The reverse electrical actuation causes a flow direction of P → B.

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

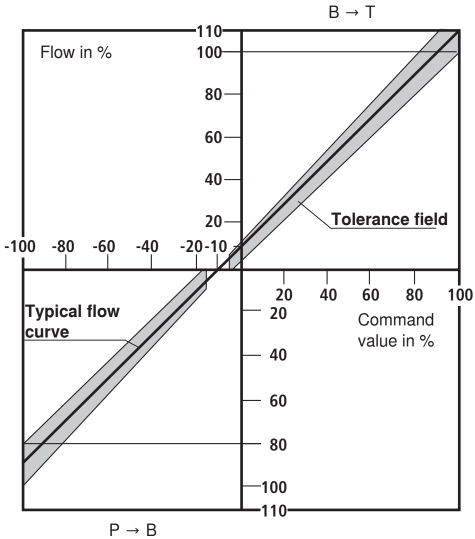
Important:
Observe flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

Tolerance field of the flow/signal function at constant valve pressure differential Δp

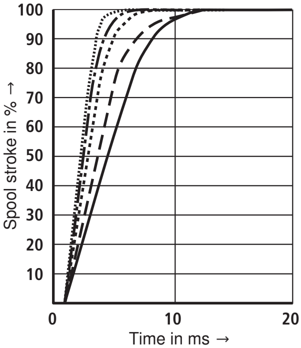


4

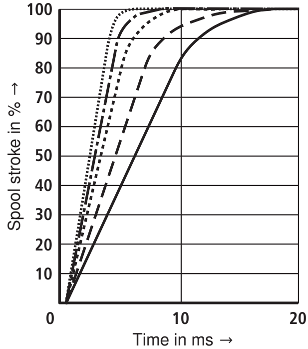
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **5, 10, 20 l/min**



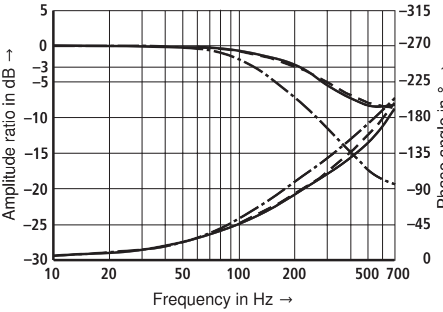
Rated flow **30 l/min**



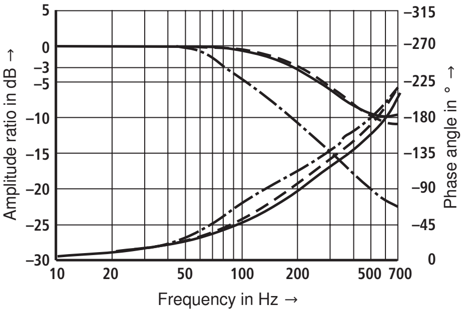
40 bar, 70 bar, 140 bar, 210 bar, 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **5, 10, 20 l/min**



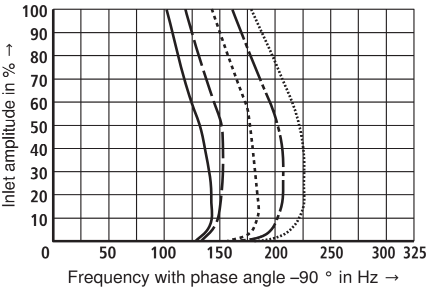
Rated flow **30 l/min**



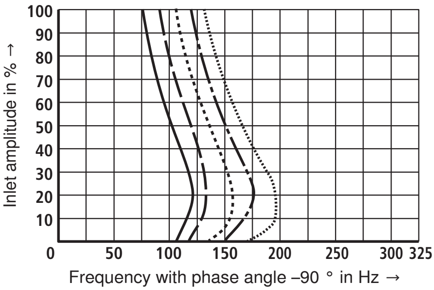
±5 % X_{eN}, ±25 % X_{eN}, ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **5, 10, 20 l/min**



Rated flow **30 l/min**

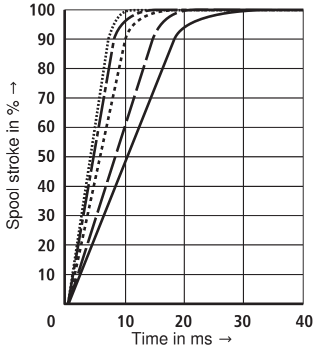


40 bar, 70 bar, 140 bar, 210 bar, 315 bar

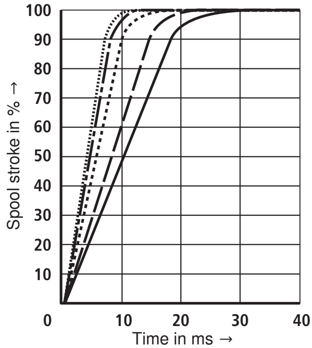
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **45 l/min**



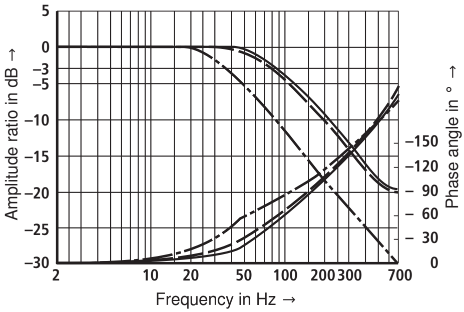
Rated flow **60 l/min**



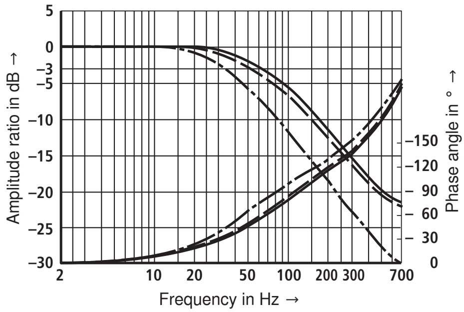
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **45 l/min**



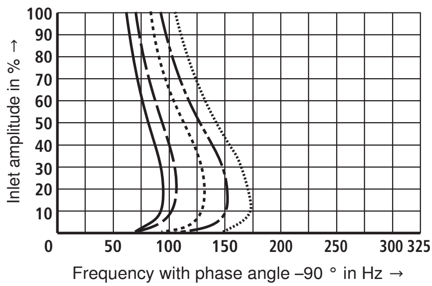
Rated flow **60 l/min**



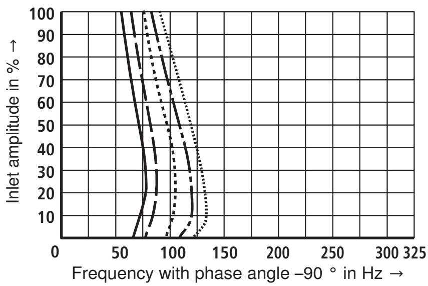
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **45 l/min**



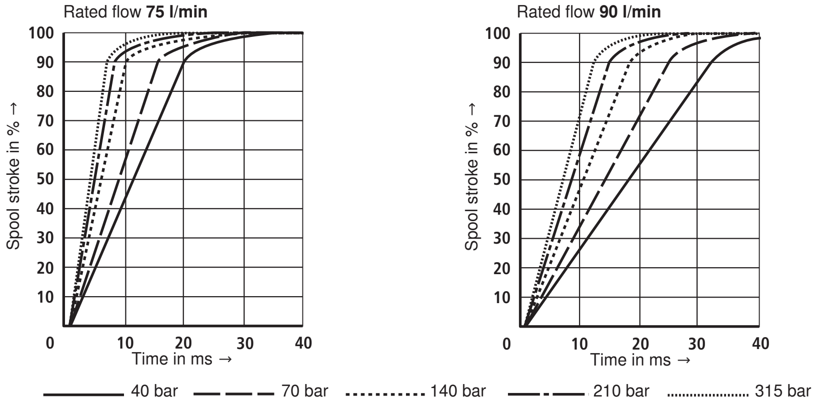
Rated flow **60 l/min**



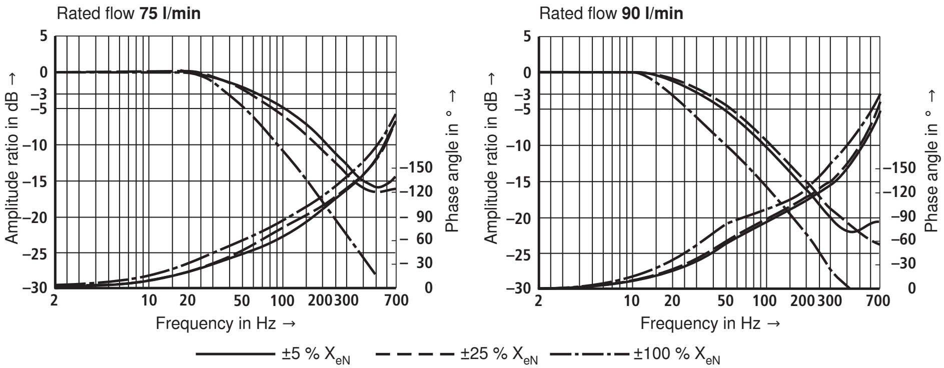
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ±5 °C)

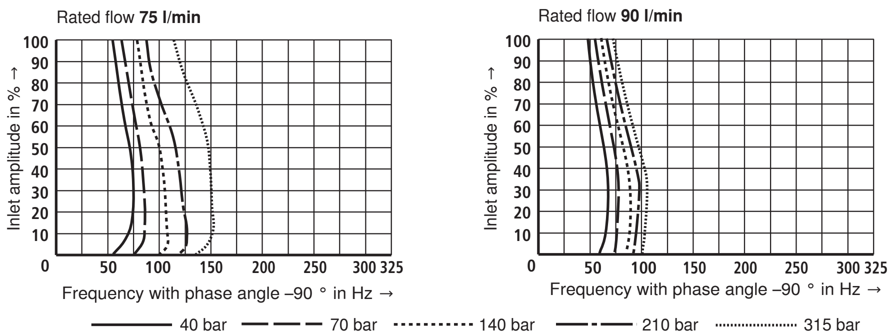
Transition function with pressure rating 315 bar, step response without flow



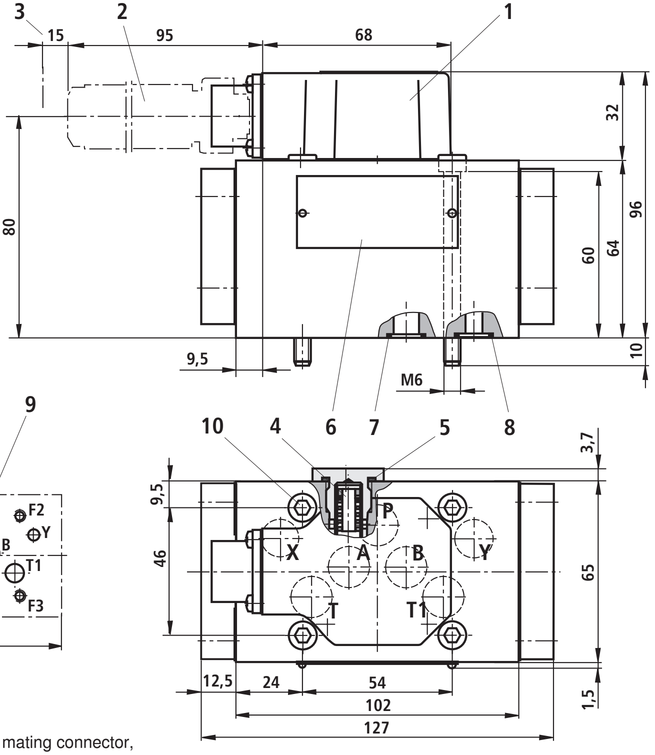
Frequency response with pressure rating 315 bar, stroke frequency without flow

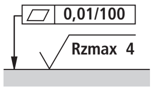


Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

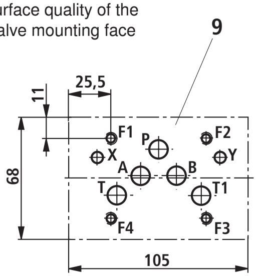


Unit dimensions (dimensions in mm)





Required
surface quality of the
valve mounting face



1 Cap

2 Mating connector
(separate order, see page 6)

3 Space required for removing the mating connector, additionally observe the bending radius of the connection line

4 Exchangeable filter element
material no.: **R900306843**

5 Profile seal for filter screw M16 x 1.5
material no.: **R900012503** (FKM seal)

6 Name plate

7 Identical seal rings for ports P, A, B, T and T1

8 Identical seal rings for ports X and Y
Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

9 Processed valve mounting face
Porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

10 Valve mounting screws
For reasons of stability, exclusively the following valve mounting screws may be used:
4 hexagon socket head cap screws
ISO 4762-M6x70-10.9-flZn-240h-L
(Friction coefficient 0.09 – 0.14 according to
VDA 235-101) (included in the delivery)

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions as in the data sheet 45054 (must be ordered separately)

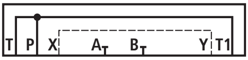
Important:

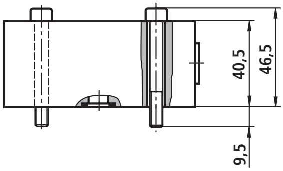
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively the following mounting screws may be used:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101) (included in the delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XN-114-B3, section 3.2.

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Phone +49 (0) 93 52 / 18-0
Fax +49 (0) 93 52 / 18-23 58
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional servo valve with mechanical position feedback

RE 29583-XD-B2/04.12
Replaces: 03.10

Type 4WS2EM 10...XD...

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min

H7684

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

– Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
– Type of protection: Ex d IIB T4 Gb according to EN 60079-0:2009 / EN 60079-1:2007
– Ambient temperature range –30 °C ≤ T_a ≤ +80 °C

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XD-B0**
Part II	Data sheet 29583-XD-B2	
Part III	Product-specific instructions 29583-XD-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo valve for proper use in explosive areas of zone 1
- Valve to control position, force, pressure or velocity
- 2-stage servo valve in 4-way version with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-05-05-0-05
  with ports X and Y
  Subplates available in FE/ZN version (see page 12)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Wear-free control spool return element
- Control:
  External control electronics in Euro-card format or in modular design (separate order, see page 6)
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Control spool with flow force compensation
- Control sleeve centrically fixed, thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10	–	5X	/		B	11	XD			C		V

Electrically operated 2-stage servo valve in 4/3 directional design for **external** control electronics

Mechanical feedback **= M**

Size 10 **= 10**

Component series 50 to 59 **= 5X**
(50 to 59: Unchanged installation and connection dimensions)

Rated flow [1)]

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics
Coil no. 11 (30 mA/85 Ω per coil) [2)] **= 11**

Seal material
V = FKM seals
Suitable for mineral oil (HL, HLP) according to DIN 51524

Control spool overlap [5)]
E = 0 … 0.5 % negative
D = 0 … 0.5 % positive

Electrical connection
C = Cable connection, see page 7

Inlet pressure range to the 1st stage [4)]
210 = 10 … 210 bar
315 = 10 … 315 bar

Pilot oil supply and return [3)]
– = Supply external, return external
E = Supply internal, return external
T = Supply external, return internal
ET = Supply internal, return internal
(ET = standard version)

XD = Explosion protection "pressure-resistant encapsulation"
For details see information on the explosion protection, page 6

Included in the scope of delivery:
– Valve mounting screws
– Valve operating instructions with declaration of conformity in part III

1) **Rated flow**
The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10 % must be taken into account (see flow signal function page 8).

2) **External control electronics**
The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal. Control electronics (servo amplifier) see page 6.

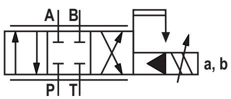
3) **Pilot oil**
Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous. The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.
Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

4) **Inlet pressure range**
Care should be taken that the system pressure is as constant as possible. Pilot pressure range: 10 … 210 bar or 10 … 315 bar
With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

5) **Control spool overlap**
The control spool overlap is specified in % of the control spool stroke. Others upon request

4

Symbol



Function, section

4WS2EM 10…XD

Valves of this type are electrically operated, 2-stage directional servo valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the control spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

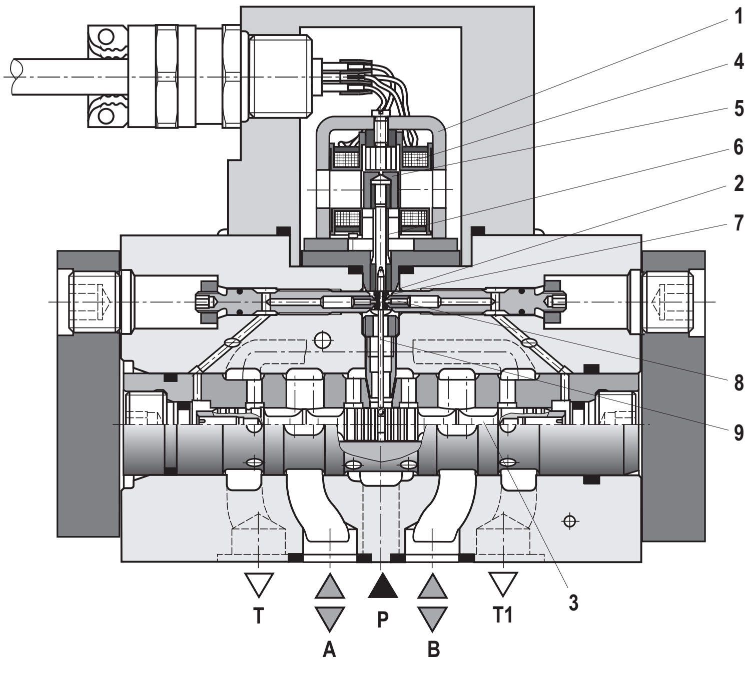
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the control spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XD



Technical data

general

Porting pattern		ISO 4401-05-05-0-05
Installation position		Any (ensure that during start-up of the system, the pilot control is supplied with sufficient pressure (≥ 10 bar)!)
Surface protection		Nitro-carburated
Storage temperature range	°C	–20 … +80
Ambient temperature range	°C	–30 … +80
Weight	kg	3.97

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	up to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks < 100 permitted, static < 10							
	Pilot oil return external	bar	Up to 315							
	Port Y	bar	Pressure peaks < 100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	–20 ... +80; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 1)							
Zero flow $q_{V,L}$ 2) with control spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 0.7 \frac{l}{min}$	$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 0.9 \frac{l}{min}$	$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 1.2 \frac{l}{min}$			$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 1.5 \frac{l}{min}$		$\sqrt{\frac{p_P\ ^{4)}}{70\ bar}} \cdot 1.7 \frac{l}{min}$
Rated flows $q_{v\ rated}$ 3), tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1.5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % control spool stroke change (from the hydraulic zero point)		% of p_P 4)	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
	Hydraulic fluid temperature	% / 20 K	≤ 1							
	Ambient temperature	% / 20 K	≤ 1							
	Operating pressure 80 … 120 % of p_P 4)	% / 100 bar	≤ 2							
	Return flow pressure 0 … 10 % of p_P 4)	% / bar	≤ 1							

1) The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.

For the selection of the filters see www.boschrexroth.com/filter.

2) $q_{V,L}$ = zero flow in l/min
3) $q_{v\ rated}$ = rated flow in l/min
4) p_P = operating pressure in bar

4

Technical data

electric

Protection class according to EN 60529			IP 65
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100 % rated current	Serial connection	H	1.0
	Parallel connection	H	0.25
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal.			

Information on the explosion protection

Type examination certificate			BVS 09 ATEX E 116 X
Area of application as per directive 94/9/EC			II 2G
Type of protection according to EN 60079-0:2009 / EN 60079-1:2007			Ex d IIB T4 Gb
Ambient temperature range		°C	–30 … +80
Hydraulic fluid temperature range		°C	–20 … +80
Maximum current per coil	I_{max}	mA	100
Conditions for use in zone 1			⚠ **DANGER – Risk of explosion** For ensuring the type of protection "pressure-resistant encapsulation" the occurrence of explosive atmospheres in the hydraulic area of the valve must be securely avoided. This may be ensured by applying a sufficiently high control pressure (≥ 10 bar in channel P and/or X) before applying an electrical signal at the coils or the electronics.

External control electronics

Servo amplifier (separate order)	Euro-card format [1]	Analog	Type VT-SR2-1X/.60 according to data sheet 29980
	Modular design [1]	Analog	Type VT 11021 according to data sheet 29743

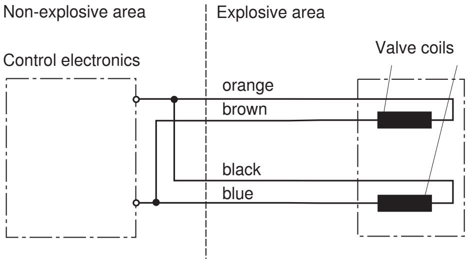
⚠ **DANGER – Risk of explosion**

– The external servo amplifier must be operated outside the explosive area!

[1] Order separately

Electrical connection

Example: Parallel connection



The connection cable is 3 m long and fixedly attached to the valve.
It may be shortened.
It must not be exchanged.

The electrical connection can be designed as parallel or serial connection. For reasons of operational safety and the resulting lower coil inductivity, we recommend the parallel connection.

Parallel connection:
Connect the
"orange" cable litz with "black"
and
"brown" with "blue".

Serial connection:
Connect the "brown" cable litz with "black".

The electrical control to "orange" (+) and "blue" (–) provides for the flow direction P → A and B → T. Inverted electrical control provides for the flow direction P → B and A → T.

⚠ DANGER – Risk of explosion

The free end of the connection cable must be connected as follows according to the construction provisions:

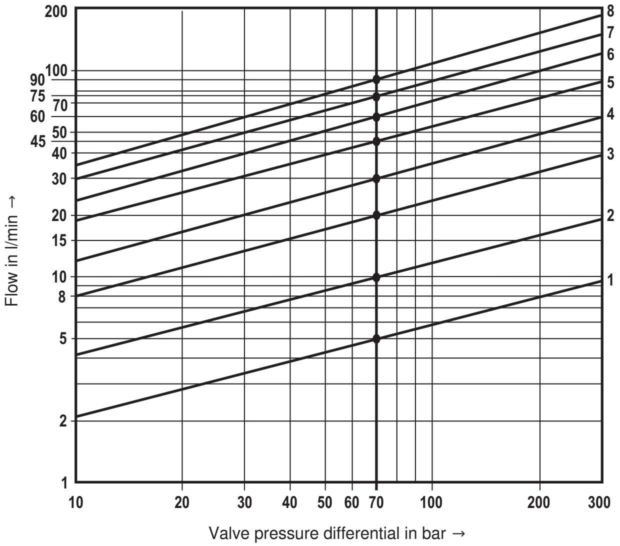
- **Outside the explosive area**

  or
- **Within the explosive area in terminal boxes of an acknowledged protection type**

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

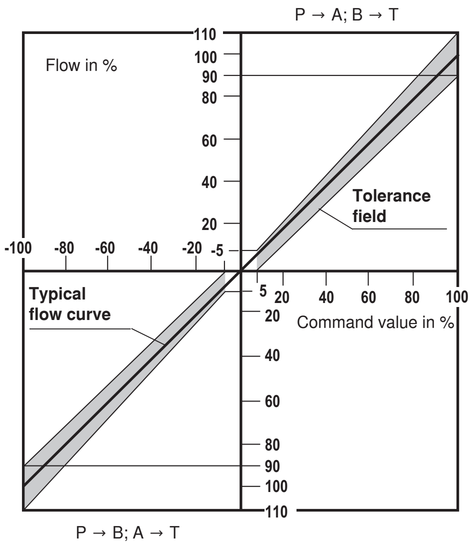
Important:
Observe the flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

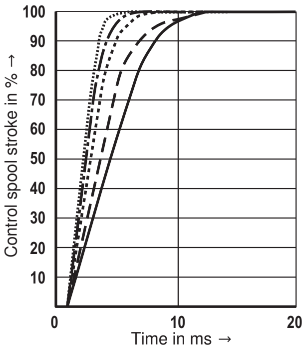
Tolerance field of the flow/signal function with constant valve pressure differential Δp



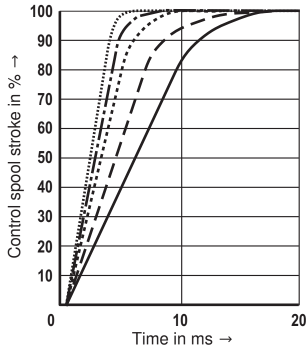
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **5, 10, 20 l/min**



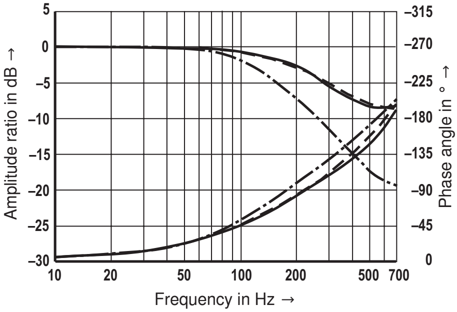
Rated flow **30 l/min**



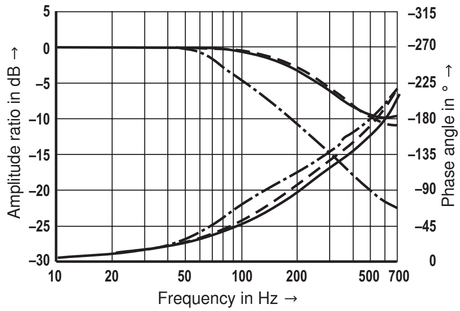
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **5, 10, 20 l/min**



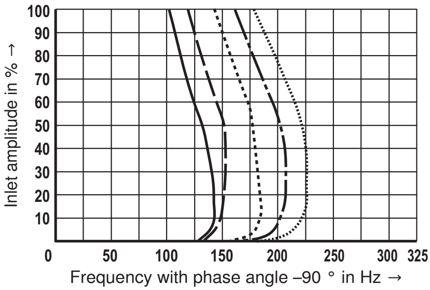
Rated flow **30 l/min**



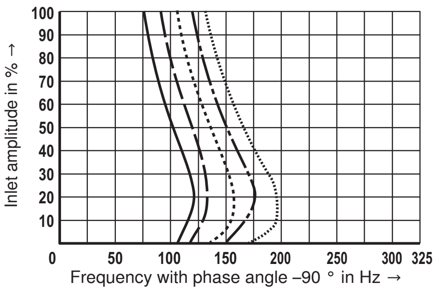
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **5, 10, 20 l/min**



Rated flow **30 l/min**

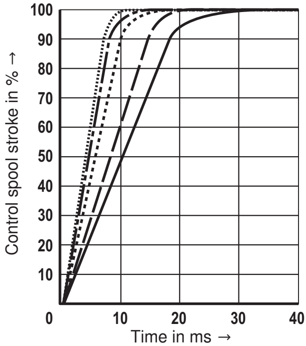


40 bar — 70 bar — 140 bar — 210 bar — 315 bar

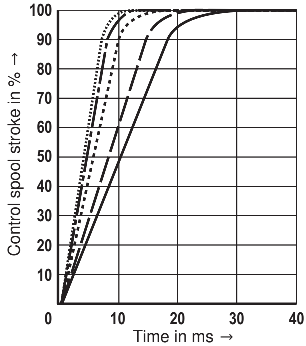
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **45 l/min**



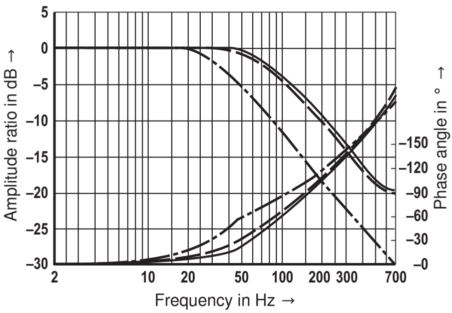
Rated flow **60 l/min**



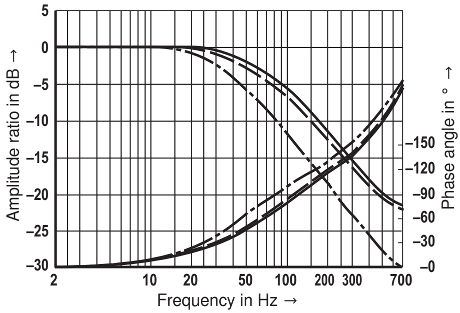
40 bar 70 bar 140 bar 210 bar 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **45 l/min**



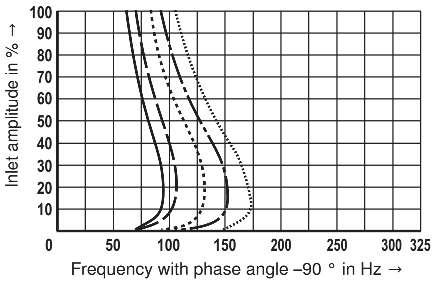
Rated flow **60 l/min**



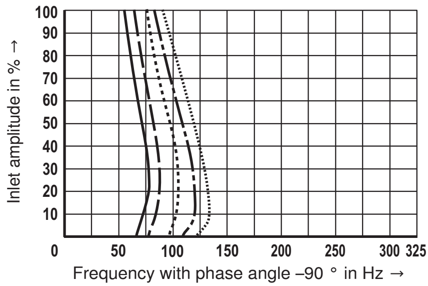
±5 % X_{eN} ±25 % X_{eN} ±100 % X_{eN}

Dependency of the frequency f at –90 ° on the operating pressure p and the inlet amplitude

Rated flow **45 l/min**



Rated flow **60 l/min**

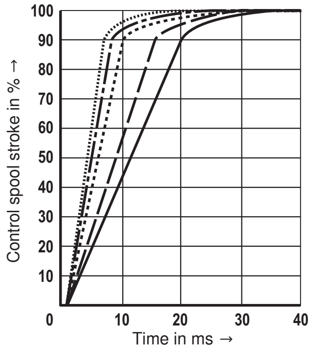


40 bar 70 bar 140 bar 210 bar 315 bar

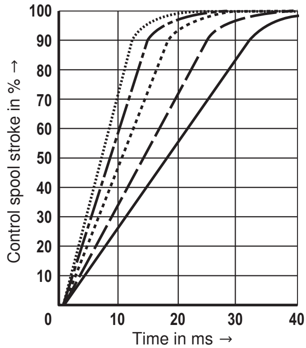
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **75 l/min**



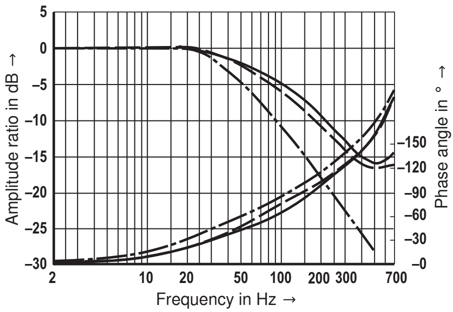
Rated flow **90 l/min**



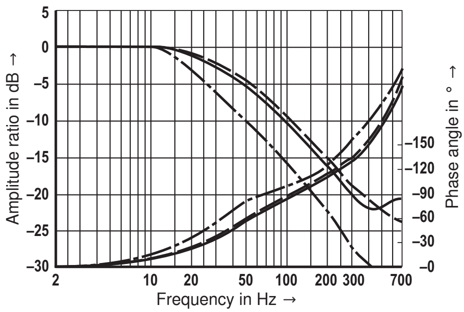
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **75 l/min**



Rated flow **90 l/min**

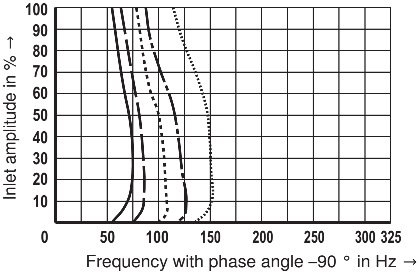


±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

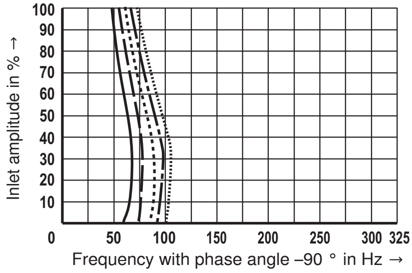
4

Dependency of the frequency f at –90 ° on the operating pressure p and the inlet amplitude

Rated flow **75 l/min**

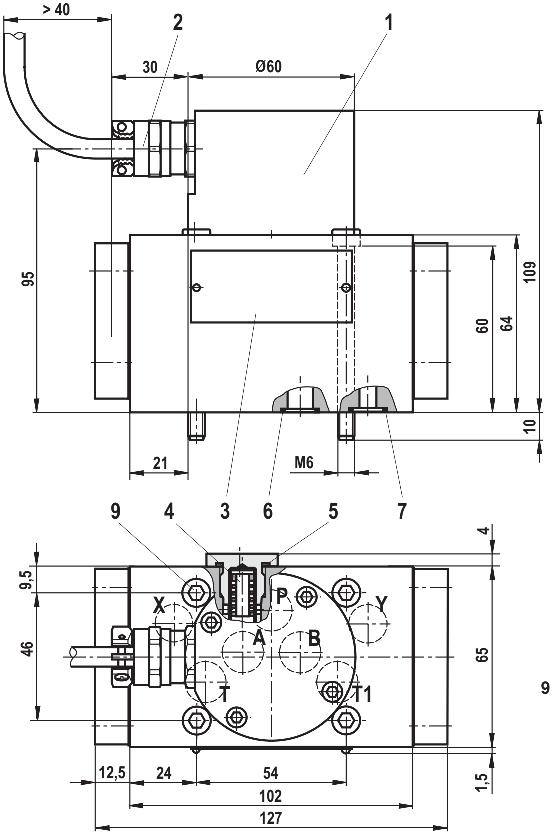


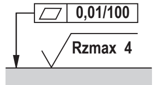
Rated flow **90 l/min**



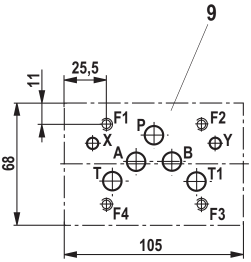
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Unit dimensions (dimensions in mm)





Required surface quality of the valve mounting face



9 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x70-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)

1 Cap
2 Cable gland with cable 3 m long
3 Name plate
4 Exchangeable filter element
Material no.: **R961001950**
5 Profile seal for filter screw 16 x 1.5, part of item 4
6 Identical seal rings for ports P, A, B, T and T1
7 Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.
8 Machined valve mounting face
Porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)
with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions like in data sheet 45054 (must be ordered separately)

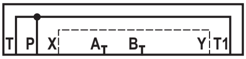
Important:

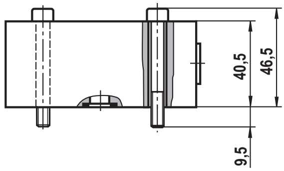
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively use the following mounting screws:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the scope of delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XD-B3, section 3.2.

4

Notes

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Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

4/3 directional servo valve with mechanical position feedback

RE 29583-XD-100-B2/04.12
Replaces: 03.10

Type 4WS2EM 10...XD...-100

Size 10
Component series 5X
Maximum operating pressure 315 bar
Maximum flow 180 l/min

H7684

ATEX units
For explosive areas

Part II Data sheet

Information on the explosion protection:

- Area of application in accordance with the Explosion Protection Directive 94/9/EC: **II 2G**
- Type of protection: Ex d IIB T4 Gb according to EN 60079-0:2009 / EN 60079-1:2007
- Ambient temperature range –30 °C ≤ T_a ≤ +80 °C

What you need to know about these operating instructions

These operating instructions apply to the explosion-proof version of Rexroth valves and consist of the following three parts:

Part I	General information 07010-X-B1	**Operating instructions 29583-XD-100-B0**
Part II	Data sheet 29583-XD-100-B2	
Part III	Product-specific instructions 29583-XD-100-B3	

You can find further information on the correct handling of Rexroth hydraulic products in our publication "General product information on hydraulic products" 07008.

Table of contents

Features

- Directional servo valve for proper use in explosive areas of zone 1
- Valve to control position, force, pressure or velocity
- 2-stage servo valve in 4-way version with mechanical feedback
- 1st stage as nozzle flapper plate amplifier
- For subplate mounting,
  porting pattern according to ISO 4401-05-05-0-05
  with ports X and Y
  Subplates available in FE/ZN version (see page 12)
- Dry control motor, no contamination of the solenoid gaps by the hydraulic fluid
- Wear-free control spool return element
- Control:
  External control electronics in Euro-card format or in modular design (separate order, see page 6)
- Valve is adjusted and tested
- Internal/external pilot oil supply and return can be ordered individually
- Control spool with flow force compensation
- Control sleeve centrically fixed, thus low susceptibility to temperature and pressure
- Pressure chambers at the control sleeve with gap seal, therefore no wear of the seal ring
- Filter for 1st stage freely accessible from the outside

Ordering code and scope of delivery

4WS2E	M	10	5X	/	B	11	XD			C		V	100

Electrically operated 2-stage servo valve in 4/3 directional design for **external** control electronics = 4WS2E

Mechanical feedback = **M**

Size 10 = **10**

Component series 50 to 59 = **5X**
(50 to 59: Unchanged installation and connection dimensions)

Rated flow [1]

5 l/min	**= 5**
10 l/min	**= 10**
20 l/min	**= 20**
30 l/min	**= 30**
45 l/min	**= 45**
60 l/min	**= 60**
75 l/min	**= 75**
90 l/min	**= 90**

Valve for **external** control electronics
Coil no. 11 (30 mA/85 Ω per coil) [2] **= 11**

XD = Explosion protection "pressure-resistant encapsulation"
For details see information on the explosion protection, page 6

Pilot oil supply and return [3]

– =	Supply external, return external
E =	Supply internal, return external
T =	Supply external, return internal
ET =	Supply internal, return internal (ET = standard version)

Inlet pressure range to the 1st stage [4]

210 =	10 … 210 bar
315 =	10 … 315 bar

Electrical connection
C = Cable connection, see page 7

Control spool overlap [5]

E =	0 … 0.5 % negative
D =	0 … 0.5 % positive

Seal material
V = FKM seals
Suitable for mineral oil (HL, HLP) according to DIN 51524

100 = Special number [6]

Included in the scope of delivery:
- Valve mounting screws
- Valve operating instructions with declaration of conformity in part III

[1] **Rated flow**

The rated flow refers to a 100 % command value signal at 70 bar valve pressure differential (35 bar per control edge). The valve pressure differential must be regarded as reference. Other values result in the flow being changed. A possible rated flow tolerance of ±10 % must be taken into account (see flow signal function page 8).

[2] **External control electronics**

The actuating signal must be created from a flow-controlled output stage with a superimposed dither signal. Control electronics (servo amplifier) see page 6.

[3] **Pilot oil**

Care should be taken that the pilot pressure is as constant as possible. An external pilot control via port X is thus often advantageous. The valve can be operated with a higher pressure at X than at P in order to influence the dynamics in a positive form.

Important:
The ports X and Y are also pressurized in case of "internal" pilot oil supply and return.

[4] **Inlet pressure range**

Care should be taken that the system pressure is as constant as possible. Pilot pressure range: 10 … 210 bar or 10 … 315 bar

With regard to the dynamics, the frequency response dependency must be observed within the admissible pressure range.

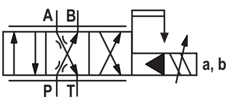
[5] **Control spool overlap**

The control spool overlap is specified in % of the control spool stroke. Others upon request

[6] **Special number "100"**

Without actuation (de-energized condition), channels P → B and A → T are open for 10 % of the nominal quantity.

Symbol



4

Function, section

4WS2EM 10…XD...-100

Valves of this type are electrically operated, 2-stage directional servo valves with porting pattern according to ISO 4401-05-05-0-05. They are mainly used to control position, force, pressure or velocity.

These valves are made of an electro-mechanical converter (torque motor) (1), a hydraulic amplifier (principle: nozzle flapper plate) (2) and a control spool (3) in a sleeve (2nd stage) which is connected with the torque motor via a mechanical feedback.

An electrical input signal at the coils (4) of the torque motor generates a force by means of a permanent magnet which acts on the armature (5), and in connection with a torque tube (6) results in a torque. This causes the flapper plate (7) which is connected to the torque tube (6) via a pin to move from the central position between the two control nozzles (8), and a pressure differential is created across the front faces of the control spool (3). The pressure differential results in the control spool changing its position, which results in the pressure port being connected to one actuator port and, at the same time, the other actuator port being connected to the return flow port.

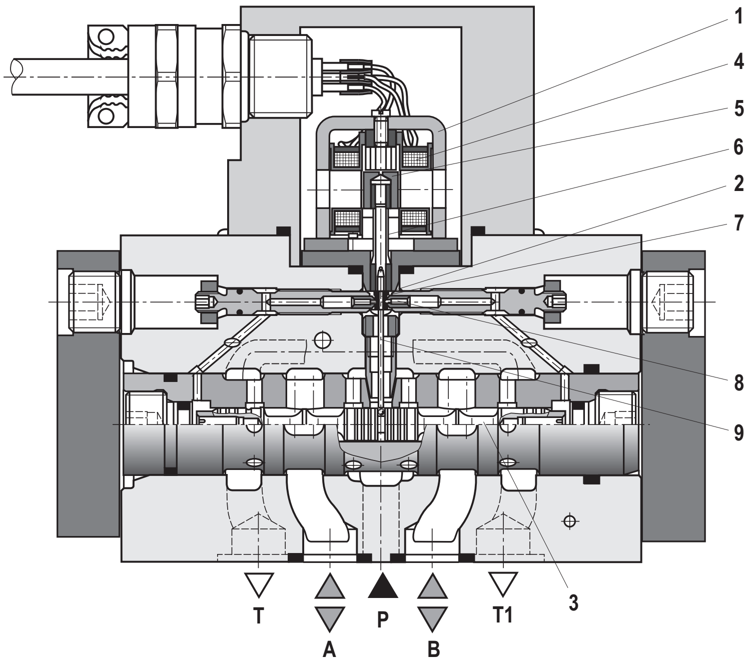
The control spool is connected to the flapper plate or the torque motor by means of a bending spring (mechanical feedback) (9). The position of the control spool is changed until the feedback torque across the bending spring and the electro-magnetic torque of the torque motor are balanced and the pressure differential at the nozzle flapper plate system becomes zero.

The stroke of the control spool and consequently the flow of the servo valve are controlled in proportion to the electrical input signal. It must be noted that the flow depends on the valve pressure drop.

External control electronics (separate order)

External control electronics (servo amplifier) serve the actuation of the valve, amplifying an analog input signal (command value) so that with the output signal, the servo valve is actuated in a flow-controlled form.

Type 4WS2EM 10…XD...-100



Technical data

general

Porting pattern		ISO 4401-05-05-0-05
Installation position		Any (ensure that during start-up of the system, the pilot control is supplied with sufficient pressure (≥ 10 bar)!)
Surface protection		Nitro-carburated
Storage temperature range	°C	–20 … +80
Ambient temperature range	°C	–30 … +80
Weight	kg	3.97

hydraulic (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Operating pressure	Pilot control stage, pilot oil supply	bar	10 … 210 or 10 … 315							
	Main valve, ports P, A, B	bar	up to 315							
Return flow pressure	Port T									
	Pilot oil return internal	bar	Pressure peaks < 100 permitted, static < 10							
	Pilot oil return external	bar	Up to 315							
	Port Y	bar	Pressure peaks < 100 permitted, static < 10							
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524 Ignition temperature > 150 °C							
Hydraulic fluid temperature range		°C	–20 ... +80; preferably +40 ... +50							
Viscosity range		mm^2/s	15 ... 380; preferably 30 ... 45							
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 18/16/13 [1]							
Zero flow $q_{V,L}$ [2] with control spool overlap E measured without dither signal		l/min	$\sqrt{\frac{p_P}{70\ \text{bar}}} \cdot 0.7\ \frac{l}{min}$ [4]	$\sqrt{\frac{p_P}{70\ \text{bar}}} \cdot 0.9\ \frac{l}{min}$ [4]	$\sqrt{\frac{p_P}{70\ \text{bar}}} \cdot 1.2\ \frac{l}{min}$ [4]			$\sqrt{\frac{p_P}{70\ \text{bar}}} \cdot 1.5\ \frac{l}{min}$ [4]		$\sqrt{\frac{p_P}{70\ \text{bar}}} \cdot 1.7\ \frac{l}{min}$ [4]
Rated flows $q_{v\ rated}$ [3], tolerance ±10 % with valve pressure differential Δp = 70 bar (35 bar/edge)		l/min	5	10	20	30	45	60	75	90
Max. control spool stroke possible with mechanical end position (in case of error) related to nominal stroke		%	120 … 170				120 … 150			
Feedback system			Mechanical							
Hysteresis (dither-optimized)		%	≤ 1.5							
Range of inversion (dither-optimized)		%	≤ 0.3							
Response sensitivity (dither-optimized)		%	≤ 0.2							
Pressure gain with 1 % control spool stroke change (from the hydraulic zero point)		% of p_P [4]	≥ 30					≥ 60		≥ 80
Zero adjustment flow over the entire operating pressure range		%	≤ 3, long-term ≤ 5							
Zero shift upon change of:										
	Hydraulic fluid temperature	% / 20 K	≤ 1							
	Ambient temperature	% / 20 K	≤ 1							
	Operating pressure 80 … 120 % of p_P [4]	% / 100 bar	≤ 2							
	Return flow pressure 0 … 10 % of p_P [4]	% / bar	≤ 1							

[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems. Effective filtration prevents faults and at the same time increases the service life of the components.

For the selection of the filters see www.boschrexroth.com/filter.

[2] $q_{V,L}$ = zero flow in l/min
[3] $q_{v\ rated}$ = rated flow in l/min
[4] p_P = operating pressure in bar

Technical data

electric

Protection class according to EN 60529			IP 65
Type of signal			Analog
Rated current per coil		mA	30
Resistance per coil		Ω	85
Inductivity with 60 Hz and 100 % rated current	Serial connection	H	1.0
	Parallel connection	H	0.25
In case of actuation using non-Rexroth amplifiers, we recommend a superimposed dither signal.			

Information on the explosion protection

Type examination certificate		BVS 09 ATEX E 116 X
Area of application as per directive 94/9/EC		II 2G
Type of protection according to EN 60079-0:2009 / EN 60079-1:2007		Ex d IIB T4 Gb
Ambient temperature range	°C	–30 … +80
Hydraulic fluid temperature range	°C	–20 … +80
Maximum current per coil	I_{max} mA	100
Conditions for use in zone 1		⚠ **DANGER – Risk of explosion** For ensuring the type of protection "pressure-resistant encapsulation" the occurrence of explosive atmospheres in the hydraulic area of the valve must be securely avoided. This may be ensured by applying a sufficiently high control pressure (≥ 10 bar in channel P and/or X) before applying an electrical signal at the coils or the electronics.

External control electronics

Servo amplifier (separate order)	Euro-card format [1]	Analog	Type VT-SR2-1X/.60 according to data sheet 29980
	Modular design [1]	Analog	Type VT 11021 according to data sheet 29743

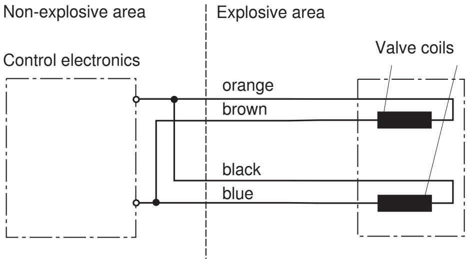
⚠ **DANGER – Risk of explosion**

– The external servo amplifier must be operated outside the explosive area!

[1] Order separately

Electrical connection

Example: Parallel connection



⚠ DANGER – Risk of explosion

The free end of the connection cable must be connected as follows according to the construction provisions:

- **Outside the explosive area**

  or

- **Within the explosive area in terminal boxes of an acknowledged protection type**

The connection cable is 3 m long and fixedly attached to the valve.
It may be shortened.
It must not be exchanged.

The electrical connection can be designed as parallel or serial connection. For reasons of operational safety and the resulting lower coil inductivity, we recommend the parallel connection.

Parallel connection:
Connect the
"orange" cable litz with "black"
and
"brown" with "blue".

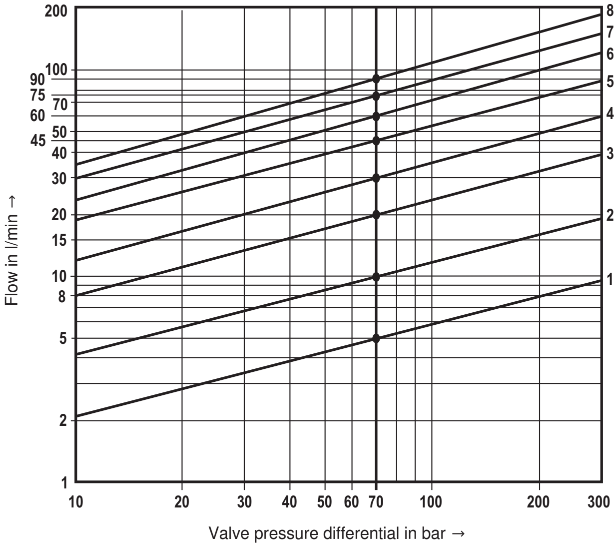
Serial connection:
Connect the "brown" cable litz with "black".

The electrical control to "orange" (+) and "blue" (–) provides for the flow direction P → A and B → T. Inverted electrical control provides for the flow direction P → B and A → T.

Characteristic curves (measured with HLP32, ϑ_{oil} = 40 °C ± 5 °C)

Flow/load function (tolerance ±10 %) with 100 % command value signal

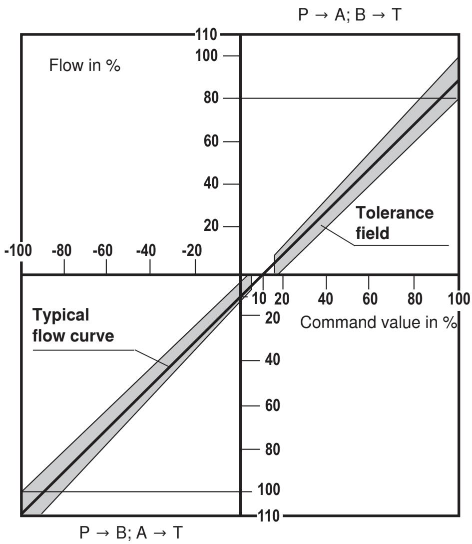
Important:
Observe the flow values in the max. command value range (see tolerance field of the flow/signal function)



Ordering code	Rated flow	Curve
5	5 l/min	1
10	10 l/min	2
20	20 l/min	3
30	30 l/min	4
45	45 l/min	5
60	60 l/min	6
75	75 l/min	7
90	90 l/min	8

Δp = Valve pressure differential (inlet pressure p_P minus load pressure p_L minus return flow pressure p_T)

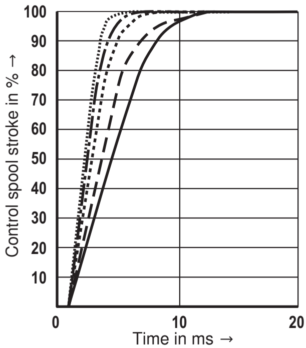
Tolerance field of the flow/signal function with constant valve pressure differential Δp



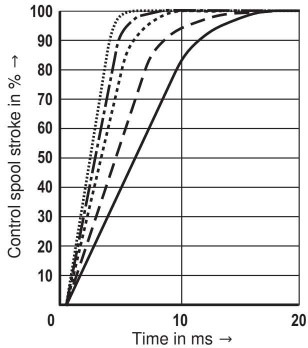
Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

Transition function with pressure rating 315 bar, step response without flow

Rated flow **5, 10, 20 l/min**



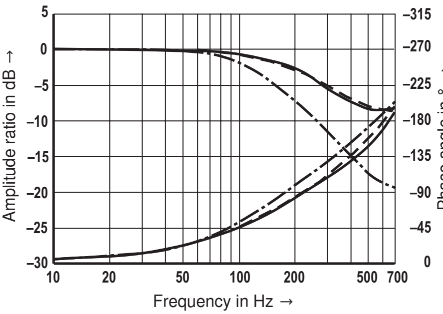
Rated flow **30 l/min**



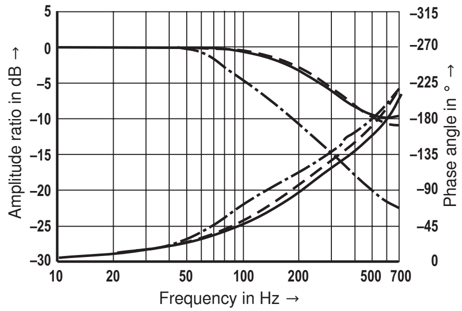
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

Frequency response with pressure rating 315 bar, stroke frequency without flow

Rated flow **5, 10, 20 l/min**



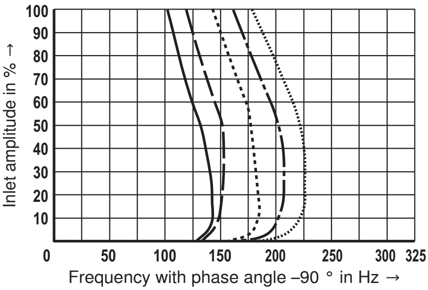
Rated flow **30 l/min**



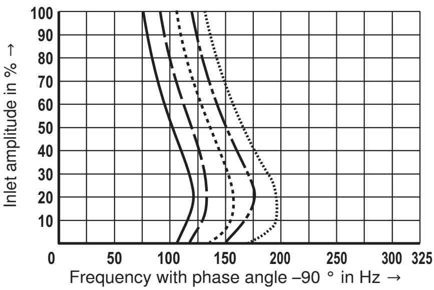
±5 % X_{eN} — ±25 % X_{eN} — ±100 % X_{eN}

Dependency of the frequency *f* at –90 ° on the operating pressure *p* and the inlet amplitude

Rated flow **5, 10, 20 l/min**



Rated flow **30 l/min**

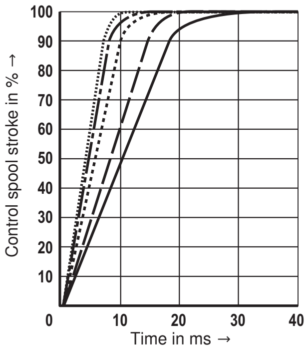


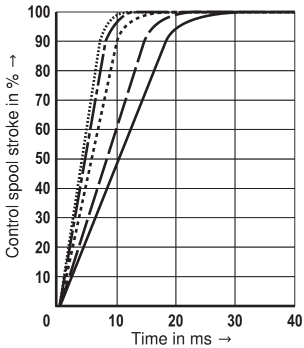
40 bar — 70 bar — 140 bar — 210 bar — 315 bar

4

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

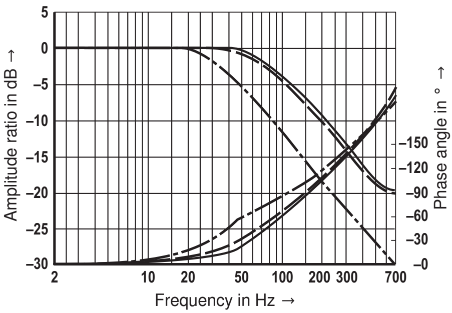
Transition function with pressure rating 315 bar, step response without flow

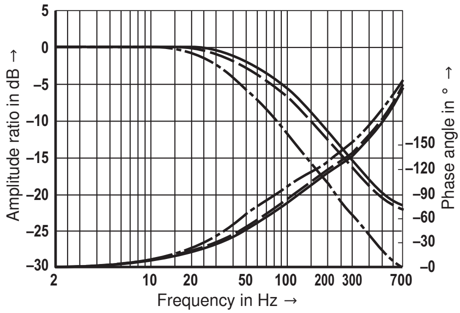




40 bar 70 bar 140 bar 210 bar 315 bar

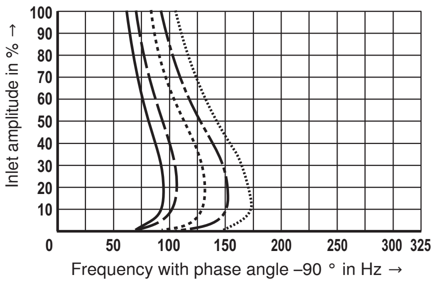
Frequency response with pressure rating 315 bar, stroke frequency without flow

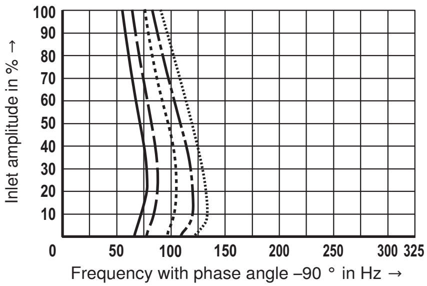




±5 % X_{eN} ±25 % X_{eN} ±100 % X_{eN}

Dependency of the frequency f at –90 ° on the operating pressure p and the inlet amplitude

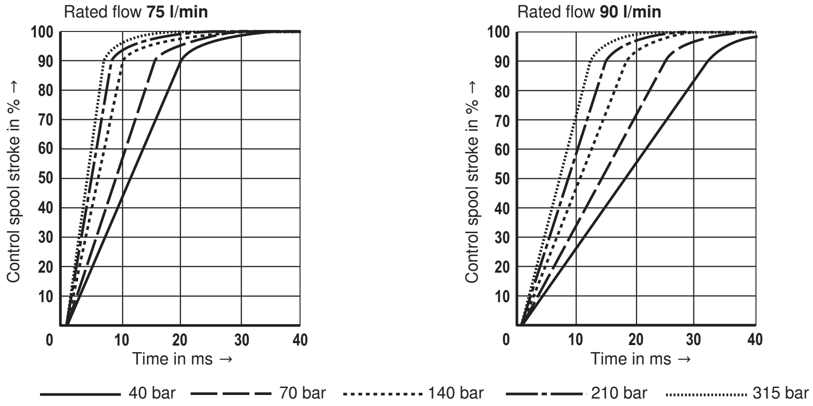




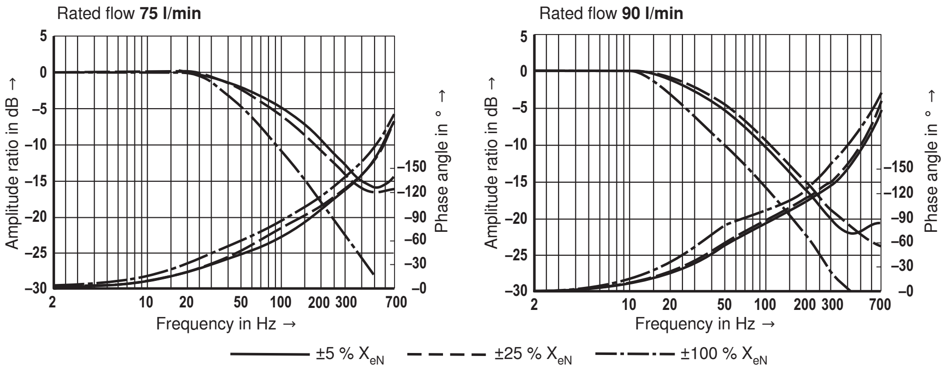
40 bar 70 bar 140 bar 210 bar 315 bar

Characteristic curves (measured with HLP 32, ϑ_{oil} = 40 °C ± 5 °C)

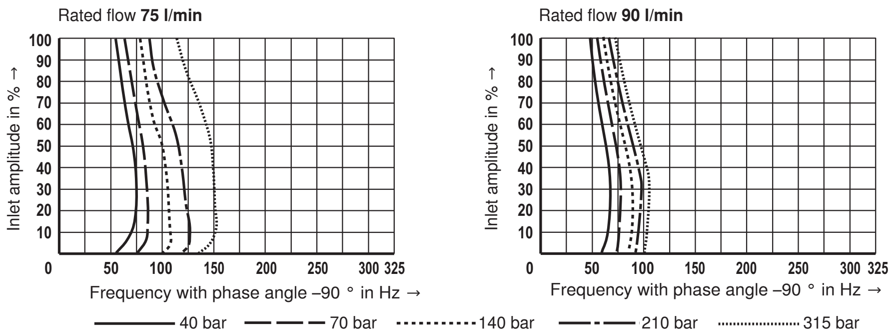
Transition function with pressure rating 315 bar, step response without flow



Frequency response with pressure rating 315 bar, stroke frequency without flow

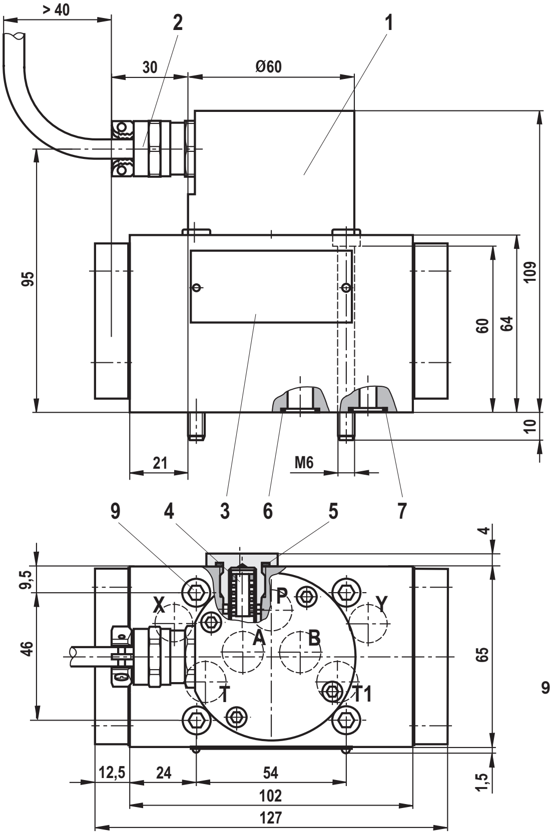


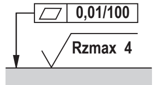
Dependency of the frequency f at –90 ° on the operating pressure p and the inlet amplitude



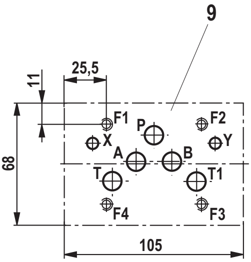
4

Unit dimensions (dimensions in mm)





Required surface quality of the valve mounting face



9 Valve mounting screws
For reasons of stability, exclusively use the following valve mounting screws:
4 hexagon socket head cap screws
ISO 4762-M6x70-10.9-flZn-240h-L
(friction coefficient 0.09 - 0.14 according to VDA 235-101)
(included in the scope of delivery)

1 Cap
2 Cable gland with cable 3 m long
3 Name plate
4 Exchangeable filter element
Material no.: **R961001950**
5 Profile seal for filter screw 16 x 1.5, part of item 4
6 Identical seal rings for ports P, A, B, T and T1
7 Ports X and Y are also pressurized in case of "internal" pilot oil supply and return.
8 Machined valve mounting face
Porting pattern according to ISO 4401-05-05-0-05
Port T1 is optional and is recommended for reducing the pressure drop from B → T with rated flows > 45 l/min.

Subplates

G 66/01 FE/ZN (G3/8)
G 67/01 FE/ZN (G1/2)

with ports X and Y:
G 535/01 FE/ZN (G3/4)
G 535/02 FE/ZN (M27 x 2)
G 536/01 FE/ZN (G1)
G 536/02 FE/ZN (M33 x 2)
with dimensions like in data sheet 45054 (must be ordered separately)

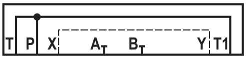
Important:

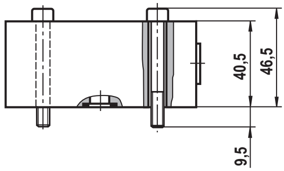
Subplates are no components in the sense of directive 94/9/EC and can be used after the manufacturer of the overall system has assessed the risk of ignition.

The G...FE/ZN versions are free from aluminum and/or magnesium and galvanized.

Flushing plate with porting pattern according to ISO 4401-05-05-0-05 (dimensions in mm)

Symbol





Ordering code and more information

- Material number: **R900912450**
- Weight: 2 kg
- Identical seal rings for ports P, A, B, T and T1
- Identical seal rings for ports X and Y
- Mounting screws
  For reasons of stability, exclusively use the following mounting screws:
  4 hexagon socket head cap screws
  ISO 4762-M6x50-10.9-flZn-240h-L
  (friction coefficient 0.09 - 0.14 according to VDA 235-101)
  (included in the scope of delivery)

Important

Before the assembly, observe the information in the Product-specific instructions 29583-XD-100-B3, section 3.2.

Notes

Bosch Rexroth AG
Hydraulics
Zum Eisengießer 1
97816 Lohr am Main, Germany
Phone +49 (0) 93 52 / 18-0
documentation@boschrexroth.de
www.boschrexroth.de

Electronics

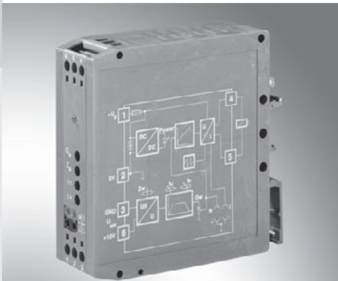
5

Amplifier module for controlling the explosion-proof proportional pressure valve DBET-6X...XE [1]

RE 30223-200/03.11 1/6
Replaces: 02.07

Type VT-MSPA1-200

Component series 1X



H6833

Table of contents

Contents	**Page**

[1] **For the operation of the valve in the explosive area, additional safety measures are required. Here, we recommend using the Rexroth monitoring module VT-MUXA2-2. In this connection, observe data sheet 30290.**

Features

- Amplifier module is not subject to the directive 94/9/EC (ATEX directive)
- In connection with the Rexroth monitoring module [1] VT-MUXA2-2 suitable for controlling the proportional pressure valve of type DBET-6X...XE
- Inverse-polarity protection of the operating voltage
- Differential input for command value voltage +10 V
- Ramp generator up and down can be set separately
- Zero point potentiometer
- 1 command value attenuator
- Characteristic curve generator
- Synchronized power output stage
- Output short-circuit-proof
- LED display: • Ready for operation (green)
- Measuring sockets for: • Pressure command value
  • Actual current value
- Dither generator with command value- and operating voltage-dependent frequency

Ordering code

VT-MSPA1 – 200 – 1X / V0 / *

Analog amplifier module			Further details in the plain text
For controlling the valve DBET-6X...XE	**= 200**	**V0 =**	Standard version
Component series 10 to 19 (10 to 19: Identical technical data and pinout)	**= 1X**		

Functional description

Analog amplifier for controlling pressure valves without electric return. The modular design allows for simple top hat rail assembly as is usual in control cabinets.

( ) = Assignment to the block diagram on page 3

Command value input (4)

The module amplifier is controlled by means of a standard command value signal 0 to +10 V. By means of the zero point trimmer (Zw) (6), a zero point offset can be corrected.

Ramp generator (5)

In the ramp generator (5), the actuating variable rise is limited. Using the trimmer "t <" (7), the time for the increasing command value signal is set and using trimmer "t >" (8), the time for the decreasing command value voltage is set. The adjustable time is in each case 30 ms to > 5 s.

Characteristic curve generator (10)

Using the trimmer "Gw" (9), the rated current of 1.0 A for the solenoid is set. In the characteristic curve generator (10), the command value signal is changed so that a linear command value/pressure characteristic curve results.

Clock generator (12)

In the clock generator (12), a frequency for the output stage adjusted to the command value is generated.

Power output stage (11) to (14)

Using the actuating variable coming from the characteristic curve generator (10) and the clock frequency, the power output stage generates a PWM signal that is fed into the solenoid. The solenoid current is recorded and in the current controller (11) compared with the actuating variable and the difference is compensated.

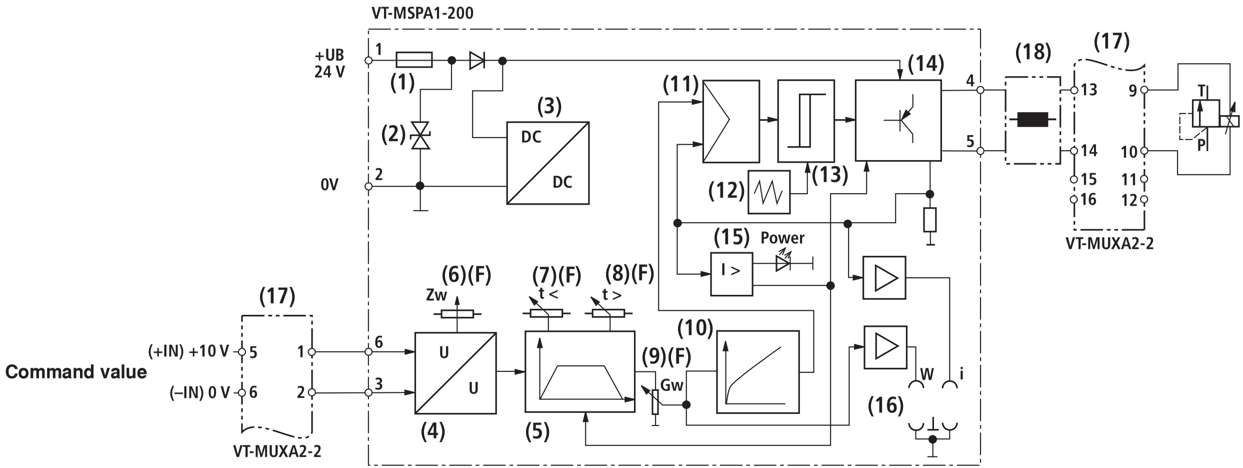
Fault detection (15)

Monitors the solenoid lines with regard to cable break and short circuit as well as overcurrent of the output stage. If there is an error, the green Ready for operation display goes out.

Monitoring and limitation of the solenoid current (17)

The VT MUXA2-2 module provides for the monitoring and limitation of the solenoid current. The functioning is described in data sheet 30290.

Block diagram



(1)	Fuse
(2)	Suppressor diode
(3)	Power supply
(4)	Command value input
(5)	Ramp generator
(6)	Potentiometer zero point
(7)	Potentiometer ramp up
(8)	Potentiometer ramp down
(9)	Potentiometer I_{max}
(10)	Linearization
(11)	Current controller
(12)	Oscillator
(13)	Schmitt trigger
(14)	Output stage
(15)	Fault recognition
(16)	Measuring socket
(F)	On front side
(17)	VT-MUXA2-2 monitoring module (order separately)
(18)	Ferrite sleeve (only included in the delivery of the monitoring module)

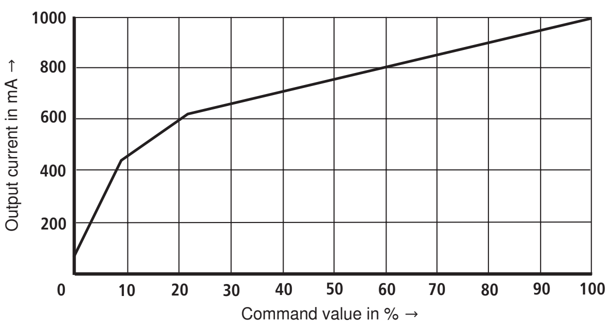
5

Technical Data (For applications outside these parameters, please consult us!)

Operating voltage	U_B	24 VDC +40 % –10 %
Operating range:		
– Upper limit value	$u_B(t)_{max}$	35 V
– Lower limit value	$u_B(t)_{min}$	21 V
Power consumption	P_{max}	< 50 VA
Current consumption	I_{max}	< 1.3 A
Fuse	I_s	Electronic overload protection and SMD fuse (soldered in)
Inputs:		
– Command value (differential input)	$U_{command}$	0 to +10 V; R_e = 100 kΩ
Outputs:		
– Solenoid current / resistance	I_{max}	1.0 A; R_{20} = 8.3 Ω
– Frequency	f	180 to 450 Hz
Setting ranges:		
– GW: Solenoid current	I	60 mA…1000 mA
– ZW: Zero point		±25 %
– t >: } Ramp – t <: }	t	60 ms…5 sec
Measuring sockets:		
– Command value "w"	U	0 to 10 V
– Actual current value "I"	U	1 mV ≙ 1 mA solenoid current
Type of connection		6 screw terminals
Mounting type		Top hat rail TH 3-7.5 according to EN 60715
Protection class		IP 20 according to EN 60529
Dimensions (W x H x D)		25 x 79 x 85.5 mm
Admissible operating temperature range	ϑ	0 to +50 °C
Storage temperature range	ϑ	–25 to +85 °C
Weight	m	0.15 kg

Note!
For information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30223-U.

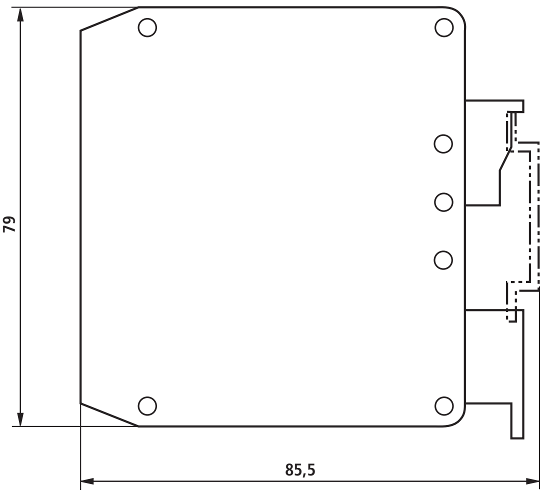
Output characteristic curve

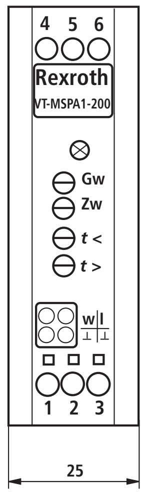


Terminal assignment

Terminal	
1	$+U_B$
2	Ground
3	$-U_{command}$
4	Solenoid +
5	Solenoid –
6	$+U_{command}$

Device view/unit dimensions (dimensions in mm)





Potentiometer:	"Gw"	Pressure command value
	"Zw"	Zero point
	"t <"	Ramp time up
	"t >"	Ramp time down
Sockets:	"w"	Pressure command value
	"I"	Actual current value
	"⊥"	Measurement null

Important notes

Explosion hazard caused by incorrect assembly!

For achieving the prescribed safety when operating the valve in the explosive area, it has to be ensure that the solenoid current does not exceed 1 A. For monitoring and limiting the valve current, we recommend using the Rexroth monitoring module VT-MUXA2-2. In this connection, observe data sheet 30290.

The VT-MSPA1-200 amplifier module and the VT-MUXA2-2 monitoring module may only be installed outside the explosive area!

The VT-MSPA1-200 amplifier module and the VT-MUXA2-2 monitoring module are not subject to the directive 94/9/EC (ATEX directive)!

More information:

- The amplifier module may only be wired when de-energized!
- Do not lay signal lines close to power cables and lines!
- Do not use free-wheeling diodes in the solenoid lines!
- The distance to aerial lines, radios, and radar systems has to be 1 m at least!
- Always shield command value lines, connect shielding to protective earthing (PE) on the module side!
  • Also shield the solenoid lines!
  • For solenoid lines up to 50 m in length, use the line type LiYCY 1.5 mm^2!
  • With greater lengths please consult us!
  • In applications in connection with the VT-MUXA2-2 monitoring module, please observe the wiring specified in the block diagram of data sheet 30290.
- For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents)!
- Only carry out measurements at the module using instruments with R_i > 100 kΩ.
- For setting the potentiometers, use a screwdriver with a blade width of 4 mm!
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of at least 2200 μF.
  Recommendation: Capacitor module VT 11110 (see data sheet 30750), sufficient for up to 3 amplifier modules

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Amplifier module for controlling [1] the explosion-proof proportional directional valves 4WRA...XE, 3DREP 6...XE and 4WRZ...XE

RE 30228-200/03.11 1/8
Replaces: 07.05

Type VT-MSPA2-200

Component series 1X

H 7282

Table of contents

Features

- Amplifier module is not subject to the directive 94/9/EC (ATEX directive)
- In connection with the Rexroth monitoring module [1] VT-MUXA2-2 suitable for controlling proportional directional valves without electric position feedback, types 4WRA...XE, 3DREP 6...XE and 4WRZ...XE
- Command value input ±10 V (differential input)
- Ramp generation with separately adjustable ramp time "up/down"
- Characteristic curve correction by means of separately adjustable step heights
- Release input
- Reverse polarity protection for the voltage supply
- Power supply with DC/DC converter without raised zero point for the internal supply
- LED displays: • Ready for operation (green)
  • Release (yellow)

[1] **For the operation of the valve in the explosive area, additional safety measures are required. Here, we recommend using the Rexroth monitoring module VT-MUXA2-2. In this connection, observe data sheet 30290.**

Ordering code

VT-MSPA2 – 200 – 1X / V0 / 0 | *

Analog amplifier in modular design

For controlling the explosion-protected valves 4WRA...XE (component series 2X), 3DREP 6...XE (component series 2X) and 4WRZ...XE (component series 7X) **= 200**

Component series 10 to 19 (10 to 19: Identical technical data and ports) **= 1X**

Further details in the plain text

0 = Basic version

V0 = Basic version

Functional description

General

The amplifier modules are snapped onto top hat rails according to EN 60715. The electrical connection is established via screw terminals. The modules are operated with 24 V direct voltage.

( ) = Assignment to the block diagram on page 3

Power supply unit (1)

The amplifier modules have a power supply unit with switch-on current limitation. This unit supplies all internally required positive and negative supply voltages. The switch-on current limitation prevents high switch-on current peaks.

Command value provision

The internal command value signal is generated from the external command value signal available at the differential input (2).

A positive command value results in a current increase in the "b" solenoid and thus a flow in the valve from P → A and from B → T.

A negative command value results in a current increase in the "a" solenoid and thus a flow in the valve from P → B and from A → T.

Release function (10)

The release function enables the power output stage and forwards the internal command value signal to the ramp generator. The release signal is displayed by an LED on the front plate. If the release is connected, the internal command value is changed (with any kind of command value specification) by the set ramp time. Thus, a controlled valve does not open abruptly.

Ramp generator (3)

The ramp generator limits the rise of the actuating variable. The downstream step functions do not extend or shorten the ramp time.

Notes for setting and measuring the ramp time:

Value at measuring socket "t <" or "t >"	U_t in V	5	3	2
current ramp time (±20 %)	t in ms	20	33	50

U_t in V	1	0.5	0.3	0.2	0.1	0.05	0.03	0.02
t in ms	100	200	333	500	1000	2000	3333	5000

The following applies:

$$t = \frac{100\ \text{Vms}}{U_t}$$

Example: Measured $U_t = 5$ V

Results in

$$t = \frac{100\ \text{Vms}}{5\ \text{V}} = 20\ \text{ms}$$

Characteristic curve generator (4)

Using the adjustable characteristic curve generator, the step height for positive and negative signals can be set separately, adjusted to the hydraulic requirements. The actual development of the characteristic curve through the zero point is not stepped but linear. (Characteristic curve see page 5)

Amplitude limiter (5)

The command value is limited to ca. ±110 % of the nominal range.

Current controller (6)

The current is controlled according to the command value.

Power output stage (7)

The power output stage creates the clocked solenoid current for the proportional valve. The rated solenoid current is 1000 mA per output. the output stage outputs are short-circuit-proof. The output stages are de-energized in case of an internal fault signal or if the release is missing.

Clock generator (8)

The clock generator creates the clock frequency f of the output stages.

f = 150 Hz … 400 Hz, adjustable by means of the potentiometer "f" (preset to 240 Hz)

Fault detection (10)

The solenoid line is monitored for cable break as well as overcurrent of the output stage.

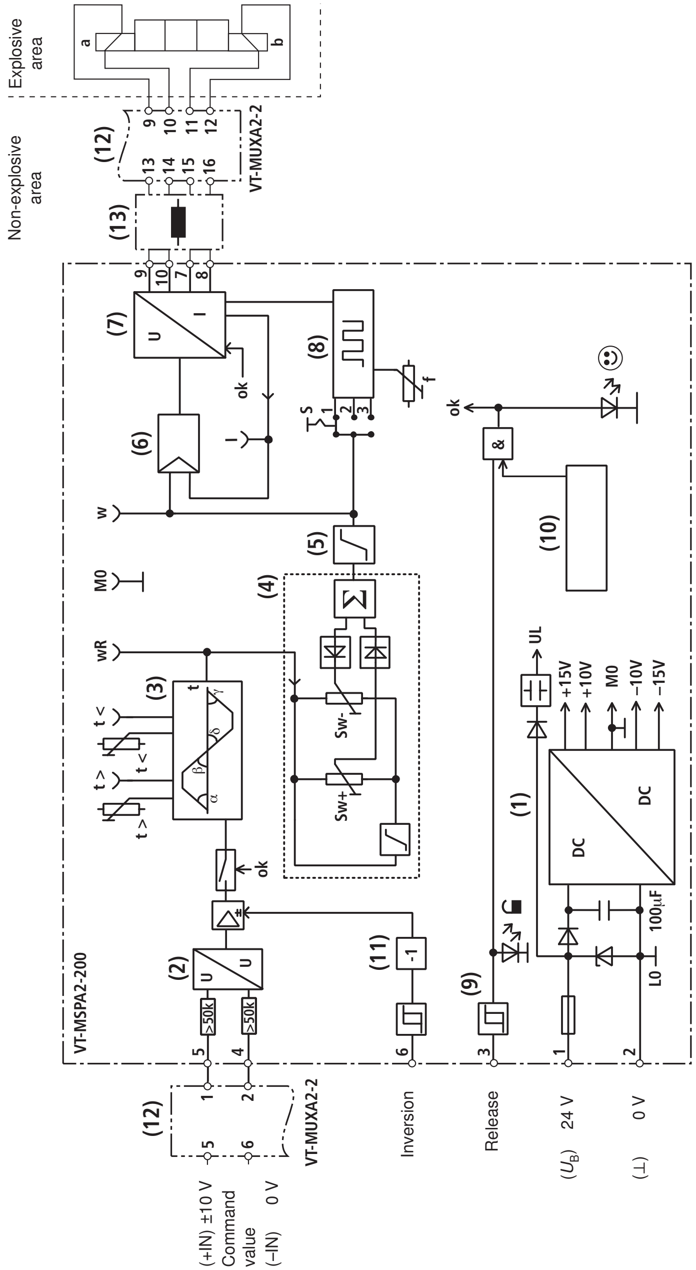
Command value inversion (11)

The command value created internally from the input signal and the zero point offset signal can be inverted by an external signal.

Monitoring and limitation of the solenoid current (12)

The VT MUXA2-2 module provides for the monitoring and limitation of the solenoid current. The functioning is described in data sheet 30290.

Block diagram



t > Ramp time "down"
t < Ramp time "up"
Sw Step height
w Command value
wR Command value after ramp

☺ Ready for operation
Release

(1) Power supply
(2) Differential amplifier
(3) Ramp generator
(4) Characteristic curve generator
(5) Amplitude limiter
(6) Current controller
(7) Power output stage
(8) Clock generator

(9) Release function
(10) Fault recognition
(11) Inversion
(12) Monitoring module VT-MUXA2-2 (order separately)
(13) Two ferrite sleeves (only included in the delivery of the monitoring module)

Technical Data (for applications outside these parameters, please consult us!)

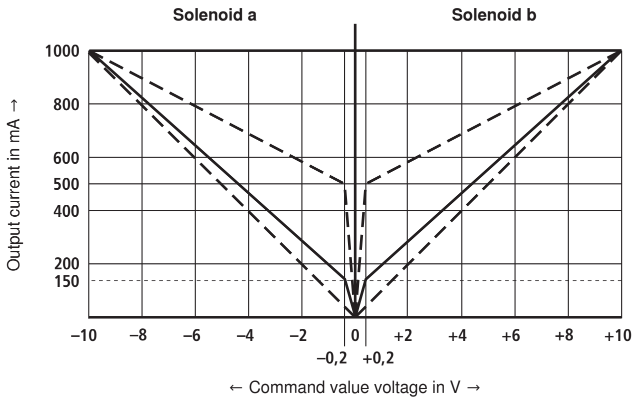
Operating voltage	Nominal value		U_B	24 VDC
	Maximum value		$u_B(t)_{max}$	35 V
	Minimum value		$u_B(t)_{min}$	18 V
Power consumption			P	< 24 VA
Current consumption			I	< 1 A
Fuse				Thermal overload protection (with restart if the value falls below the temperature threshold)
Inputs				
Analog	Command value (differential input)		U_e	0 … ±10 V; R_e > 50 kΩ
Digital	Release	ON	U	8.5 V … U_B; R_e > 100 kΩ
		OFF	U	0 … 6.5 V; R_e > 100 kΩ
	Inversion	ON	U	8.5 V … U_B; R_e > 100 kΩ
		OFF	U	0 … 6.5 V; R_e > 100 kΩ
Setting ranges				
Clock frequency			f	150 Hz … 400 Hz, adjustable, preset to 240 Hz
Ramp times (potentiometer "t <" and "t >")			$t <, t >$	20 ms…5 s
Step heights (potentiometer "Sw+" and "Sw–")				0 % … 50 %
Outputs				
Power output stages			I	0 … 1000 mA, short-circuit-proof; clocked
Measuring sockets	Ramp time "t <"		U	20 mV…5 V
	Ramp time "t >"		U	20 mV…5 V
	Actual value "I"		U	0 … ±1000 mV (measured value in mV $\triangleq$ solenoid current in mA)
	Command value "w"		U	0 … ±10 V
	Command value after ramp "wR"		U	0 … ±10 V
Type of connection				Screw terminals
Connection cross-section			A	0.5 … 2.5 mm^2
Mounting type				Top hat rail TH 35-7.5 according to EN 60715
Protection class				IP 20 according to EN 60529
Dimensions (W x H x D)				See unit dimensions
Admissible operating temperature range			ϑ	0 … +50 °C
Storage temperature range			ϑ	–25 °C … +70 °C
Weight			m	0.14 kg

Note!

For information on the environment simulation testing for the areas EMC (electromagnetic compatibility), climate and mechanical load, see data sheet 30228-U.

Characteristic curves

Dependency of the output current from the command value voltage

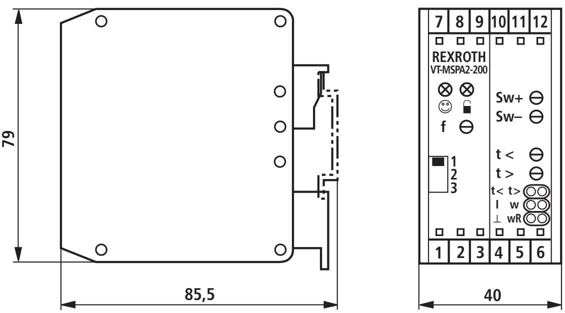


Setting range of the step height of the output current: 0 … 500 mA
Pre-setting ex works: 150 mA

Terminal assignment

Operating voltage	$+U_B$	1	7	Solenoid "b"
	0 V	2	8	
Release	U_F	3	9	Solenoid "a"
Command value input	0 V (–IN)	4	10	
	±10 V (+IN)	5	11	n.c.
	Inversion	6	12	n.c.

Device view / unit dimensions (dimensions in mm)



LED displays:

☺ Ready for operation (green)

🔓 Release (yellow)

Potentiometer:

Sw+ Step height for positive direction

Sw– Step height for negative direction

t < Ramp time for increasing command values

t > Ramp time for decreasing command values

f Frequency setting, 240 Hz pre-set,
150 Hz …400 Hz adjustable

Mode selector switch: without function

Measuring sockets:

t < Ramp time "up"

t > Ramp time "down"

I Actual current value

w Command value

wR Command value after ramp

⊥ Measurement null

Important notes / setting information

Explosion hazard caused by incorrect assembly!

For achieving the prescribed safety when operating the one of the specified valves in the explosive area, it has to be ensure that the solenoid current does not exceed 1 A. For monitoring and limiting the valve current, we recommend using the Rexroth monitoring module VT-MUXA2-2. In this connection, observe data sheet 30290.
The VT-MSPA2-200 amplifier module and the VT-MUXA2-2 monitoring module may only be installed outside the explosive area!

The VT-MSPA2-200 amplifier module and the VT-MUXA2-2 monitoring module are not subject to the directive 94/9/EC (ATEX directive)!

More information:

- The amplifier module may only be wired when de-energized!
- Do not lay signal lines close to power cables and lines!
- Do not use free-wheeling diodes in the solenoid lines!
- The distance to aerial lines, radios, and radar systems has to be 1 m at least!
- Always shield command value lines, connect shielding to protective earthing (PE) on the module side!
  • Also shield the solenoid lines!
  • For solenoid lines up to 50 m in length, use the line type LiYCY 1.5 mm^2!
  • With greater lengths please consult us!
  • In applications in connection with the VT-MUXA2-2 monitoring module, please observe the wiring specified in the block diagram of data sheet 30290.
- For switching command values, relays with gold-plated contacts have to be used (small voltages, low currents)!
- Only carry out measurements at the module using instruments with R_i > 100 kΩ.
- For setting the potentiometers, use a screwdriver with a blade width of 4 mm!
- With a strongly fluctuating operating voltage, it may in the individual case be necessary to use an external smoothing capacitor with a capacity of at least 2200 μF.
  Recommendation: Capacitor module VT 11110 (see data sheet 30750), sufficient for up to 3 amplifier modules
- In connection with the VT-MUXA2-2 monitoring module, the operating voltage has to be fed in via a capacitor module.
  The solenoid current connections to the VT-MUXA2-2 monitoring module must be led via ferrite sleeves. The ferrite sleeves are included in the scope of delivery of the VT-MUXA2-2 monitoring module.
- In the condition as supplied, the clock frequency is set to 240 Hz. Rotating the "f" potentiometer changes the valve hysteresis and may lead to disturbing noise developments.

Setting information

Prerequisite: The system-specific wiring must have been completed.

Signal	Setting
Ramp times:	– Set ramp time according to formula or table (see functional description "Ramp generator) and check it at the measuring sockets "t >" or "t <"
Step height:	– Apply the release signal – with an external command value provision of +0.3 V, set the measuring signal at "wR" to +0.3 V – using the "Sw+" potentiometer, set the necessary positive step height – with an external command value provision of –0,3 V, set the measuring signal at "wR" to –0,3 V – using the "Sw–" potentiometer, set the necessary negative step height Note: With an external command value provision, it must at least result in +0.3 V / –0.3 V at the "wR" measuring socket.
Clock frequency:	Condition as supplied: *f* = 240 Hz **Note:** The new setting of the frequency can be carried out with a digital multimeter that is able to measure frequencies. Measure at connection terminals 7 or 9 against 2 (ground).

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Notes

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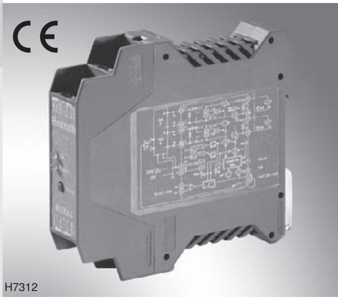
Module for monitoring and limiting the solenoid currents in proportional valves

RE 30290/02.11
Replaces: 11.09

Type VT-VT-MUXA2-2



Component series 1X
Maximum solenoid current 1.0 A

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Features

– Shut-off of the solenoid currents after exceedance of the admissible maximum current
– Additional, not safety-relevant command value correction prevents early switch-off of the solenoid currents
– Additional fuse protection for the solenoid circuits by means of non-exchangeable fuses 1.25 A, fast-acting according to IEC 60127-4
– Redundant relay contacts per solenoid circuit
– Redundant solenoid current measurement per solenoid circuit
– Protection against reversed polarity of the solenoid circuits
– Protection against reversed polarity of the operating voltage
– Reset input – edge-triggered
– Differential input
– Command value output
– OK output
– Top hat rail mounting
– Plug-in terminals

Use

The VT-MUXA2-2 module is able to monitor 1 or 2 solenoid circuits. The solenoid currents are limited so that there is no overheating of the solenoids. The solenoid currents necessary for operating the valve are provided by an amplifier (order separately).
The amplifier is adjusted according to the rated current data of the solenoid (rated current = 1.03 A). With a command value provision of 10 V, it provides an output current of 1.0 A.

In case of defect or incorrect operation, the amplifier may provide a current of more than 1.0 A. The interconnected VT-MUXA2-2 monitoring module recognizes the over-current, reduces the command value or switches off the solenoid current.

The VT-MUXA2-2 monitoring module must be protected against voltage peaks from the 24 V mains. Our VT 11110 capacitor module protects from voltage peaks and smoothens the 24 V supply voltage.

Explosion hazard in case of incorrect assembly!

Please observe the following rules in any circumstance!

1. **The Rexroth electronics mentioned in this data sheet must be installed and operated outside the explosive area.**
2. **The VT-MUXA2-2 module must be switched between amplifier output and solenoids and between control output (command value provision by superior control) and amplifier input (see block diagram).**
3. **Only connect valve solenoids the maximum current of which complies with the monitoring current of the VT-MUXA2-2 monitoring module.**

Ordering code and scope of delivery

VT-MUXA	2	– 2	– 1X	/ V0	/ 1A	*

Analog module for monitoring solenoid coils

Monitoring for valves with one or two solenoids **= 2**

2 = Serial number (module type)

1X = Component series 10 to 19 (10 to 19: unchanged technical data and ports)

V0 = Standard version

1A = I_{max} = 1.0 A

* Further details in the plain text

Included in the delivery:

– One or two ferrite sleeves for lines between amplifier and monitoring module conducting solenoid current

Function

Power supply unit (1)

The internal power supply unit provides the internally required auxiliary voltages.
A green LED (power) shows that the power supply unit is working.

Power supply unit monitoring (2)

If the internal supply voltages are missing, this causes the relay switch-off via the NTF signal. Voltages without which the relays cannot be controlled are not monitored additionally.

Current measurement (3)

The solenoid currents I_A and I_B are in each case measured in the supply path and in the return path (AV, AR, BV, BR). Both measurement results are analyzed independent of each other. Against reverse polarity, protective diodes are provided.
The two currents I_A and I_B are added as neither each individual solenoid current nor the total of the currents must exceed the specific limit value.

Symmetry monitoring (4)

As the supply and return currents must be identical, the total currents are identical, as well. If there are deviations, e.g. in case of earth fault or faulty current measurement, the DI error signal for the relay switch-off is generated.

Correction signal generation (5)

The correction signals serve

a) As auxiliary signal for correcting (amount reduction) the command value forwarded to the amplifier as soon as the maximally admissible solenoid current is exceeded.

b) As auxiliary signal for switching off the solenoid circuits if measure a) is not effective.

Command value correction (6)

As long as the solenoid current is within the nominal range, the command value for the solenoid current coming from the control is forwarded to the valve amplifier without being influenced. If the maximally admissible current is exceeded, the command value amount is within few seconds reduced with a ramp-shaped development until the current reaches the limit value. Thus, an abrupt shut-off of the current is avoided. If the corrected command value reaches a value smaller than 50 % of the nominal value and the solenoid current is not reduced, there is a switch-off by the relay contacts. The command value correction is not structured in a redundant form. A circuit failure or an incorrect command value signal always results in the switch-off by the relay contacts if the solenoid current values are inadmissible.

Relay control (7)

The relays for switching the solenoid currents on and off all have own control electronics with DI, NTF inputs and the signals of the correction signal generation (5).

Shut-off

Shut-off is initiated in case the admissible maximum current is exceeded and as soon as at least one correction signal does not result in a current reduction or one of the redundant current measurements shows differences in the measurements (symmetry monitoring). Moreover, the relays remain switched off as long as after switch-on or reset, the self-test is executed.

Switch-on

The relays are always only switched-on after passed self-test.

Safety measures

- Power supply unit monitoring
- Redundant current measurement
- Symmetry monitoring of the current measurement
- Redundant correction signal generation
- Redundant relay control circuits and relays
- Relay with positively driven contacts
- Self-test.

Self-test (8)

The self-test is necessary as an occurred error has to be detected in the redundant monitoring functions. The command value correction circuit (6) is not checked by means of the self-test. The self-test is carried out after each operating voltage switch-on and each manual and each electronic reset of the electronics. The manually started self-test is performed after actuating the “S1” reset pushbutton. The electronic reset is performed by a positive edge at the 24 V reset input.

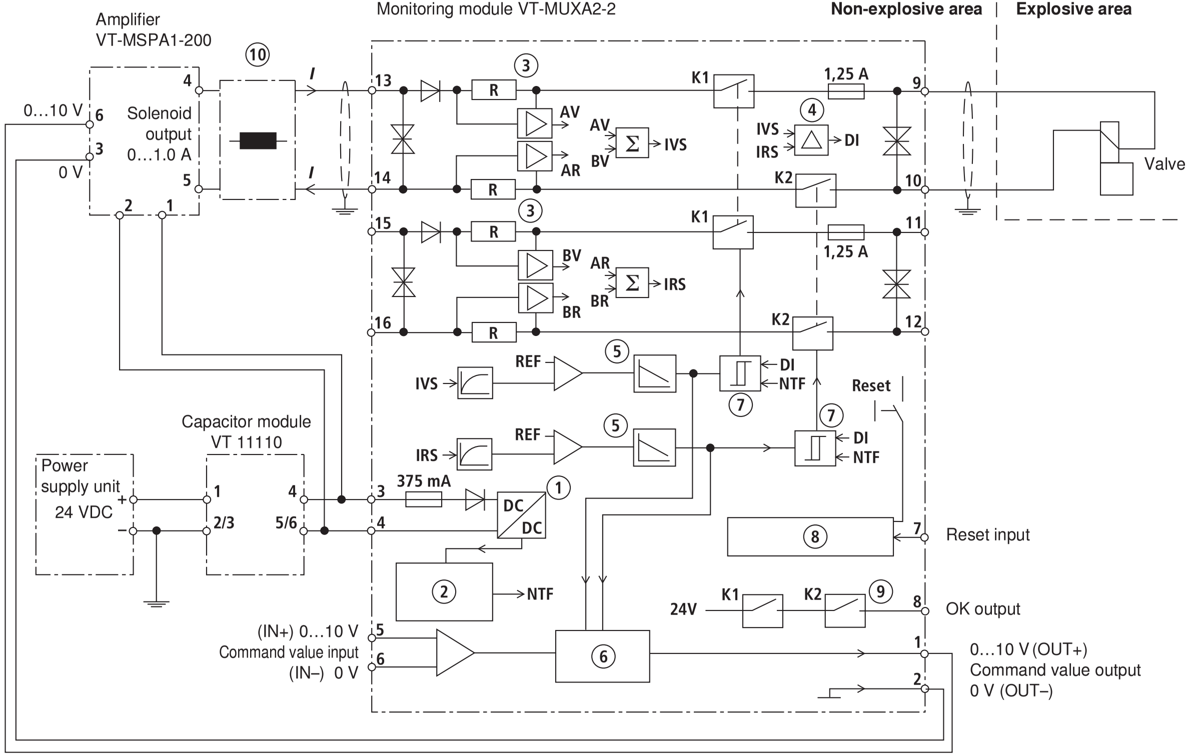
Unwanted movements of the system/machine are possible!

If the self-test is activated during operation, both relays are opened. Thus, the hydraulic function is considerably disturbed.
The function of the “S1” reset pushbutton can be suppressed by a 24 V signal at the reset input in order to prevent an accidental tripping.
So that the self-test for checking the VT-MUXA2-2 monitoring module can be performed, the 24 V signal must be removed again.

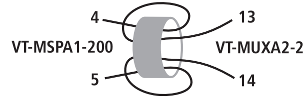
“OK” output (9)

As soon as the “Test OK” signal is set and both relays have switched, as well, this is signaled by a 24 V output signal and by the LED.

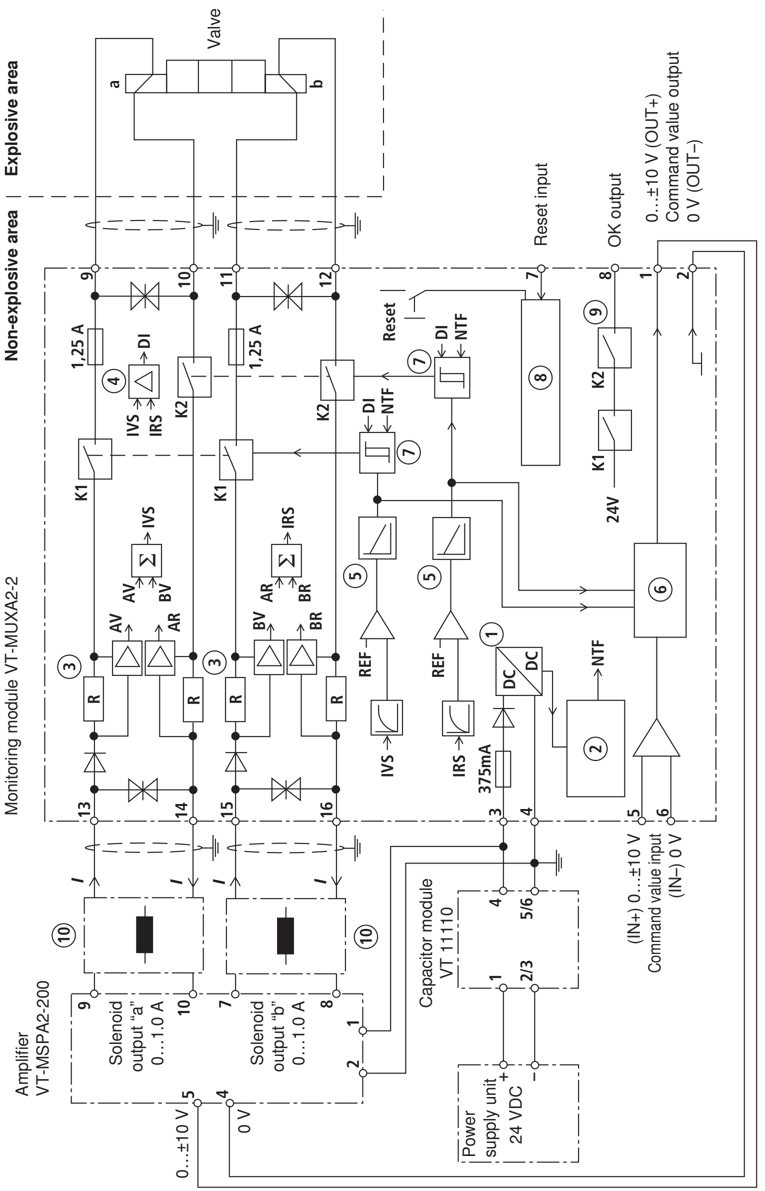
Block diagram VT-MUXA2-2 for one solenoid

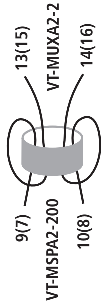


(1) Internal power supply unit
(2) Power supply unit monitoring
(3) Current measurement
(4) Symmetry monitoring
(5) Correction signal generation
(6) Command value correction
(7) Relay control
(8) Self-test
(9) OK output
(10) One ferrite sleeve connection like shown on the right



Block diagram VT-MUXA2-2 for two solenoids





(1) Internal power supply unit
(2) Power supply unit monitoring
(3) Current measurement
(4) Symmetry monitoring
(5) Correction signal generation
(6) Command value correction
(7) Relay control
(8) Self-test
(9) OK output
(10) Two ferrite sleeves connection like shown on the right

5

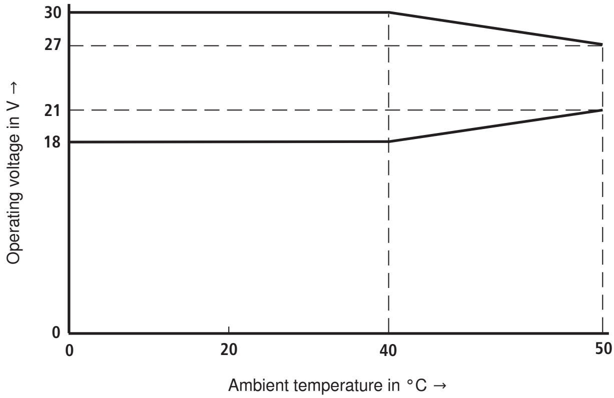
Technical data

Operating voltage	Nominal value	U_B	24 V DC
	Maximum value	$u(t)_{max}$	max. 30 V with 0 °C ≤ ϑ_U ≤ 40 °C [1]
	Minimum value	$u(t)_{min}$	min. 18 V with 0 °C ≤ ϑ_U ≤ 40 °C [1]
	Protection against reversed polarity		yes
Power consumption		P	< 5 VA
Current consumption		I	< 0.2 A
Fuses/short-circuit protection	1 or 2 fuses for the solenoid currents, not exchangeable	I	1.25 A fast-acting (SMD)
Display LEDs	OK	Green	Is illuminated if the self-test has been completed, the relays have operated and there is no error
	Power	Green	Is illuminated if the internal power supply unit works
Inputs	Command value differential input	U	0 … +10 V or 0 … ±10 V, R_i = 100 kΩ
	Reset input – Low – High	 U_R U_R	Edge-triggered, Low → High 0 … 6.5 V 10 V … U_B
	1 or 2 monitored solenoid current inputs – Admissible common-mode voltage – Protection against reversed polarity – Admissible clock frequency of the solenoid currents	 U Hz	 –2 V … U_B By means of diodes 0 … 500
Outputs	Command value output	U	0 … +10 V or 0 … ±10 V, I = 2 mA (command value provision to amplifier)
	2 solenoid current outputs	I	1.0 A (monitored to ±2 %)
	OK output: High = OK		U_B – 3 V / 50 mA, short-circuit protected
	OK output: Low = $\overline{\text{OK}}$		< 2 V, R_i = 10 kΩ
Clearances and creepage distances			According to EN 50178
Admissible degree of contamination			2 according to EN 60664
Type of connection			16-pin terminal housing with removable terminals
Connection cross-section		A	0.2 … 2.5 mm²
Mounting type			Top hat rail TH 35-7.5 according to EN 60715
Protection class			IP 20 according to EN 60529
Dimensions (W x H x D)			See unit dimensions on page 8
Operating temperature range		ϑ	0 … +50 °C [1]
Storage temperature range		ϑ	–25 … +85 °C
Weight		m	0.15 kg
Maximum admissible operating hours		h	40000

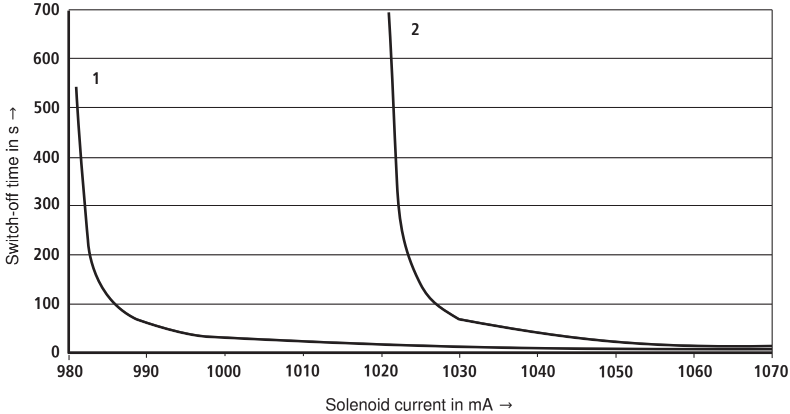
[1] See also derating characteristic curves on page 7

Characteristic curves

Temperature derating for the operating voltage



Switch-off behavior



1 and 2 are limit curves

Terminal assignment

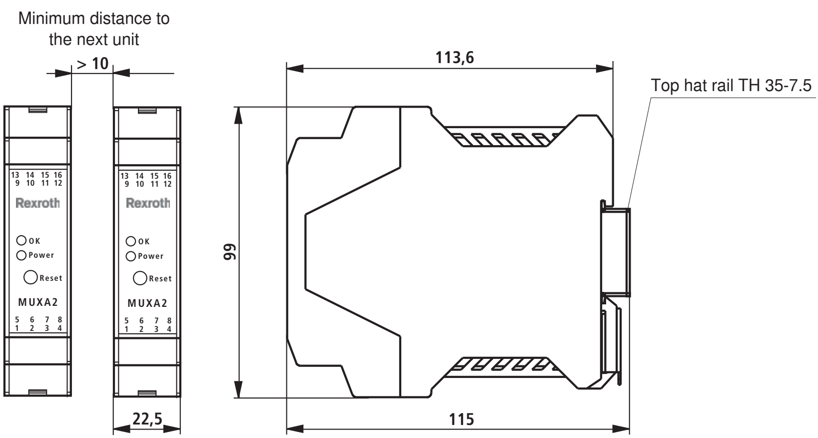
VT-MUXA2-2 for one solenoid

Terminal	Function	Terminal	Function
1	Command value output 0…10 V (OUT+)	9	Solenoid: "+" output
2	Command value output 0…0 V (OUT–)	10	Solenoid: "–" output
3	$+U_B$	11	Not connected!
4	Weight	12	Not connected!
5	Command value input 0…10 V (IN+)	13	Solenoid: "+" input
6	Command value input 0 V (IN–)	14	Solenoid: "–" input
7	Reset input	15	Not connected!
8	OK output	16	Not connected!

VT-MUXA2-2 for two solenoids

Terminal	Function	Terminal	Function
1	Command value output 0…±10 V (OUT+)	9	Solenoid a "+" output
2	Command value output 0…0 V (OUT–)	10	Solenoid a "–" output
3	$+U_B$	11	Solenoid b: "+" output
4	Weight	12	Solenoid b: "–" output
5	Command value input 0…±10 V (IN+)	13	Solenoid a "+" input
6	Command value input 0 V (IN–)	14	Solenoid a "–" input
7	Reset input	15	Solenoid b: "+" input
8	OK output	16	Solenoid b: "–" input

Installation conditions and unit dimensions



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Mobile Hydraulics

Designation	Type	Size	Component series	p_{max} in bar	Data sheet	Page
Control blocks						
Load-sensing control block in sandwich plate design	M4-12–XC, M4-12-XH	12	2X	350	64276-X-B2	731
Load-sensing control block in sandwich plate design	M4-15–XC, M4-15-XH	15	2X	350	64283-X-B2	759
Pumps						
Axial Piston Variable Pump A4VSO for Explosive Areas II 3G c T4	A4VSO...A	40 ...250	Baureihe 10, 11, 30	210	92050-X-B2	791

Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

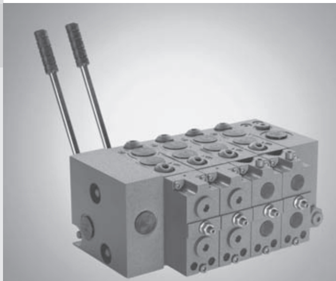
Rexroth
Bosch Group

Load sensing control block in sandwich-plate design

RE 64276-X-B2/05.2011 1/28
Replaces: 04.2009

Model M4-12-XC and M4-12-XH

Nominal size 12
Series 2X
Nominal pressure 350 bar (pump side)
Nominal pressure 420 bar (consumer side)
Maximum flow rate
– pump side: 200 l/min with central inlet element
150 l/min with lateral inlet element
– consumer side: 130 l/min with pressure compensator and load-holding function



HAD 7517

ATEX-devices
For potentially explosive atmospheres

Operating Instructions
Part II Technical Datasheet

Information about explosion protection:

Area of application according to Explosion Protection Directive 94/9/EC:

- IM2: Ignition protection type Ex ia I according to EN 60079-0: 2006 and EN 60079-11: 2007
- II2G: Ignition protection type Ex ia IIB T4 according to EN 60079-0: 2006 and EN 60079-11: 2007
- II2D: Ignition protection type Ex tD A21 IP67 T110 °C according to EN 61241-0: 2006 and EN 61241-1: 2004
- Ambient temperature range -20 °C ≤ T_a ≤ +80 °C

What you need to know about these Operating Instructions

These Operating Instructions apply to Rexroth explosion-proof valves and consist of the following three parts:

Part I	General Information RE 07010-X-B1	
Part II	Technical Datasheet RE 64276-X-B2	**Mat.-No. R901219571**
Part III	Product-specific Instructions RE 64276-X-B3	

For further information on the correct use of Rexroth hydraulic products please refer to our publication entitled *General product information on hydraulic products, RE 07008.*

Table of contents

Characteristics

System
– Load-pressure independent flow rate control
  • Open Center for fixed displacement pump
  • Closed Center for variable displacement pump

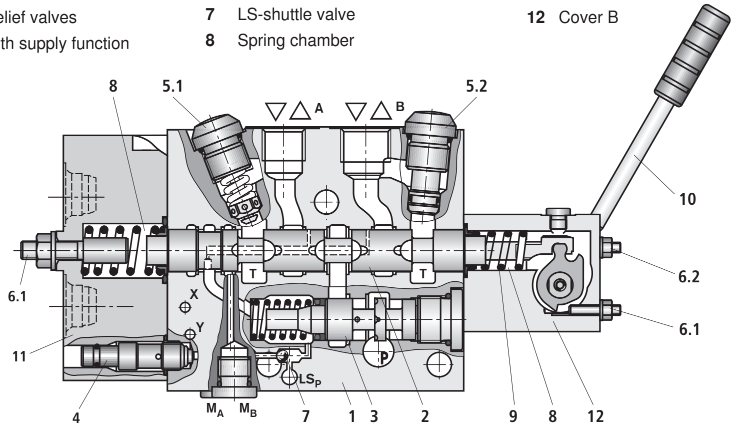
Construction
– Sandwich-plate design
  • Inlet element
  • up to 10 directional valve elements, of which max. 6 with servo control
  • up to 20 directional valve elements with central-inlet element, of which max. 6 with servo control
  • End element
– Actuation types
  • mechanical (hand lever)
  • hydraulic
  • servo-hydraulic

Flow rate
– load pressure compensated
– high repeating accuracy
– low hysteresis

Pressure limitation
– Inlet element
  • pilot-operated pressure valves with large nominal width
– Directional valve element / consumer ports
  • compact relief valve with supply function
– LS pressure limitation
  • selectable pressure setting per consumer port on request (design by technical sales)

Function, section

1 Housing
2 Main spool
3 Pressure compensator
4 LS pressure-relief valves
5.1 Relief valve with supply function
5.2 Screw cap
6.1 Travel limitation A-side
6.2 Travel limitation B-side
7 LS-shuttle valve
8 Spring chamber
9 Compression spring
10 Hand lever
11 Cover A
12 Cover B



Control block M4-12

The directional control valves are proportional valves in accordance with the load-sensing principle.

Consumer activation

The flow direction and the size of the flow rate reaching the consumer ports (A or B) are determined at the main spool (**2**).

External pilot units control the position of the main spool (**2**). The extent of the control pressure in the spring chambers (**8**) determines the travel of the main spool (P → A; P → B).

The pressure difference at the main spool (**2**) and therefore also the flow rate to the consumer is kept constant via the pressure compensator (**3**).

Load pressure compensation

Pressure changes at the consumers or the pump are compensated respectively by the pressure compensator (**3**). The flow rate to the consumer remains constant even under different loads.

Flow rate limitation

The maximum flow rate can be individually limited from the works to order specifications by means of travel stops (**6**).

Pressure limitation

The manipulation of the LS pressure of each consumer port can take place internally via the LS pressure relief valves (**4**) or externally via the LS ports M_A, M_B.

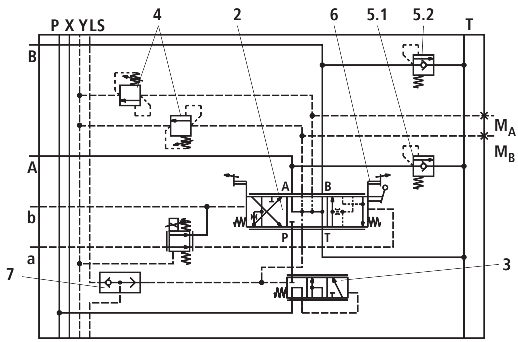
Relief valves with large nominal widths with combined supply function (**5**) protect consumer ports A and B from pressure peaks.

The highest load pressure is signalled to the pump via the LS line and the integrated shuttle valves (**7**).

Symbol

Connections:

P	Pump
A, B	Consumer
T	Tank
X	Control oil supply
Y	Control oil drain
LS	Load sensing (LS)
M_A, M_B	external LS-ports



Technical data (please ask in case of applications outside the stated values!)

general

Mounting orientation				any
Type of port				Pipe thread according to ISO 228/1
Mass	Inlet element	Closed Center J	kg	4,3
		Open Center P	kg	6,0
	Central inlet element Closed Center JZ		kg	8,4
	Directional valve element, mechanical		kg	6.9
	Directional valve element, hydraulic		kg	5,4
	Additional weight hand lever		kg	1.5
	End element		kg	2,6
Surface protection				Paint
Ambient temperature range		ϑ	°C	–20 to +80

mechanical

Actuating force at hand lever	N	< 20

hydraulic

Flow rate	Port P	q_{Vmax}	l/min	200 with central inlet element
			l/min	150 with lateral inlet element
	Port A, B	q_{Vmax}	l/min	130 with pressure compensator and load-holding function
Nominal pressure		p_{nom}	bar	350
max. operating pressure at port	P	p	bar	350
	A / B	p	bar	420
	LS	p	bar	330
	T	p	bar	30
	Y	p	bar	depressurized to tank
max. control pressure at port	X	p	bar	35
	a, b	p	bar	35
Control pressure range	hydraulic	p	bar	8.5 to 22.5
required regulating-Δp at control block [1]	Model S	p	bar	18
Primary pressure limitation		p	bar	max. 370 (set at the works to order specifications), min. 20 bar above the pressure cut-off value of the pump
LS pressure limitation		p	bar	50 to 330 (adjusted at the works to order specifications). The highest relief pressure for the LS pressure relief valves of the valve manifold set at the works must be at least 20 bar lower than the pressure cut-off value of the pump.
Hydraulic fluid				Mineral oil (HL, HLP) to DIN 51524, other hydraulic fluids on request, ignition temperature > 190 °C
Temperature range of hydraulic fluid		ϑ	°C	–20 to +80
Viscosity range	hydraulic	ν	mm²/s	10 to 380
	servo-hydraulic	ν	mm²/s	16 to 200 [2]
maximum permitted contamination level of hydraulic fluid Purity class to ISO 4406 (c)				Class 20/18/15, we recommend for this a filter with a minimum retention rate of $\beta_{10} \geq 75$

Information about explosion protection

Protection class in accordance with Directive 94/9/EC		IM2	II2G	II2D
max. surface temperature		–	T4	110 °C
Explosion protection type valve	structural safety XC	c (EN 13463-5)		
	fail-safe XH	EN 60079-0, EN 60079-11	EN 60079-0, EN 60079-11	EN 61241-0, EN 61241-1

☞ **Note!** The technical data has been established at a viscosity of ν = 30 mm²/s (HLP46: 50 °C).

[1] *Observe the design information for control oil supply with servo-hydraulic operation on page 14.*

[2] Between 200 and 380 mm²/s reduced maximum quantity.

Technical Data STDS 0014-1X

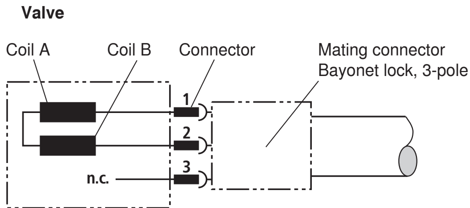
electric			
Protection class according to EN 60529:1991+A1:2000			IP 67 with mating connector correctly mounted and locked
Type of signal			Direct current analogue
Rated current		mA	20
Resistance per coil (Total)		Ω	135 (270)
Inductivity (Connection in series)		H	1.7
Connector (Bayonet lock)			3-pole

Information on explosion protection			
Type examination certificate			BVS 08 ATEX E031
Protection class according to directive 94/9/EC			IM2
Type of protection according to EN 60079-0:2006, EN 60079-11:2007			Ex ia I
Ambient temperature range		°C	$-20 \leq T_a \leq +100$
The electric actuation must be realized from intrinsically safe electrical circuits with the following maximum values	U_{max}	V	17.5
	I_{max}	mA	150
	P_{max}	mW	657

⚠ **WARNING – Risk of explosion**

- The connection with other devices must be checked separately.
- As soon as the valve has been operated with higher electric power than the one specified above, it must no longer be used in explosive areas.

Electrical connection



Mating connector, bayonet lock, 3-pole:
Type: 845-11-1325-001, company Souriau

Relating mating connector see data sheet of the company Souriau, series 845.
The servo valve may only be supplied through these mating connectors.

Technical Data STDS 0015-1X

electric				
Protection class according to	DIN 40050-9:1993 EN 60529:1991+A1:2000		IP 69K IP 67	with mating connector correctly mounted and locked
Type of signal			Direct current analogue	
Rated current		mA	20	
Resistance per coil (Total)		Ω	135 (270)	
Inductivity (Connection in series)		H	1.7	
Connector (Compatible with MS 3102 C14S-2P)			4-pole	

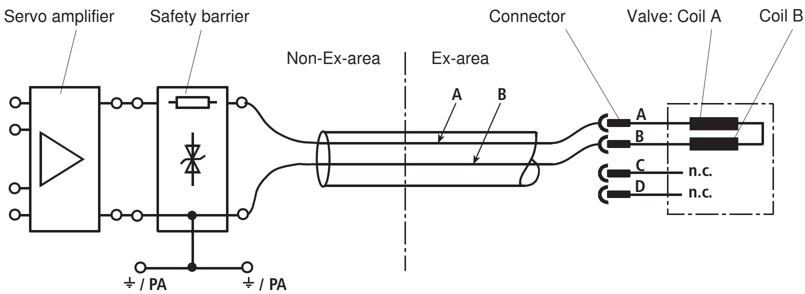
Information on explosion protection			
Type examination certificate			PTB 05 ATEX 2058
Protection class according to directive 94/9/EC			II2G, II2D
Type of protection according to EN 60079-0:2006, EN 60079-11:2007			Ex ia IIB T4
Type of protection according to EN 61241-0:2006 and EN 61241:2004			Ex tD A21 IP67 T110 °C
Maximum surface temperature [2]		°C	110
Ambient temperature range		°C	–20 ≤ T_a ≤ +100
Hydraulic fluid temperature range		°C	–20 … +100
Maximum values for supply circuits	U_{max}	V	17,5
	I_{max}	mA	150
	P_{max}	mW	657
Important: In case of use in II2G, the valve may only be supplied electrically from certified, intrinsically safe electrical circuits Recommended safety barrier [1]		Single-channel	e.g. company Stahl, type 9001/02-133-150-101 or 9001/02-175-100-101

[1] Only necessary with II2G, separate order

[2] Surface temperature > 50 °C, provide contact protection

Electrical connection

The electrical actuation with plus (+) to A and minus (–) to B provides for pressure at port A > pressure at port B and/or flow from P to A and B to T. Pins C and D on the connector are not connected.



Important:

– In case of use in II2D, the safety barrier is not necessary.

– In case of use in II2D, the mating connector must meet the requirements according to EN 61241-0:2006.

Modular structure: Control block with lateral inlet element

Control blocks from series M4-12 are of modular construction. They can be optimally assembled for the respective application.

1. Inlet element
- A: Open Center "P"
- B: Closed Center "J"

2. Directional valve elements

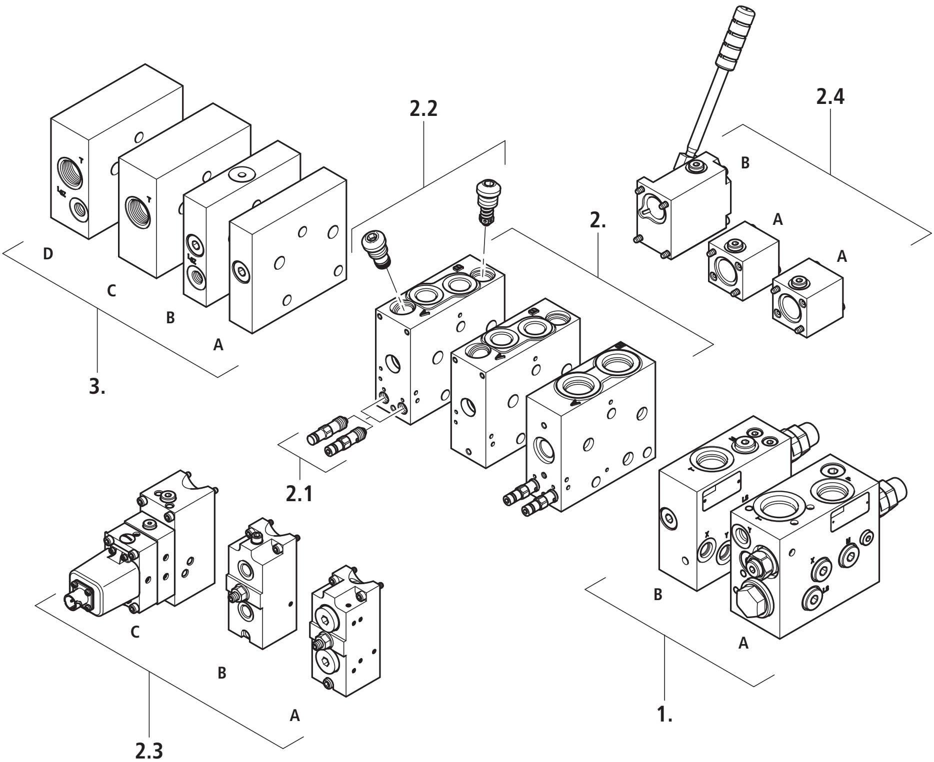
2.1 LS pressure limitation

2.2 Secondary valves

2.3 Actuation of cover, A-side
- A: Mechanical actuation "M"
- B: Hydraulic actuation "H"
- C: Servo-hydraulic actuation "S"

2.4 Actuation of cover, B-side
- A: Standard cover "–"
- B: Mechanical actuation "G2" with hand lever

3. End element
- A: With LS relief "LA", "LAK"
- B: With LS connection "LZ", "LZK"
- C: LA with additional P and T port "LAPT"
- D: LZ with additional P and T port "LZPT"



Modular structure: Control block with central inlet element

1. **Central inlet element "JZ"**
2. **Directional valve elements**

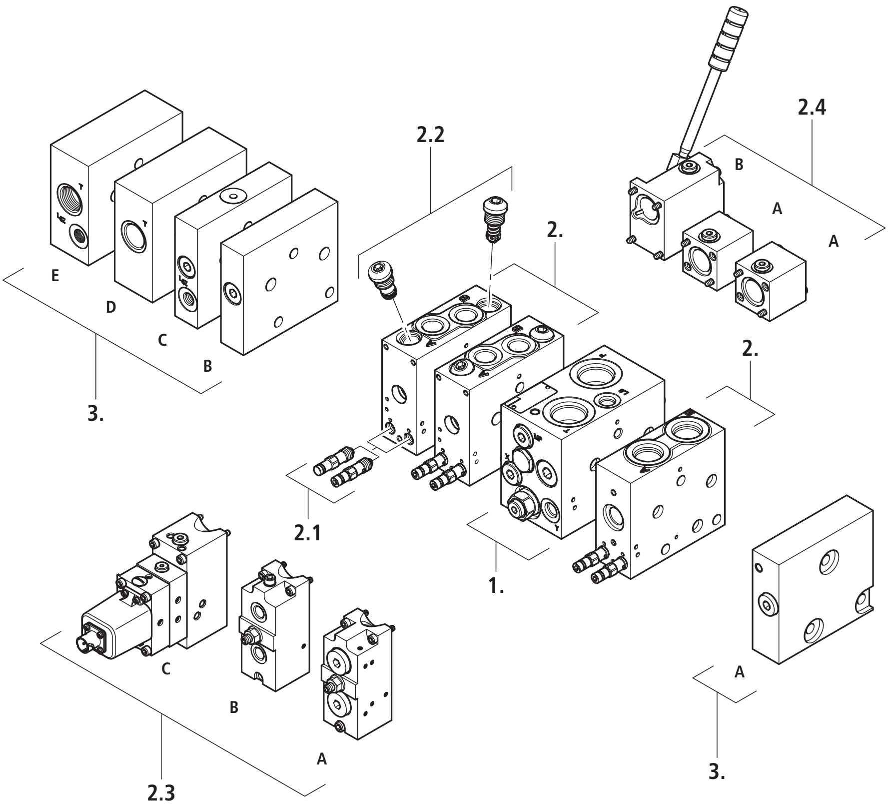
2.1 LS pressure limitation

2.2 Secondary valves

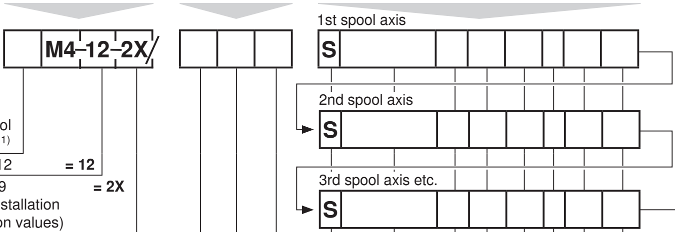
2.3 Actuation of cover, A-side
- A: Mechanical actuation "M"
- B: Hydraulic actuation "H"
- C: Servo-hydraulic actuation "S"

2.4 Actuation of cover, B-side
- A: Standard cover "–"
- B: Mechanical actuation "G2" with hand lever

3. **End element**
- A: Deflection plate "LU"
- B: With LS relief "LA", "LAK"
- C: With LS connection "LZ", "LZK"
- D: LA with additional P and T port "LAPT"
- E: LZ with additional P and T port "LZPT"



Ordering details



Continuation page 11

Number of directional control valves 1 to 20 [1]	
Nominal size 12	= 12
Series 20 to 29 (unchanged installation and connection values)	= 2X
Closed Center, lateral	= J
Open Center, lateral	= P
Closed Center, central	= JZ
with primary pressure-relief valve (pressure in bar, 3-digit)	= …

Control oil supply

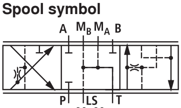
with internal control oil supply [2]	= Y
for external control oil supply	= X
with pressure compensator, **with** load-holding function	= S

LS valve

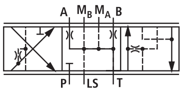
with LS-pressure-relief valve (pressure in bar, 3-digit) (no **Z** possible)	= …	M	…
with LS-DB-screw cap (no **Z** possible)	= Q	M	Q
without LS-pressure-relief valve (LS-DB cannot be retrofitted) (no **M** possible)	= Z	Z	Z

Housing **with** test ports	= M
Housing **without** test ports	= Z

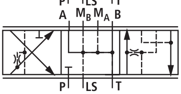
Spool symbol



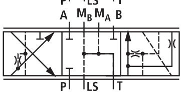
= E



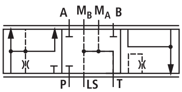
= Q



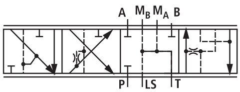
= J



= R



= P



= W

Flow rate in l/min, 3-digit, e.g. 070-070; consumer port "A" and "B"	= … – …

Actuation of cover, A-side

mechanical [3]	= M
hydraulic [4]	= H
servo-hydraulic [4); 7)]	= S

Secondary valves

H …	=	Relief/supply valve, not adjustable
Q	=	Screw cap (secondary valve can be retrofitted) [6]
Z	=	G 3/4 without secondary valve (cannot be retrofitted) [6]
X	=	G 1/2 without secondary valve (cannot be retrofitted) [6]

Actuation of cover, B-side

	Hand lever position		
Standard cover	–		
Actuation with hand lever [5]	60°	0°	-60°
Hand lever, rotating (clamping piece with lever)	B	F	D
Hand lever, rotating (clamping piece without lever)	T	U	V
Hand lever, non-rotating (clamping piece with lever)	G	H	J
Hand lever, non-rotating (clamping piece without lever)	Q	S	C

[1] Max. 10 elements per side, of which max. 6 with servo-hydraulic control.

[2] Only in conjunction with J.

[3] Always in conjunction with rotating hand lever.

[4] Not in conjunction with rotating hand lever.

[5] For additional constructions and explanations see page 22.

[6] Secondary valves must be present in the hydraulic operating circuit.

[7] For details concerning control oil supply see page 14.

Ordering details

End element	Additional information				
		01			*

*	more details in plain text
	Protection class
IM2 =	Protection class IM2
II2GD =	Protection class II2GD
	Ignition protection type
XC =	Structural safety [9]
XH =	fail-safe
	Connections
01 =	Pipe thread according to ISO 228/1
	Seal material
V =	FKM seals [8]
M =	NBR seals (only on request)
	End element
LA =	End element without connections, **with** internal LS relief
LAPT =	End element LA with additional P and T port
LAK =	End element LA with internal control oil supply for servo-hydraulic actuation [7]
LZ =	End element with LS connection, **without** internal LS relief
LZPT =	End element LZ with additional P and T port
LZK =	End element LZ with internal control oil supply for servo-hydraulic actuation [7]
LU =	End element for use with central inlet element

Type code

Entire control blocks are defined according to the type code. The order text is intended for the definition of the technical characteristics and requirements. A type code and a material number are derived from the order text by the Bosch Rexroth sales organisation.

Example of a type code of an M4-12 control block with three directional valve elements:

M4 – 7654 – 2 0 / 3 M4 – 12 J H – V 01 XH IM2

7654	Control block no.
2	Unit series of production series (2 X)
0	Modification status of the series
3	Number of directional valve elements
J	Inlet
H	Actuation A-side (predominant actuation)
–	Actuation B-side (predominant actuation)
V	Seal material
01	Threaded connection
XH	Ignition protection type: fail-safe
IM2	Protection class: IM2

[7] For details concerning control oil supply see *page 14.*

[8] The block preferably contains FKM, but also NBR seals. Make sure that the seal is suitable for the hydraulic fluid used!

[9] Always in conjunction with protection class IM2.

6

Ordering example for Closed Center with lateral inlet element

Example:
- Triple control block
- Variable-displacement pump
  q_{Vmax} = 150 l/min

Number of directional control valves, inlet element
- Closed Center with primary pressure-relief valve at the side, set to 250 bar, for external control oil supply

Directional valve elements

1st spool axis
- with pressure compensator, with load retaining function
- without LS pressure relief valve hole
- Spool symbol J, flow rate in A and B 100 l/min
- Actuation: hydraulic
- Secondary valve holes closed

2nd spool axis
- with pressure compensator, with load retaining function
- with LS pressure relief valve for consumer port A and B 180 bar
- Spool symbol J, flow rate in A and B 85 l/min
- Actuation: hydraulic
- Secondary valves: relief/supply valves, consumer port A and B 350 bar (not adjustable)

3rd spool axis
- with pressure compensator, with load-holding function
- with LS pressure relief valve for consumer port 180 bar, consumer port B 120 bar
- Spool symbol J, flow rate in A and B 85 l/min
- Actuation: mechanical
- Hand lever actuation (up)
- Secondary valves: relief/supply valves, consumer port A and B 350 bar (not adjustable)

End element
- with internal LS relief

Additional information
- FKM seals
- Pipe thread connections
- Ignition protection type: structural safety
- Protection class: IM2

Ordering details:

3	M4 –	12 –	2X /	J250X

1st spool axis

S	Z Z Z	J	100-100	H	–	Q	Q

2nd spool axis

S	180M180	J	085-085	H	–	H350	H350

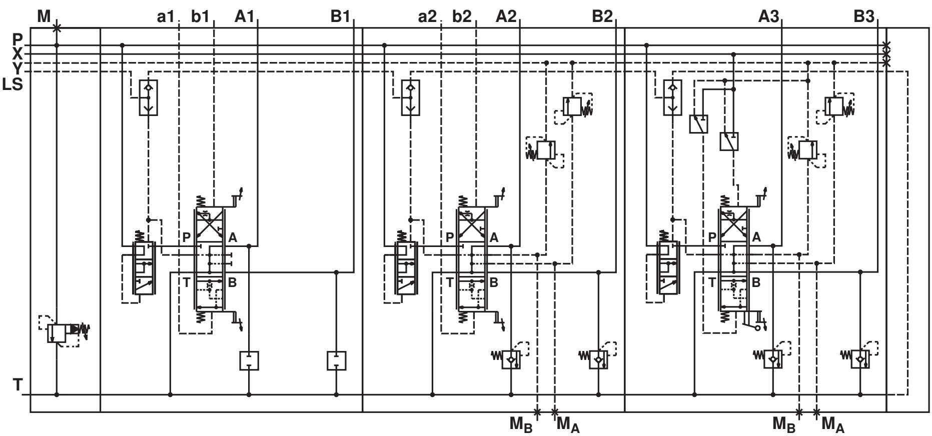
3rd spool axis

S	180M120	J	085-085	M	B2	H350	H350

End element

LA

V	01	XC	IM2



Ordering example for Closed Center for central inlet with primary valve

Example:
- Double control block
- Variable-displacement pump q_{Vmax} = 200 l/min

Number of directional control valves, end element
- Deflection plate

Directional valve element
1st spool axis
- with pressure compensator, with load-holding function
- with LS pressure relief valves, consumer port A 270 bar, consumer port B 300 bar
- Spool symbol E, flow rate in A and B 100 l/min
- Actuation: mechanical
- Hand lever actuation (up)
- Secondary valve holes closed

Inlet element
- Primary pressure relief valve set to 350 bar
- for external control oil supply

Directional valve element
2nd spool axis
- with pressure compensator, with load-holding function
- without LS pressure-relief valves, cannot be retrofitted
- Spool symbol J, flow rate in A and B 90 l/min
- Actuation: servo-hydraulic
- without secondary valve holes

End element
- with LS connection
- with additional P and T port

Additional information
- FKM seals
- Pipe thread connections
- Ignition protection type: fail-safe
- Protection class IM2, e.g. for coal mining

Ordering details:

2	M4 – 12 – 2X / LU

1st spool axis

S	270M300	E	100-100	M	B2	Q	Q

Inlet element

JZ	350	X

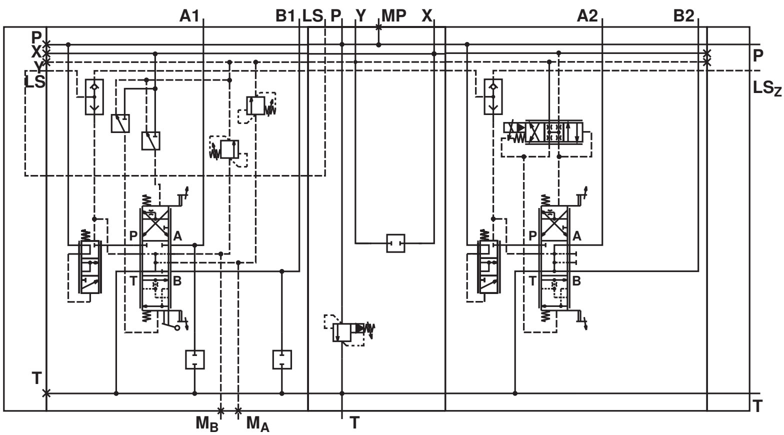
2nd spool axis

S	Z Z Z	J	090-090	S	–	Z	Z

End element

LZPT

V	01	XH	IM2

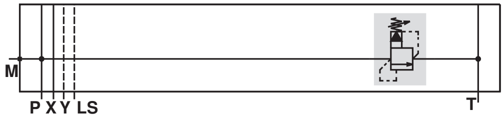


Inlet elements Closed Center (J)

With primary pressure-relief valve, for external control oil supply

Ordering details:

M4 – 12 – 2X /	J	…	X

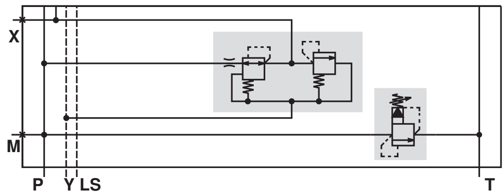


Brief description
- For variable displacement pumps up to 150 l/min
- Pressure in bar behind J… required (3-digit)

With primary pressure-relief valve, with internal control oil supply

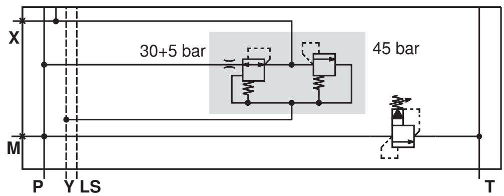
Ordering details:

M4 – 12 – 2X /	J	…	Y



Brief description
- For variable displacement pumps up to 150 l/min
- Pressure in bar behind J… required (3-digit)

Control oil supply (Y)
- Pressure limitation 45 bar
- Control pressure max. 30 +5 bar



⚠ Caution!

Control oil can also be supplied for other consumers via the X port. This can affect the switching times on the M4-12. Contact the technical sales department concerning the potential effects.

The "X" port is generally not closed for external control oil supply. It must be closed when not in use (e.g. during hydraulic actuation "H").

Design information for control oil supply with servo-hydraulic operation

If a servo-hydraulic actuation is used in the control block, please observe the following:

External control oil supply:
- p_{st} = 30 +2 bar constant
- q_{st} = 2 l/min per servo-hydraulic spool axis
- Imperative for inlet element P

Internal control oil supply:
- Maximum 6 servo-hydraulically controlled spool axes possible
- No control oil supply for external consumers
- Δp on the inlet element must be at least 35 bar
- No internal control oil supply in the inlet element

Central inlet elements Closed Center (JZ)

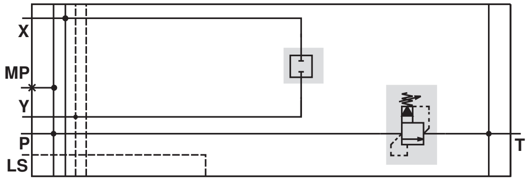
With primary pressure-relief valve, for external control oil supply

Ordering details:

M4 – 12 – 2X /	JZ	…	X

Brief description

– For variable displacement pumps up to 200 l/min
– Pressure in bar behind JZ… required (3-digit)



With primary pressure-relief valve, with internal control oil supply

Ordering details:

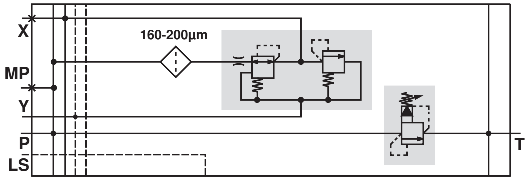
M4 – 12 – 2X /	JZ	…	Y

Brief description

– For variable displacement pumps up to 200 l/min
– Pressure in bar behind JZ… required (3-digit)

⚠ **Caution!**

Observe the design information for control oil supply with servo-hydraulic operation on page 14.



Inlet elements Open Center (P)

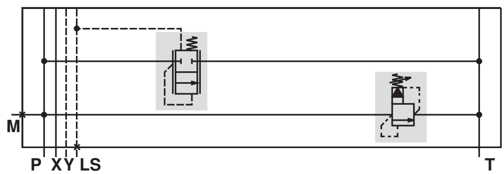
With primary pressure-relief valve, for external control oil supply

Ordering details:

M4 – 12 – 2X /	P	…	X

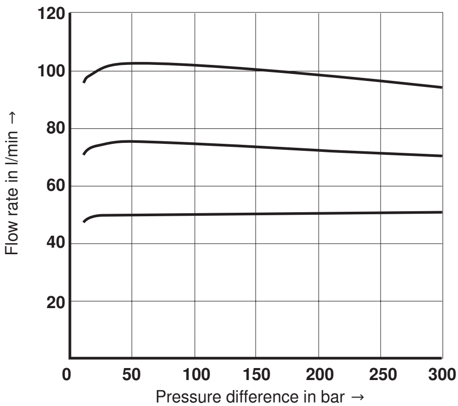
Brief description

– For fixed displacement pumps up to 150 l/min
– Pressure in bar behind P… required (3-digit)



Directional valve elements: pressure compensator

Flow rate regulation via pressure compensator



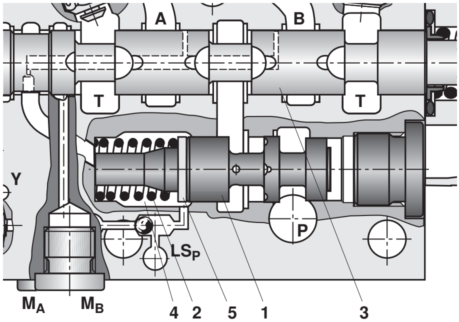
When the main spool is in the center position there is no connection from P to consumer ports A and B. In this operating status, the pressure compensator spool (**1**) is displaced to the left against the spring (**2**) by means of the pump pressure.

When the main spool (**3**) (= orifice) is actuated, the LS pressure enters the spring chamber (**4**) and pushes the pressure compensator spool to the right into the adjustment position. The flow rate is kept constant even in case of parallel operation
of consumers with different load pressures.

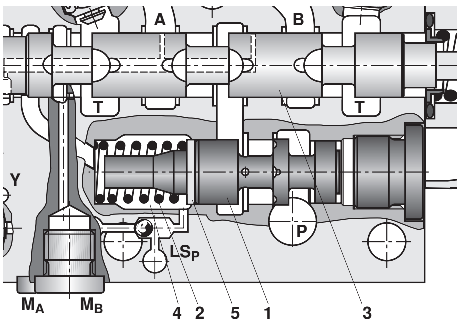
The pressure compensator "S" is equipped with a load-holding function. This operation is not leakage oil free.

It is fitted with a ring (**5**) as standard. The number of rings inserted is dependent on the desired flow rate.

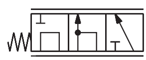
Main spool in center position



Main spool actuated



Pressure compensator spool variants

Ordering details:	Brief description	Symbol
S	– with pressure compensator – with load-holding function [1] – max. flow rate 130 l/min	

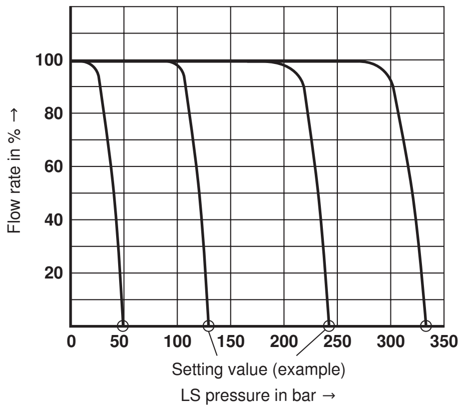
[1] The load-holding function is not leakage oil free.

Directional valve elements: LS pressure limitation

Characteristic curves

Reduction of consumer flow rate by LS pressure limitation

Minimum setting value: 50 bar
Maximum setting value: 330 bar



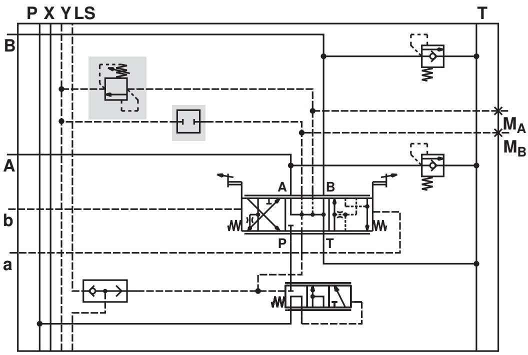
With LS pressure-relief valve and LS screw cap

Ordering details:

S	… M Q	J	…–…	H	–	H…	H…

Brief description

- Pressure in bar for consumer port A (3-digit)
- Screw cap for consumer port B
- The LS pressure limitation on the directional valve element can be retrofitted for the "QMQ" model.
- The LS pressure can be externally influenced via ports M_A and M_B. These ports can also be used as test ports.



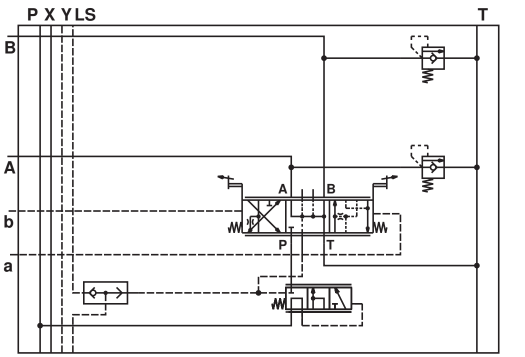
Without LS pressure-relief valves

Ordering details:

S	Z Z Z	J	…–…	H	–	H…	H…

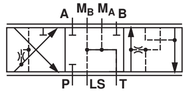
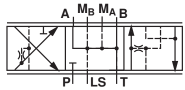
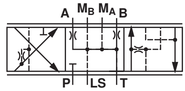
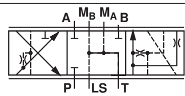
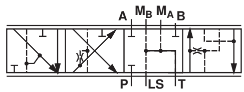
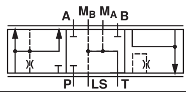
Brief description

- LS-DB cannot be retrofitted
- Housing without test ports

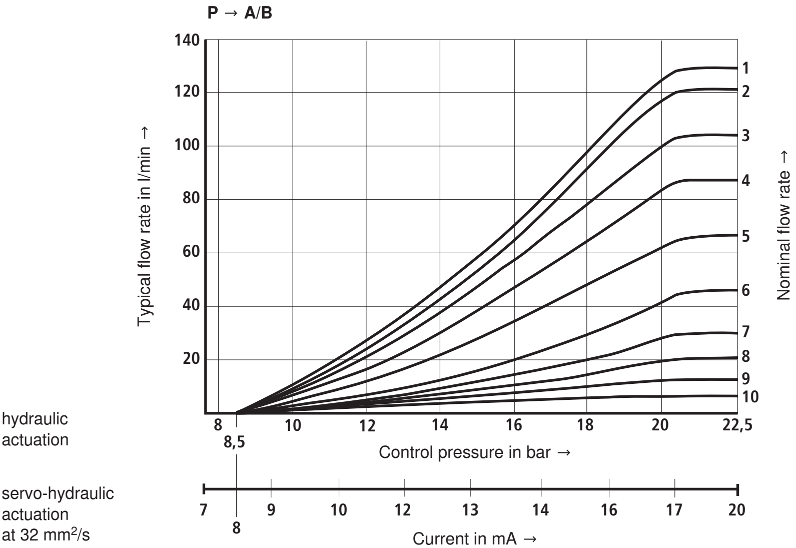


Directional valve elements: main spool

Main spool variants

Ordering details Flow rate details in l/min	Main application	Symbol
E … – …	Hydro-cylinder as a consumer	
J … – …	Hydro-motors as consumers	
Q … – …	Application with specified remaining orifice (A/B → T) Consumer port relieved in neutral position	
R … – …	Regeneration function (P, B → A)	
W … – …	Floating position	
P … – …	Plunger cylinder as consumer	

Spool characteristic curves (symmetrical spools)



Directional valve elements: flow rate

Symmetrical spools

Spool type	Pressure compensator	Flow rate in l/min (for spool characteristic curve see page 21)							
E, J, Q	S	130–130 (1)	100–100	073–073	052–052	034–034	023–023	014–014	007–007
		120–120 (2)	085–085 (4)	065–065 (5)	045–045 (6)	030–030 (7)	020–020 (8)	012–012 (9)	006–006 (10)
		100–100 (3)	070–070	057–057	038–038	026–026	017–017	010–010	005–005

Asymmetrical spools

Spool type	Pressure compensator	Flow rate in l/min				
E, J, Q	S	100–073	100–052	052–034	034–023	023–014
		085–065	085–045	045–030	030–020	020–012
		070–057	070–038	038–026	026–017	017–010

Floating position, regeneration and plunger spool

Spool type	Pressure compensator	Nominal flow rate in l/min (others on request)			
W	S				030–030
R	S	130–101	085–030	065–025	
P	S	140–000			

(1)… (10) For information on spool characteristics see page 18.

☞ **Note!**

Please contact the technical sales department.

Example:

– Spool type J
– Pressure compensator S
– Reference value: $Q_{Consumer}$ = 90 l/min

Solution:

→ 85 litre spool + 2 modules = 100 l/min
→ Set 90 litre via travel limitation.

Spool type	**Pressure compensator**	**Flow rate in l/min**
E, J, Q	S	100–100
		085–085
		070–070

Flow rate without module (pressure compensator Δp = 4 to 7 bar)
Flow rate with 1 module (pressure compensator Δp = 6 to 9.5 bar)
Flow rate with 2 modules (pressure compensator Δp = 8.5 to 11.5 bar)

☞ **Note!**

Position directional valve elements with maximum flow rate as close as possible to the inlet element.

Directional valve elements: actuation types cover A

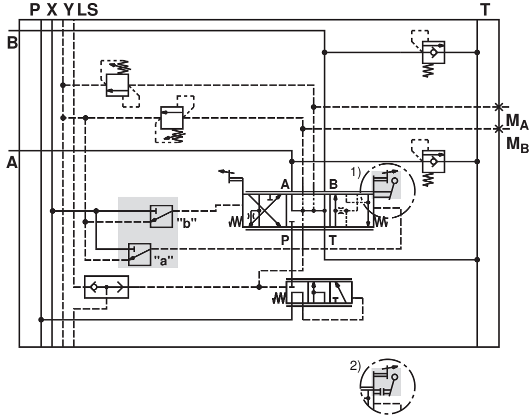
Mechanical

Ordering details:

S	… M …	J	…–…	M	B2	H…	H…

Brief description

- Mechanical actuation of main spool. If not actuated, centring in centre position by means of springs.
- All options for hand lever positions are possible (B, F, D etc.), also see type code on page 10, 24
- [1] Rotating hand lever
- [2] Non-rotating hand lever



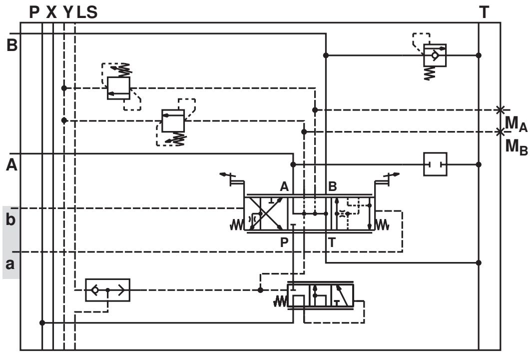
Hydraulic

Ordering details:

S	… M …	J	…–…	H	–	Q	H…

Brief description

- Hydraulic actuation of main spool. If not actuated, centring in centre position by means of springs.



Servo-hydraulic

Ordering details:

S	Z Z Z	J	…–…	S	–	Q	Q

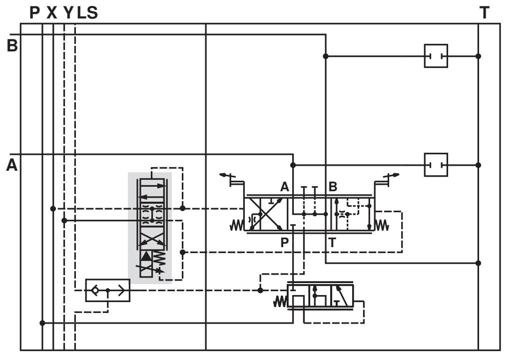
Brief description

- Voltage: min. 7 VDC
- Current type: direct current
- Rated current: ± 20 mA
- Max. current: ± 25 mA
- Dither signal (recommended):
  - Frequency f: 100 Hz +10 %
  - Amplitude I_{ss}: 5 mA

⚠ Caution!

Design by technical sales.

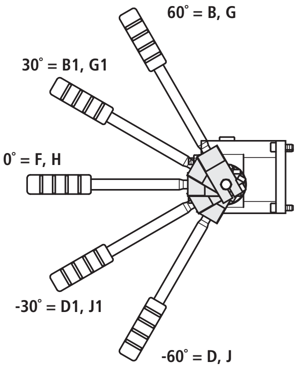
Observe the design information for control oil supply with servo-hydraulic operation on page 14.



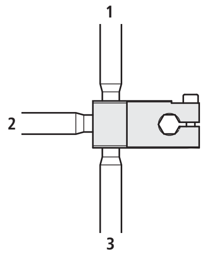
Directional valve elements: actuation types cover B

Mechanical – actuation with hand lever

Clamping piece with lever
(Example: Lever connection in pos. 2)



Lever connection on clamping piece



		top, 60°		top, 30°		straight, 0°		bottom, -30°		bottom, -60°	
Clamping piece with lever	– rotating	B	1	B1	1	F	1	D1	1	D	1
		B	2	B1	2	F	2	D1	2	D	2
		B	3	B1	3	F	3	D1	3	D	3
	– non-rotating	G	1	G1	1	H	1	J1	1	J	1
		G	2	G1	2	H	2	J1	2	J	2
		G	3	G1	3	H	3	J1	3	J	3
Clamping piece without lever	– rotating	T		T1		U		V1		V	
	– non-rotating	Q		Q1		S		C1		C	

Actuating force (on hand lever):
– mechanical < 20 N
– hydraulic, hand lever overlaid < 50 N

Further hand lever options (aluminium-free) on request.

Directional valve elements: secondary valves

Relief/supply valves, not adjustable

Ordering details:

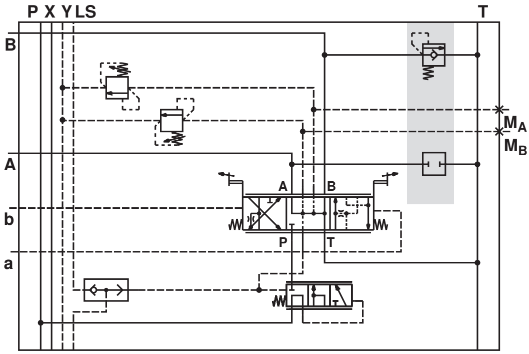
S	… M …	J	…–…	H	–	Q	H150

Brief description

- Non-adjustable relief/supply valve
- Pressure in bar behind H … required (3-digit)
- **Example: Q, H150**
  Q: screw cap for consumer port A
  H150: relief/supply valve, set to 150 bar for consumer port B

⚠ Caution!

Only suitable for the reduction of pressure peaks, not to be used as a pressure relief valve!



Preferred pressure settings for relief valves with supply function

Pressure setting in bar in consumer port A and B			
H050 = 50 bar	H140 = 140 bar	H210 = 210 bar	H280 = 280 bar
H063 = 63 bar	H150 = 150 bar	H230 = 230 bar	H300 = 300 bar
H080 = 80 bar	H160 = 160 bar	H240 = 240 bar	H320 = 320 bar
H100 = 100 bar	H175 = 175 bar	H250 = 250 bar	H350 = 350 bar
H125 = 125 bar	H190 = 190 bar		

⚠ Caution!

Relief valves are firmly set.

Without secondary valves

Ordering details:

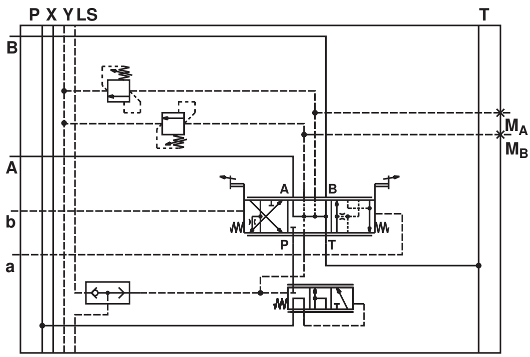
S	… M …	J	…–…	H	–	Z	Z

Brief description

- Secondary valves cannot be retrofitted
- Consumer port G 3/4

⚠ Caution!

Secondary pressure limitation must be established by customer if necessary.

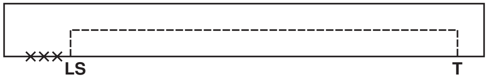


End elements

End element with LS relief

Ordering details:

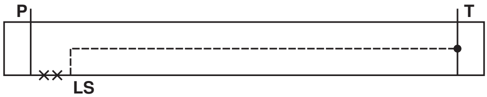
LA



End element LA with additional P and T port

Ordering details:

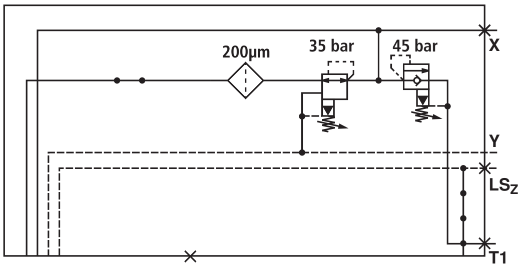
LAPT



End element with internal control oil supply for servo-hydraulic actuation

Ordering details:

LAK



- Draws oil from the P line, pressure reduced to 35 bar (firmly set), pressure relief valve set to 45 bar

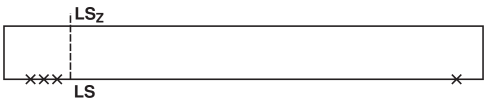
⚠ **Caution!**

Observe the design information for control oil supply with servo-hydraulic operation on page 14.

End element with LS connection

Ordering details:

LZ



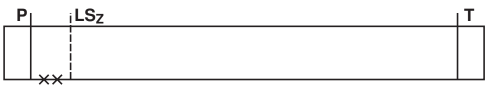
Brief description

- Supply of LS signals connected in parallel
- LS relief must be ensured externally

End element LZ with additional P and T port

Ordering details:

LZPT



Brief description

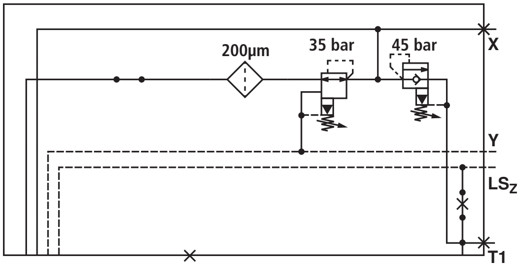
- Supply of LS signals connected in parallel
- LS relief must be ensured externally

End elements

End element with internal control oil supply for servo-hydraulic actuation

Ordering details:

LZK



Brief description

- Draws oil from the P line, pressure reduced to 35 bar (firmly set), pressure relief valve set to 45 bar
- Supply of LS signals connected in parallel
- LS relief must be ensured externally

⚠ **Caution!**

Observe the design information for control oil supply with servo-hydraulic operation on page 14.

End element for combination with central inlet element

End element for use with central inlet element

Ordering details:

M4	– 12	– 2X	/ LU

Unit dimensions: Line connection

Inlet element, lateral	Closed Center	**P**	G 3/4
		T	G 3/4
		LS	G 1/4
		X, Y	G 1/4
		M	G 1/4
	Open Center	**P**	G 3/4
		T	G 1
		LS	G 1/4
		X, Y	G 1/4
		M	G 1/4
Inlet element, central	Closed Center	**P**	G 1
		T	G 1
		LS	G 1/4
		X, Y	G 1/4
		MP	G 1/4
Directional control valve element	with secondary valves	**A, B**	G 1/2
	without secondary valves ZZ	**A, B**	G 3/4
	without secondary valves XX	**A, B**	G 1/2
		a, b	G 1/4
		M_A, M_B	G 1/4
		M_a, M_b	G 1/8
End element		**P**	G 1/2
		T	G 1/2
		LS	G 1/4
		LS_Z	G 1/4
		X, Y	G 1/4
	for LAPT, LZPT	**P, T**	G 3/4
	for LAK, LZK	**X, Y**	G 3/8

P = Pump
A, B = Consumer
a, b = Control line
T = Tank
X = Pilot supply
Y = Control oil return
LS = Load Sensing (LS)
LS_Z = LS supply
M, MP = Test port pump
M_A, M_B = Test ports LS pressure
M_a, M_b = Test ports control pressure
C = External consumer

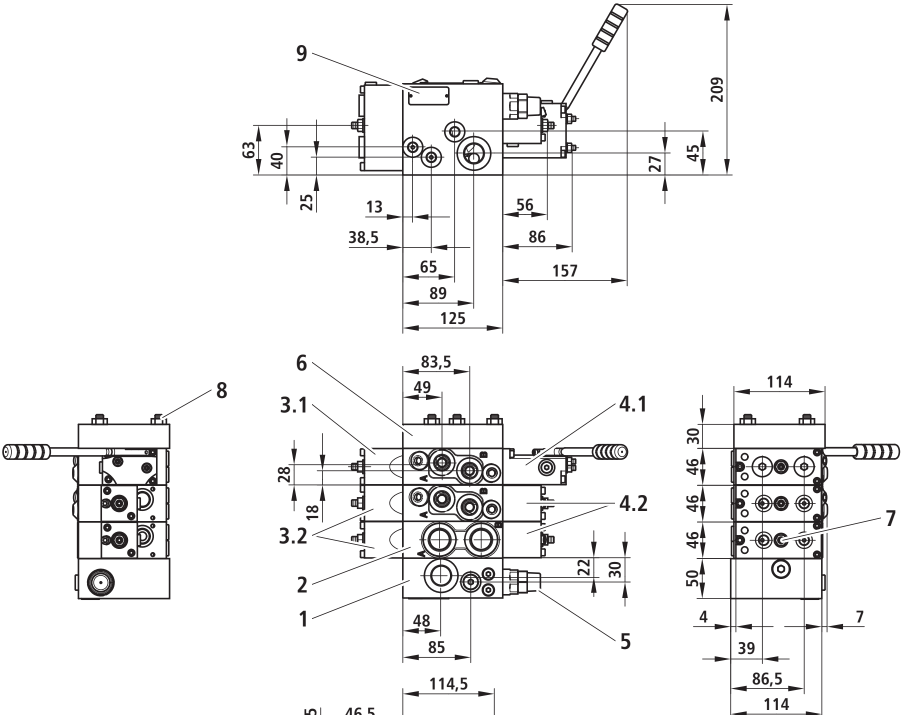
M10 securing screws
in accordance with EN ISO 4762 or EN ISO 4014:

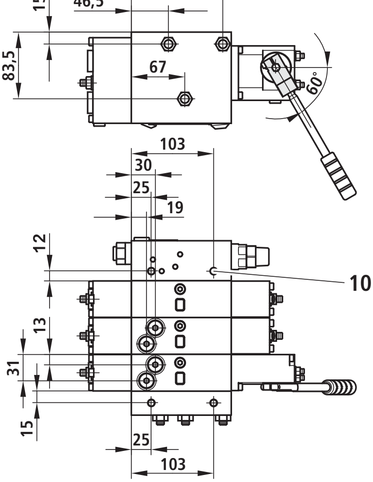
Property class:	8.8	10.9
Tightening torque:	41 ± 2 Nm	60 ± 3 Nm

Connections in accordance with ISO 1179-1

Unit dimensions: Control block with lateral inlet element

(in accordance with the ordering example on page 12, dimensions in mm)

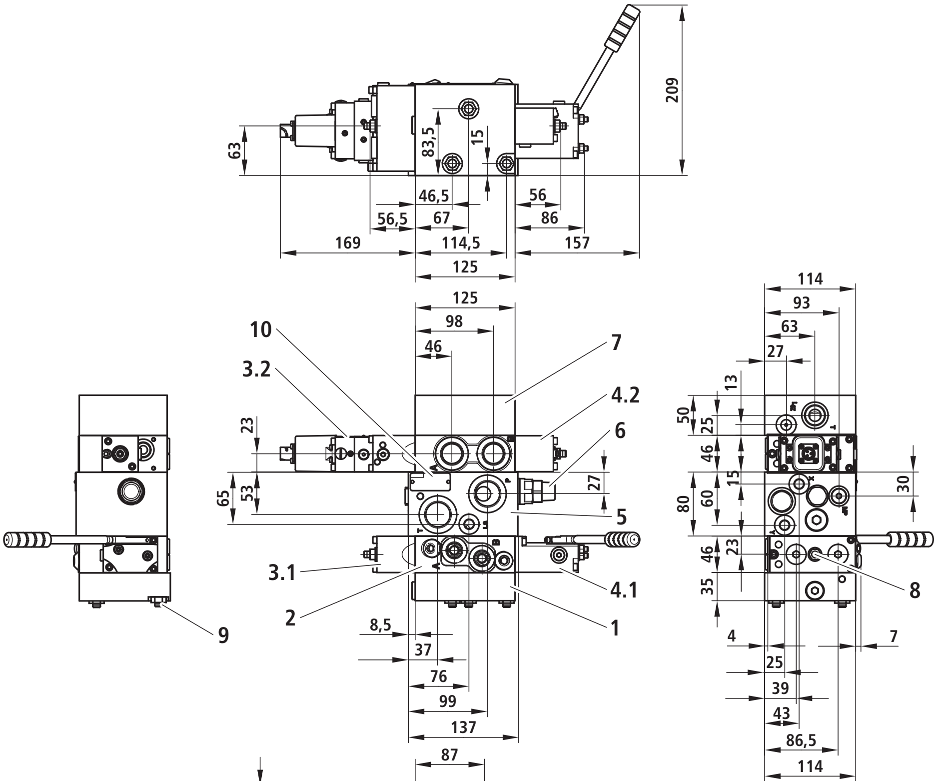


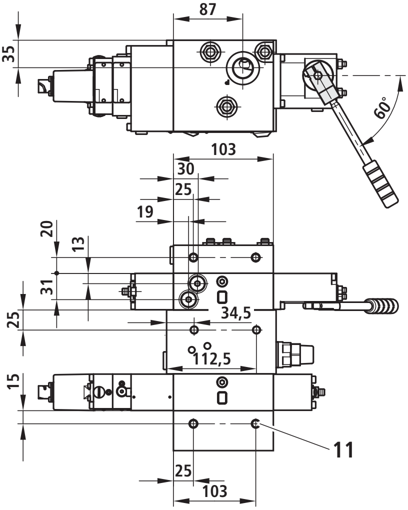


1 Inlet element J…X
2 Directional valve element
3.1 Control cover M (side A) for mechanical operation
3.2 Control cover H (side A) for hydraulic operation
4.1 Control cover B2 (side B) with hand lever
4.2 Control cover Standard (side B)
5 Primary pressure relief valve
6 End element LA
7 Travel limitation
8 Tie rods
9 Nameplate
10 Mounting thread 4 x M10; 15 deep

Unit dimensions: Control block with central inlet element and priority valve

(in accordance with the ordering example on page 13, dimensions in mm)





1 Deflection plate LU
2 Directional valve element
3.1 Control cover M (side A) for mechanical operation
3.2 Control cover S (side A) for servo-hydraulic operation
4.1 Control cover B2 (side B) with hand lever
4.2 Control cover Standard (side B)
5 Central inlet element JZ…X
6 Primary pressure relief valve
7 End element LZPT
8 Travel limitation
9 Tie rods
10 Nameplate
11 Mounting thread 4 x M10; 15 deep

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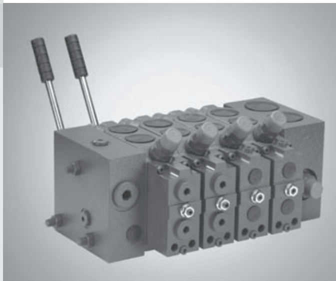
www.boschrexroth.de

Load-sensing control block in sandwich-plate design

RE 64283-X-B2/05.2011 1/32
Replaces: 04.2009

Model M4-15–XC and M4-15-XH

Nominal size 15
Series 2X
Nominal pressure 350 bar (pump side)
Nominal pressure 420 bar (consumer side)
Maximum flow rate
– pump side: 300 l/min at central input element
200 l/min at side input element
– consumer side: 200 l/min with pressure balance and load retaining function
160 l/min with pressure balance and load retaining function



HAD 7414

ATEX-devices
For potentially explosive atmospheres

Operating Instructions
Part II Technical Datasheet

Information about explosion protection:

Area of application according to Explosion Protection Directive 94/9/EC:

- IM2: Ignition protection type Ex ia I according to EN 60079-0: 2006 and EN 60079-11: 2007
- II2G: Ignition protection type Ex ia IIB T4 according to EN 60079-0: 2006 and EN 60079-11: 2007
- II2D: Ignition protection type Ex tD A21 IP67 T110 °C according to EN 61241-0: 2006 and EN 61241-1: 2004
- Ambient temperature range -20 °C ≤ T_a ≤ +80 °C

What you need to know about these Operating Instructions

These Operating Instructions apply to Rexroth explosion-proof valves and consist of the following three parts:

Part I	General Information RE 07010-X-B1	
Part II	Technical Datasheet RE 64283-X-B2	**Mat.-No. R901219663**
Part III	Product-specific Instructions RE 64283-X-B3	

For further information on the correct use of Rexroth hydraulic products please refer to our publication *entitled General product information on hydraulic products, RE 07008.*

Summary of the contents

Characteristics

System

- Load-pressure independent flow rate control
  - Open Center for fixed displacement pump
  - Closed Center for variable displacement pump

Construction

- Sandwich-plate design
  - Input element
  - up to 9 directional control valve elements, of which max. 6 with servo control
  - up to 18 directional control valve elements with central-input element, of which max. 6 with servo control
  - End element
- Actuation types
  - mechanical (hand lever)
  - hydraulic
  - servo-hydraulic

Flow rate

- load pressure compensated
- high repeating accuracy
- low hysteresis

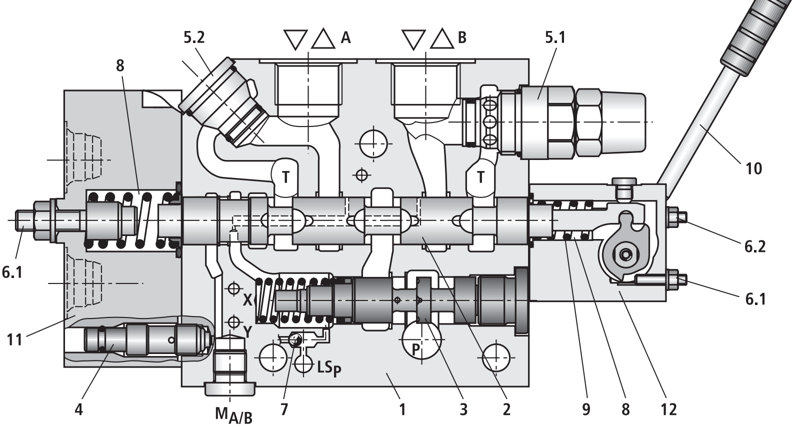
Pressure limitation

- Input element
  - pilot-operated pressure valves with large nominal width
- Directional control valve element / consumer ports
  - compact pressure-control valves with supply function
- LS pressure limitation
  - selectable pressure setting per consumer port on request (design by technical sales)

6

Function, section

1 Housing
2 Main piston
3 Pressure balance
4 LS-pressure-relief valve
5.1 Secondary valve
5.2 Screw cap
6.1 Travel limitation A-side
6.2 Travel limitation B-side
7 LS-shuttle valve
8 Spring chamber
9 Compression spring
10 Hand lever
11 Cover A
12 Cover B



Control block M4-15

The directional control valves are proportional valves in accordance with the load-sensing principle.

Consumer activation

The flow direction and the size of the flow rate reaching the consumer ports (A or B) are determined at the main piston (**2**).

External pilot units control the position of the main piston (**2**). The extent of the control pressure in the spring chambers (**8**) determines the travel of the main piston (P → A; P → B).

The pressure difference at the main piston (**2**) and therefore also the flow rate to the consumer is kept constant via the pressure balance (**3**).

Load pressure compensation

Pressure changes at the consumers or the pump are compensated respectively by the pressure balance (**3**). The flow rate to the consumer remains constant even under different loads.

Flow rate limitation

The maximum flow rate can be individually limited from the works to order specifications by means of travel stops (**6**).

Pressure limitation

The manipulation of the LS pressure of each consumer port can take place internally via the LS pressure relief valves (**4**) or externally via the LS ports M_A, M_B.

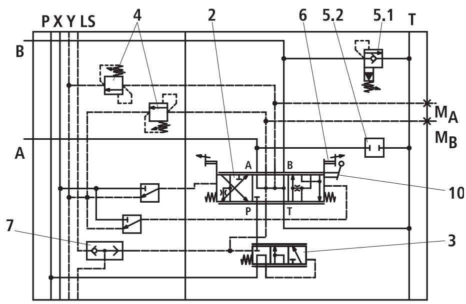
Relief valves with large nominal widths with combined supply function (**5**) protect consumer ports A and B from pressure peaks.

The highest load pressure is signalled to the pump via the LS line and the integrated shuttle valves (**7**).

Symbol

Connections:

P Pump
A, B Consumer
T Tank
X Control oil supply
Y Control oil drain
LS Load sensing (LS)
M_A, M_B external LS-ports



Technical data (please ask in case of applications outside the stated values!)

General

Mounting orientation				any
Type of port				Pipe thread according to ISO 228/1
Mass	Input element, side		kg	7
	Input element with priority valve		kg	10
	Central input element		kg	8.5
	Directional control valve element, mechanical		kg	6.9
	Directional control valve element, hydraulic		kg	7.1
	Additional weight hand lever		kg	1.5
	End element		kg	5,8
Surface protection				Paint
Ambient temperature range		ϑ	°C	–20 to +80

mechanical

Actuating force at hand lever			N	< 20

hydraulic

Flow rate	Port P	q_{Vmax}	l/min	300 with central input element
			l/min	200 with side input element
	Port A, B	q_{Vmax}	l/min	160 with pressure balance and load retaining function (model "S")
			l/min	200 with pressure balance, without load retaining function (model "T")
Nominal pressure		p_{nom}	bar	350
Max. operating pressure at port	P	p	bar	350
	A / B	p	bar	420
	LS	p	bar	330
	T	p	bar	30
	Y	p	bar	depressurized to tank
Max. control pressure at port	X	p	bar	35
	a, b	p	bar	35
Control pressure range	hydraulic	p	bar	8.5 to 22.5
required regulating-Δp at control block [1]	Model S	p	bar	18
	Model T	p	bar	25
Primary pressure limitation		p	bar	max. 370 (set at the works to order specifications), min. 20 bar above the pressure cut-off value of the pump
LS pressure limitation		p	bar	50 to 330 (adjusted at the works to order specifications) The highest relief pressure for the LS pressure relief valves of the valve manifold set at the works must be at least 20 bar lower than the pressure cut-off value of the pump
Hydraulic fluid				Mineral oil (HL, HLP) to DIN 51524, other hydraulic fluids on request, ignition temperature > 190 °C
Temperature range of hydraulic fluid		ϑ	°C	–20 to +80
Viscosity range	hydraulic	v	mm²/s	10 to 380
	servo-hydraulic	v	mm²/s	16 to 200 [2]
maximum permitted contamination level of hydraulic fluid Purity class to ISO 4406 (c)				Class 20/18/15, we recommend for this a filter with a minimum retention rate of $\beta_{10} \geq 75$

Information about explosion protection

Protection class in accordance with Directive 94/9/EC		IM2	II2G	II2D
max. surface temperature		–	T4	110 °C
Explosion protection type valve	structural safety XC	c (EN 13463-5)		
	fail-safe XH	EN 60079-0, EN 60079-11	EN 60079-0, EN 60079-11	EN 61241-0, EN 61241-1

Note The technical data has been established at a viscosity of v = 30 mm²/s (HLP46: 50 °C).

[1] *Observe the design information for control oil supply with servo-hydraulic operation on page 14.*

[2] Between 200 and 380 mm²/s reduced maximum quantity.

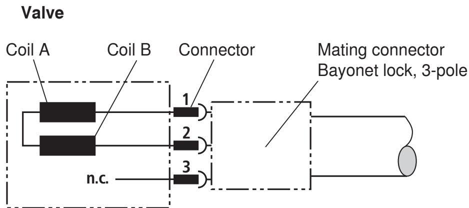
Technical Data STDS 0014-1X

electric		
Protection class according to EN 60529:1991+A1:2000		IP 67 with mating connector correctly mounted and locked
Type of signal		Direct current analogue
Rated current	mA	20
Resistance per coil (Total)	Ω	135 (270)
Inductivity (Connection in series)	H	1.7
Connector (Bayonet lock)		3-pole

Information on explosion protection			
Type examination certificate			BVS 08 ATEX E031
Protection class according to directive 94/9/EC			IM2
Type of protection according to EN 60079-0:2006, EN 60079-11:2007			Ex ia I
Ambient temperature range		°C	$-20 \leq T_a \leq +100$
The electric actuation must be realized from intrinsically safe electrical circuits with the following maximum values	U_{max}	V	17.5
	I_{max}	mA	150
	P_{max}	mW	657

⚠ **WARNING – Risk of explosion**
- The connection with other devices must be checked separately.
- As soon as the valve has been operated with higher electric power than the one specified above, it must no longer be used in explosive areas.

Electrical connection



Mating connector, bayonet lock, 3-pole:
Type: 845-11-1325-001, company Souriau

Relating mating connector see data sheet of the company Souriau, series 845.
The servo valve may only be supplied through these mating connectors.

Technical Data STDS 0015-1X

electric				
Protection class according to	DIN 40050-9:1993 EN 60529:1991+A1:2000		IP 69K IP 67	with mating connector correctly mounted and locked
Type of signal			Direct current analogue	
Rated current		mA	20	
Resistance per coil (Total)		Ω	135 (270)	
Inductivity (Connection in series)		H	1.7	
Connector (Compatible with MS 3102 C14S-2P)			4-pole	

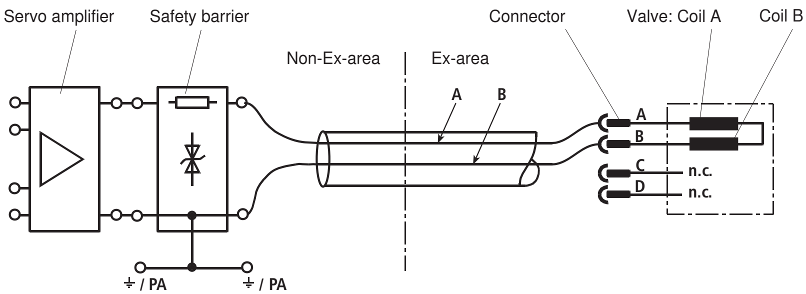
Information on explosion protection			
Type examination certificate			PTB 05 ATEX 2058
Protection class according to directive 94/9/EC			II2G, II2D
Type of protection according to EN 60079-0:2006, EN 60079-11:2007			Ex ia IIB T4
Type of protection according to EN 61241-0:2006 and EN 61241:2004			Ex tD A21 IP67 T110 °C
Maximum surface temperature [2]		°C	110
Ambient temperature range		°C	–20 ≤ T_a ≤ +100
Hydraulic fluid temperature range		°C	–20 … +100
Maximum values for supply circuits	U_{max}	V	17,5
	I_{max}	mA	150
	P_{max}	mW	657
Important: In case of use in II2G, the valve may only be supplied electrically from certified, intrinsically safe electrical circuits Recommended safety barrier [1]		Single-channel	e.g. company Stahl, type 9001/02-133-150-101 or 9001/02-175-100-101

[1] Only necessary with II2G, separate order

[2] Surface temperature > 50 °C, provide contact protection

Electrical connection

The electrical actuation with plus (+) to A and minus (–) to B provides for pressure at port A > pressure at port B and/or flow from P to A and B to T. Pins C and D on the connector are not connected.



Important:

– In case of use in II2D, the safety barrier is not necessary.

– In case of use in II2D, the mating connector must meet the requirements according to EN 61241-0:2006.

Modular construction: Control block with side input element

Control blocks from series M4-15 are of modular construction. They can be optimally assembled for the respective application.

1. **Input element**
   - A: Closed Center "VR" with external priority consumer
   - B: Open Center "P"
   - C: Closed Center "J"
2. **Directional control valve elements**

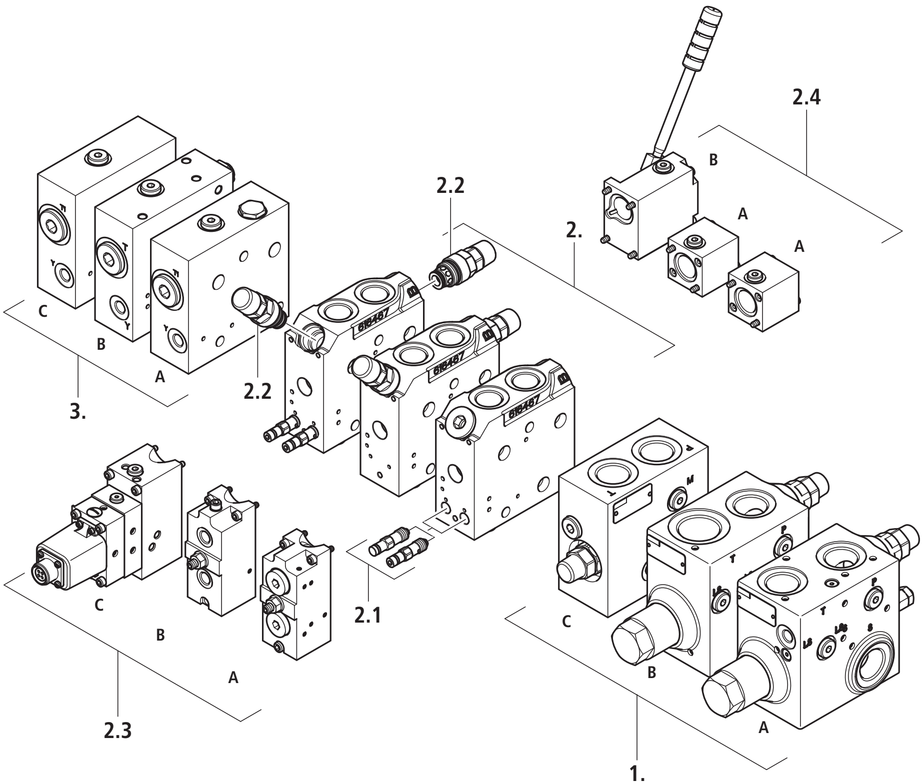
2.1 LS pressure limitation

2.2 Secondary valves

2.3 Actuation of cover, A-side
   - A: Mechanical actuation "M"
   - B: Hydraulic actuation "H"
   - C: Servo-hydraulic actuation "S"

2.4 Actuation of cover, B-side
   - A: Standard cover "–"
   - B: Mechanical actuation "B2" with hand lever

3. **End element**
   - A: With LS relief "LA" and "LZ"
   - B: With LS connection and control oil supply "LAY", "LAK", "LZY" and "LZK"
   - C: With LS connection and control oil supply "LAX" and "LZX"



Modular construction: Control block with central input element

1. Central input element
- A: Closed Center central "JZ"
- B: Closed Center central "VZ" with priority valve

2. Directional control valve elements

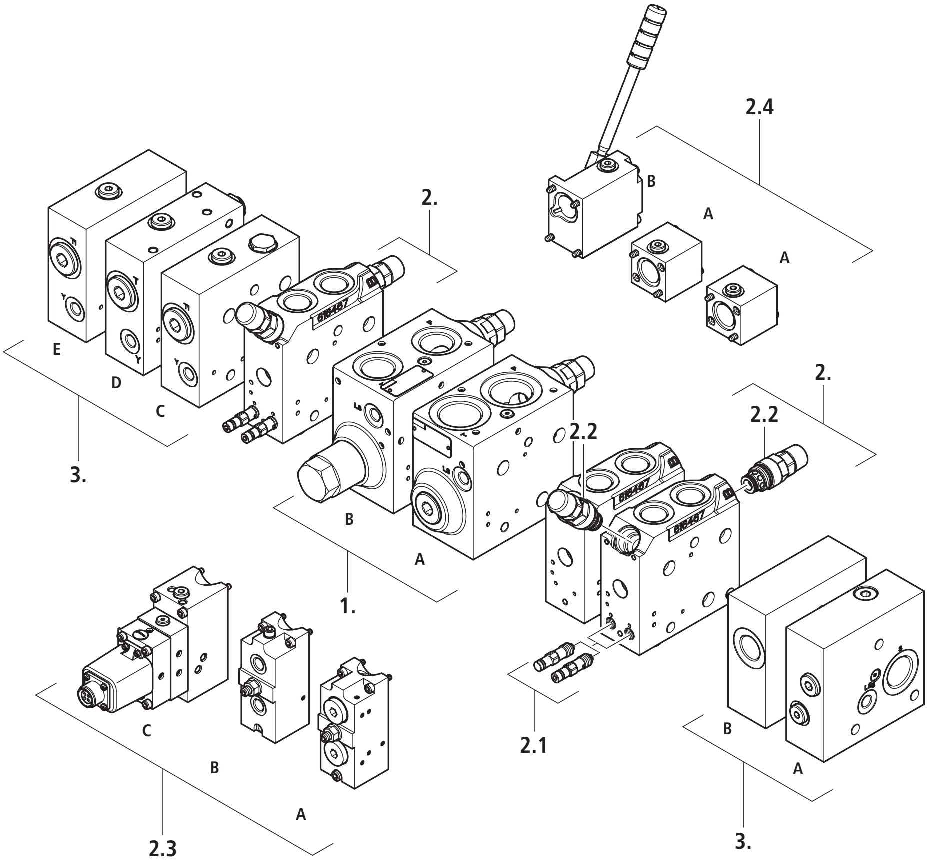
2.1 LS pressure limitation

2.2 Secondary valves

2.3 Actuation of cover, A-side
- A: Mechanical actuation "M"
- B: Hydraulic actuation "H"
- C: Servo-hydraulic actuation "S"

2.4 Actuation of cover, B-side
- A: Standard cover "–"
- B: Mechanical actuation "B2" with hand lever

3. End element
- A: Deflection plate with external priority port "LVZ"
- B: Deflection plate "LU"
- C: With LS relief "LA" and "LZ"
- D: With LS connection and control oil supply "LAY", "LAK", "LZY" and "LZK"
- E: With LS connection and control oil supply "LAX" and "LZX"



Ordering details

Type code | **Input elements** | **Directional control valve elements**

M4–15–2X/

1st piston axis

2nd piston axis

3rd piston axis etc.

Continuation page 11

Number of directional control valves 1 to 18 [1)]

Nominal size 15 **= 15**

Series 20 to 29 **= 2X**
(unchanged installation and connection values)

Closed Center, side **= J**
Open Center, side **= P**
Closed Center, priority consumers internal, subordinate consumers external **= VL**
Closed Center, priority consumers external, subordinate consumers internal **= VR**
Closed Center, central **= JZ**
Closed Center, central with priority valve **= VZ**

with primary pressure-relief valve **= …**
(pressure in bar, 3-digit)

Priority valve (only for .V)
static priority valve **= A**
dynamic priority valve **= B**

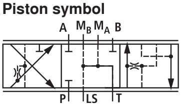
LS pressure limitation for priority valve (for .V)
static priority valve **= …**
(pressure in bar, 3-digit)

with pressure balance, **with** load retaining function **= S**
with pressure balance, **without** load retaining function **= T**

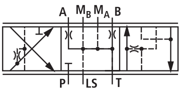
LS valve
with LS-pressure-relief valve (pressure in bar, 3-digit) (no **Z** possible) **= … M …**
with LS-DB-screw cap (no **Z** possible) **= Q M Q**
without LS-pressure-relief valve (LS-DB cannot be retrofitted) (no **M** possible) **= Z Z Z**

Housing **with** test ports **= M**
Housing **without** test ports **= Z**

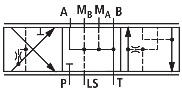
Piston symbol



= E



= Q



= J

Flow rate in l/min, 3-digit, **= … – …**
e.g. 070-070; consumer port "A" and "B"

Actuation of cover, A-side
mechanical [2)] **= M**
hydraulic [3)] **= H**
servo-hydraulic [3); 6)] **= S**

Consumer port "A"

Consumer port "B"

Secondary valves
H … = pressure / supply valve (adjustable)
E = supply valve
Q = screw cap (secondary valve retro-fittable) [5)]

Actuation of cover, B-side

Standard cover	–		
	Hand lever position		
Actuation with hand lever [4)]	**60°**	**0°**	**-60°**
Hand lever, rotating (clamping piece with lever)	**B2**	**F2**	**D2**
Hand lever, rotating (clamping piece without lever)	**T**	**U**	**V**
Hand lever, non-rotating (clamping piece with lever)	**G2**	**H2**	**J2**
Hand lever, non-rotating (clamping piece without lever)	**Q**	**S**	**C**

1) Max. 9 elements per side, of which max. 6 with servo-hydraulic control.

2) Always in conjunction with rotating hand lever.

3) Not in conjunction with rotating hand lever.

4) For additional constructions and explanations see page 23.

5) Secondary valves must be present in the hydraulic operating circuit.

6) For details concerning control oil supply see page 17.

Ordering details

End elements | **Additional information**

	01			*

more details in plain text

Protection class

IM2 = Protection class IM2
II2GD = Protection class II2GD

Ignition protection type
XC = structural safety [8]
XH = fail-safe

Connections

01 = Pipe thread according to ISO 228/1

Seal material

V = FKM seals [7]
M = NBR seals (only on request)

End element

	with LS relief	**without** LS relief	External control oil supply	Internal control oil supply	Internal control oil supply for servo-hydraulic operation [6]	with additional P and T port
LA =	●					
LAPT =	●					●
LAY =	●			●		
LAYPT =	●			●		●
LAK =	●				●	
LAX =	●		●			
LAXPT =	●		●			●
LZ =		●				
LZPT =		●				●
LZY =		●		●		
LZYPT =		●		●		●
LZK =		●			●	
LZX =		●	●			
LZXPT =		●	●			●

Only in conjunction with inputs VL, VZ, JZ:
LVZ = external priority port (connection possibility for a further LS control block)
LU = deflection plate
LUT = deflection plate with additional T port
LUPT = deflection plate with additional P and T port

[6] For details concerning control oil supply see page 17.

[7] The block preferably contains FKM, but also NBR seals. Make sure that the seal is suitable for the hydraulic fluid used.

[8] Always in conjunction with protection class IM2

Ordering details

Type code

Entire control blocks are defined according to the type code. The order text is intended for the definition of the technical characteristics and requirements. A type code and a material number are derived from the order text by the Bosch Rexroth sales organisation.

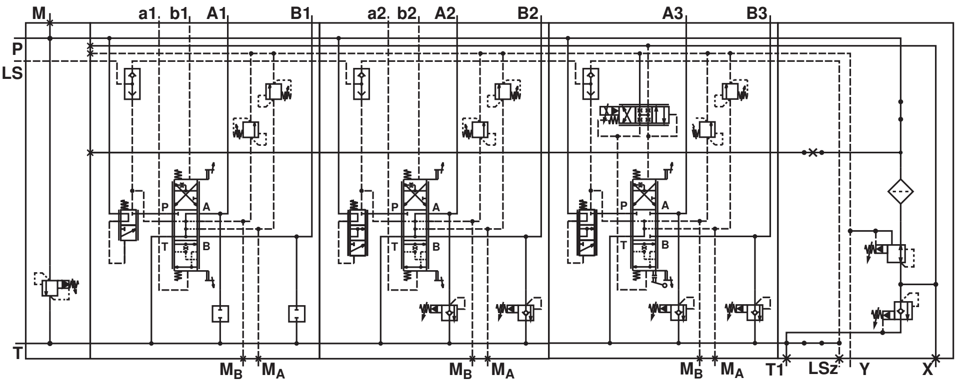
Example of a type code of an M4-15 control block with three directional control valve elements:

M4 – 4567 – 2 0 / 3 M4 – 15 J H – V 01 XH IM2

4567	Control block no.
2	Unit series of production series (2 X)
0	Modification status of the series
3	Number of directional control valve elements
J	Input
H	Actuation A-side (predominant actuation)
–	Actuation B-side (predominant actuation)
V	Seal material
01	Threaded connection
XH	Ignition protection type: fail-safe
IM2	Protection class: IM2

Ordering example for Closed Center with side input element

		Ordering details:
Example:	– Triple control block – Variable-displacement pump $q_{V\ max}$ = 200 l/min	3 | M4 – 15 – 2X / J250
Number of directional control valves, input element	– Closed Center with primary pressure-relief valve at the side, set to 250 bar	
Directional control valve elements **1st piston axis**	– With pressure balance, without load retaining function – With LS pressure relief valve for consumer port A 180 bar, consumer port B 120 bar – Piston symbol J, flow rate in A and B 100 l/min – Actuation: hydraulic – Secondary valve holes closed	1st piston axis T | 180M120 | J | 100-100 | H | – | Q | Q
2nd piston axis	– With pressure balance, with load retaining function – With LS pressure relief valve for consumer port A and B 180 bar – Piston symbol E, flow rate in A and B 85 l/min – Actuation: hydraulic – Secondary valves: pressure/supply valves, consumer port A and B 350 bar	2nd piston axis S | 180M180 | E | 085-085 | H | – | H350 | H350
3rd piston axis	– With pressure balance, with load retaining function – With LS pressure relief valve for consumer port A 180 bar, consumer port B 120 bar – Piston symbol E, flow rate in A and B 85 l/min – Actuation: servo-hydraulic – Actuation with hand lever (up), non-rotating – Secondary valves: pressure/supply valves, consumer port A and B 350 bar	3rd piston axis S | 180M120 | E | 085-085 | S | G2 | H350 | H350
End element	– With internal LS relief – With internal control oil supply for servo-hydraulic operation	End element LAK
Additional information	– FKM seals – Pipe thread connections – Ignition protection type: fail-safe – Protection class: IM2	V | 01 | XH | IM2



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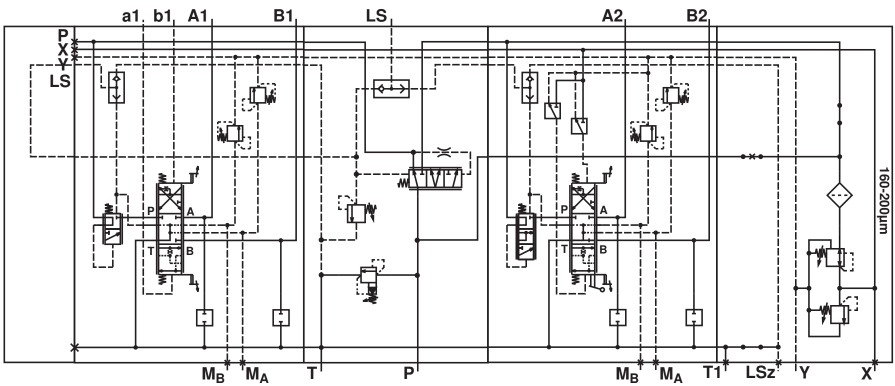
Ordering example for Closed Center for central input with primary valve

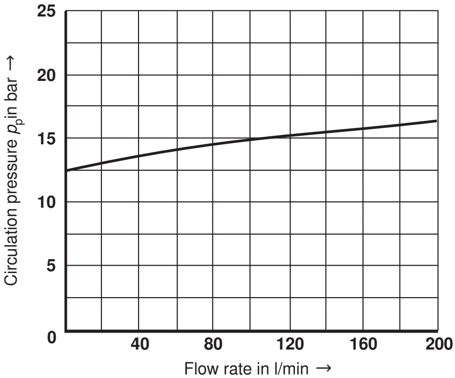
		Ordering details:
Example:	– Double control block – Variable displacement pump $q_{V\,max}$ = 200 l/min	2 | M4 – 15 – 2X / LU
Number of directional control valves, end element	– Deflection plate	
Directional control valve element **1st piston axis**	– With pressure balance, without load retaining function – With LS pressure relief valves, consumer port A 270 bar, consumer port B 300 bar – Piston symbol E, flow rate in A and B 100 l/min – Actuation: hydraulic – Secondary valve holes closed	1st piston axis T | 270M300 | E | 100-100 | H | – | Q | Q
Input element	– Primary pressure relief valve, set to 350 bar – With static priority valve, set to 250 bar	Input element VZ | 350 | A | 250
Directional control valve element **2nd piston axis**	– With pressure balance, with load retaining function – With LS pressure relief valves, consumer port A 270 bar, consumer port B 300 bar – Piston symbol E, flow rate in A and B 90 l/min – Actuation: mechanical – Hand lever actuation (up) – Secondary valve holes closed	2nd piston axis S | 270M300 | E | 090-090 | M | B2 | Q | Q
End element	– With LS relief, without LS connection – With internal control oil supply	End element LAY
Additional information	– FKM seals – Pipe thread connections – Ignition protection type: structural safety – Protection class: IM2, e.g. for coal mining	V | 01 | XC | IM2



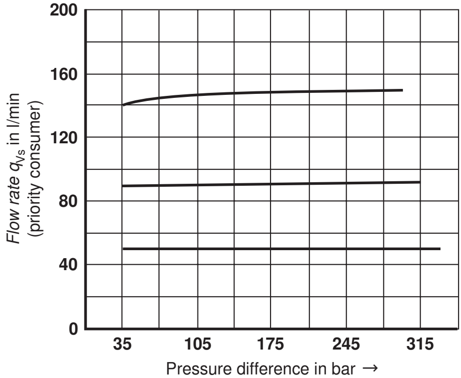
Input elements

Characteristic curves (measured at ν = 41 mm²/s and ϑ = 50 °C)

Open Center
Circulation pressure P → T

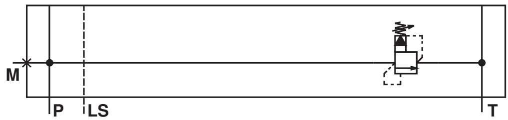


Priority valve



Closed Center with primary pressure relief valve
Ordering details:

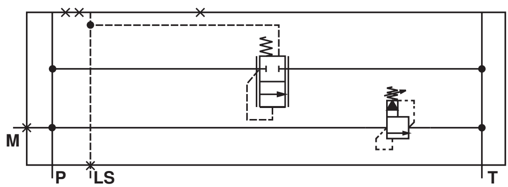
M4	– 15	– 2X	/ J	…



Brief description
- For variable displacement pumps up to 200 l/min
- Pressure in bar behind J… required (3-digit)
- Technical data for primary valve to RE 64642, characteristic curve D5

Open Center with primary pressure relief valve
Ordering details:

M4	– 15	– 2X	/ P	…



Brief description
- for fixed displacement pumps up to 200 l/min
- Pressure in bar behind P… required (3-digit)
- Technical data for primary valve to RE 64642, characteristic curve D5

Input elements

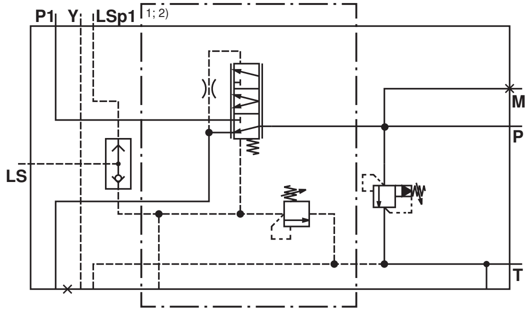
Closed Center, priority consumers internal, subordinate consumers external, with primary pressure-relief valve

Ordering details:

M4	– 15	– 2X	/ VL	…	A	…

Brief description

- For variable displacement pumps up to 200 l/min
- Pressure in bar behind VL… for primary pressure-relief valve required (3-digit)
- Pressure in bar behind A… for LS pressure relief valve for priority valve required (3-digit)



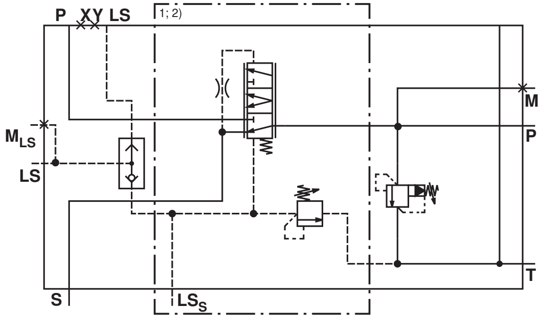
Closed Center, priority consumers external, subordinate consumers internal, with primary pressure-relief valve

Ordering details:

M4	– 15	– 2X	/ VR	…	A	…

Brief description

- For variable displacement pumps up to 200 l/min
- Pressure in bar behind VR… for primary pressure-relief valve required (3-digit)
- Pressure in bar behind A… for LS pressure relief valve for priority valve required (3-digit)



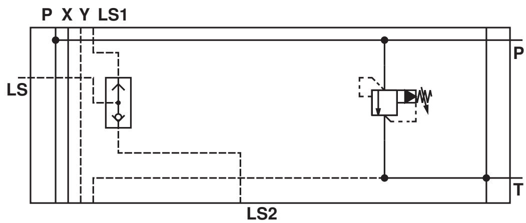
Closed Center, with primary pressure relief valve

Ordering details:

M4	– 15	– 2X	/ JZ	…

Brief description

- For variable displacement pumps up to 300 l/min
- Pressure in bar behind JZ… for primary pressure-relief valve required (3-digit)
- Technical data for primary valve to RE 64642, characteristic curve D5



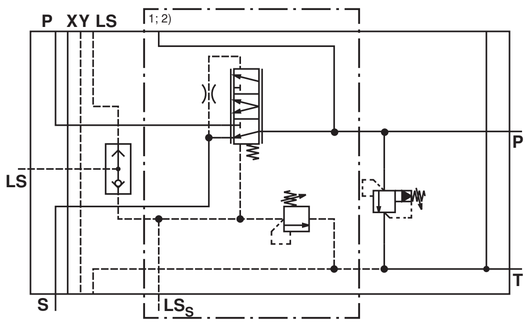
Closed Center with priority valve, with primary pressure relief valve

Ordering details:

M4	– 15	– 2X	/ VZ	…	A	…

Brief description

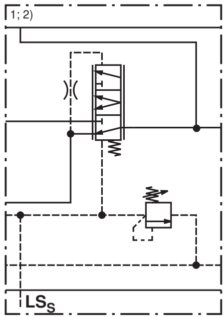
- For variable displacement pumps up to 200 l/min
- Pressure in bar behind VZ… for primary pressure-relief valve required (3-digit)
- Pressure in bar behind A… for LS pressure relief valve for priority valve required (3-digit)



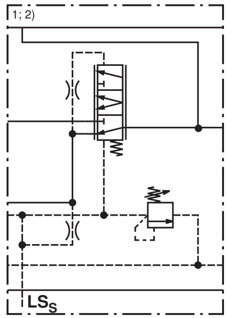
1; 2) see page 17

Input elements

1) Version **"V … A"** is recommended for priority consumers with a fixed flow rate.



2) Version **"V … B"** is recommended for dynamic priority consumers (e.g. steering).



Design information for control oil supply with servo-hydraulic operation

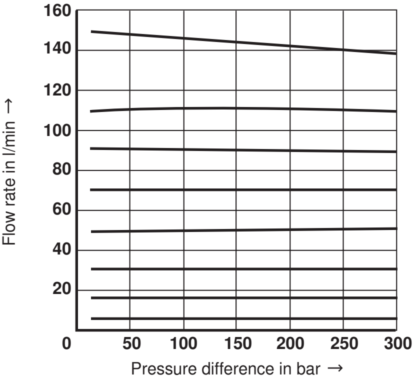
If a servo-hydraulic actuation is used in the control block, please observe the following:

External control oil supply:
- p_{st} = 30 +2 bar constant
- q_{st} = 2 l/min per servo-hydraulic piston axis
- Imperative for input element P

Internal control oil supply:
- Maximum 6 servo-hydraulically controlled piston axes possible
- No control oil supply for external consumers
- Δp on the input element must be at least 35 bar

Directional control valve elements: pressure balance

Flow rate regulation by individual pressure balance



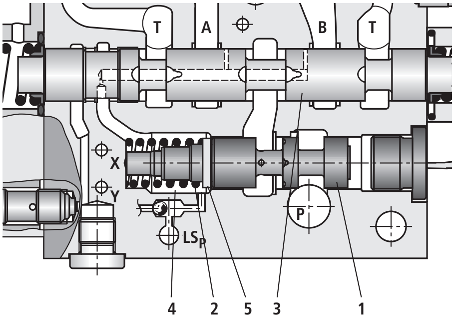
When the main piston is in the center position there is no connection from P to consumer ports A and B.
In this operating status, the pressure balance piston (**1**) is displaced to the left against the spring (**2**) by means of the pump pressure.

When the main piston (**3**) (= orifice) is actuated, the LS pressure enters the spring chamber (**4**) and pushes the pressure balance piston to the right into the adjustment position. The flow rate is kept constant even in the event of parallel operation of consumers with different load pressures.

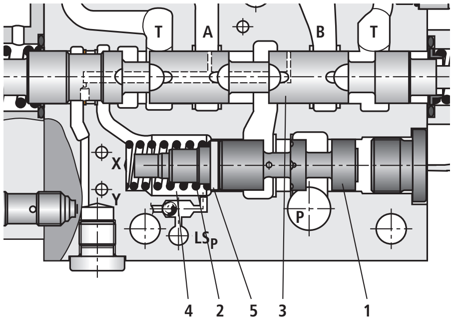
The pressure balance "S" is equipped with a load retaining function. This operation is not leakage oil free.

It is fitted with a ring (**5**) as standard. The number of rings inserted is dependent on the desired flow rate.

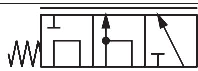
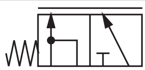
Main piston in center position



Main piston actuated



Pressure balance piston variants

Ordering details:	Brief description	Symbol
S	– with pressure balance – with load retaining function [1] – max. flow rate 160 l/min	
T	– with pressure balance – without load retaining function [1] – max. flow rate 200 l/min	

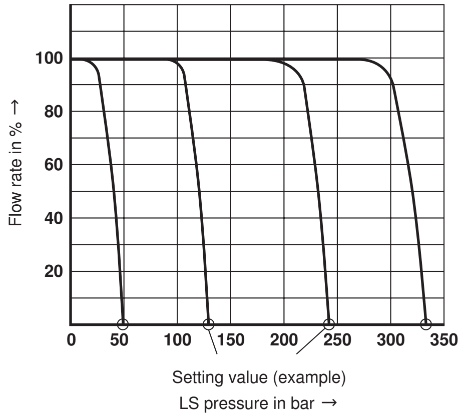
[1] The load retaining function is not leakage oil free.

Directional control valve elements: LS pressure limitation

Characteristic curves

Reduction of consumer flow rate by LS pressure limitation

Minimum setting value:	50 bar
Maximum setting value:	330 bar



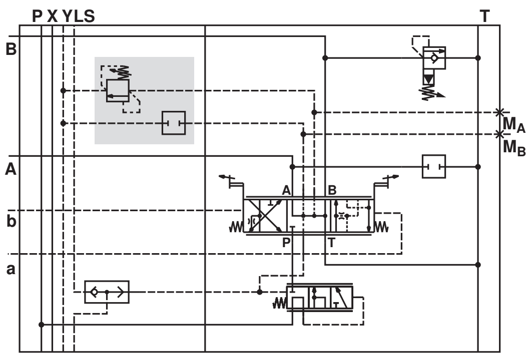
With LS pressure-relief valve and LS screw cap

Ordering details:

S	…	M	Q	J	…–…	H	–	Q	H…

Brief description

- Pressure in bar for consumer port A (3-digit)
- Screw cap for consumer port B
- The LS pressure limitation on the directional control valve element can be retrofitted for the "QMQ" model.
- The LS pressure can be externally influenced via ports M_A and M_B. These ports can also be used as test ports.



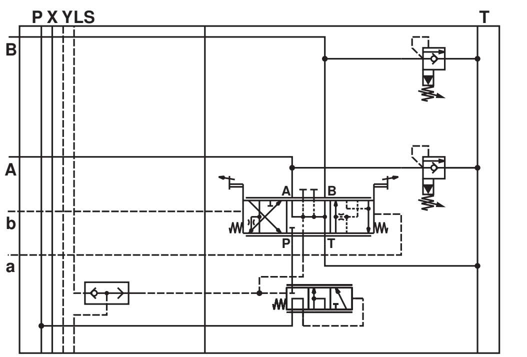
Without LS pressure-relief valves

Ordering details:

S	Z	Z	Z	J	…–…	H	–	H…	H…

Brief description

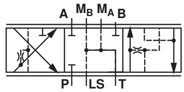
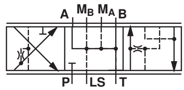
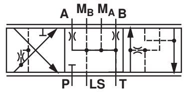
- LS-DB cannot be retrofitted
- Housing without test ports



6

Directional control valve elements: Main piston

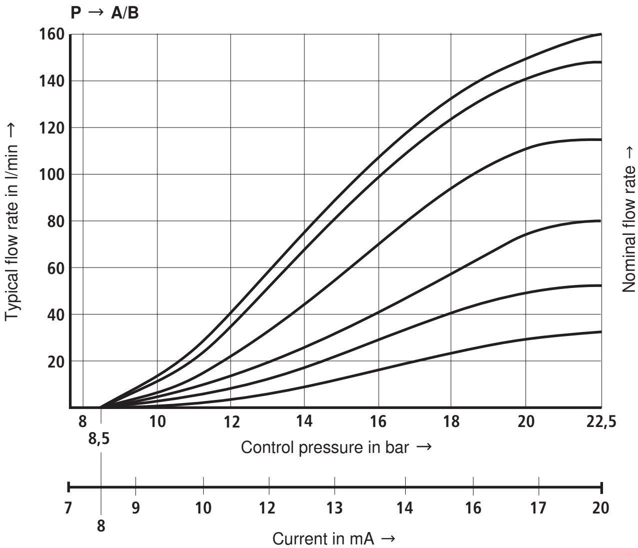
Main piston variants

Ordering details: Flow rate details in l/min	Main application	Symbol
E … – …	Hydro-cylinder as a consumer	
J … – …	Hydro-motors as consumers	
Q … – …	Application with specified remaining orifice (A/B → T) Consumer port relieved in neutral position	

Piston characteristic curves (symmetrical pistons)

hydraulic actuation

servo-hydraulic actuation at 32 mm²/s



Directional control valve elements: Flow rate

Symmetrical pistons

Piston type	Pressure balance	Flow rate in l/min (for piston characteristic curve see page 20)						
E, J, Q	S	160-160	150-150	120-120	080-080	050-050	032-032	023–023
		140-140	130-130	100-100	070-070	045-045	028-028	020-020 (8)
		120-120	110-110	085-085	060-060	040-040	025-025	017–017
	T	200-200	190-190	160-160	100-100	065-065	040-040	

Asymmetrical pistons

Piston type	Pressure balance	Flow rate in l/min			
E, J, Q	S	150-120	120-080	080-050	050-032
		130-100	100-070	070-045	045-028
		110-085	085-060	060-040	040-025
	T	190-160	160-100	100-065	065-040

Example:
- Piston type J
- Pressure balance S
- Reference value: $Q_{Consumer}$ = 140 l/min

Solution:
→ 130 litre piston + 2 modules = 150 l/min
→ Set 140 litre via stroke limiter.

Piston type	Pressure balance	Flow rate in l/min
E, J, Q	S	150–150
		130–130
		110–110

Flow rate without module (pressure balance Δp = 6 to 9 bar)
Flow rate with 1 module (pressure balance Δp = 7.5 to 10 bar)
Flow rate with 2 modules (pressure balance Δp = 9 to 12 bar)

Note!
Position directional control valve elements with maximum flow rate as close as possible to the input element.

6

Directional control valve elements: Actuation types cover A-side

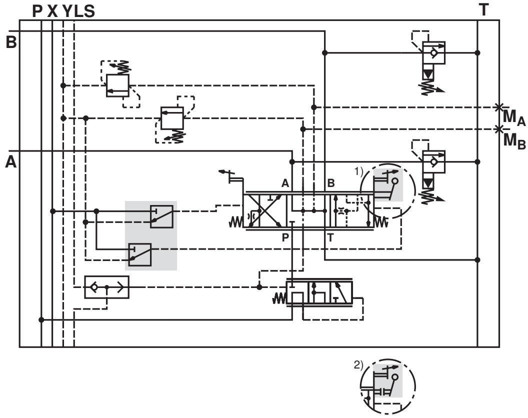
mechanical

Ordering details:

S	… M …	J	…–…	M	B2	H…	H…

Brief description

- Mechanical actuation of main piston. If not actuated, centering in center position by means of springs
- All options for hand lever positions are possible (K, L, M etc.), also see type code on page 11
- [1] Rotating hand lever
- [2] Non-rotating hand lever



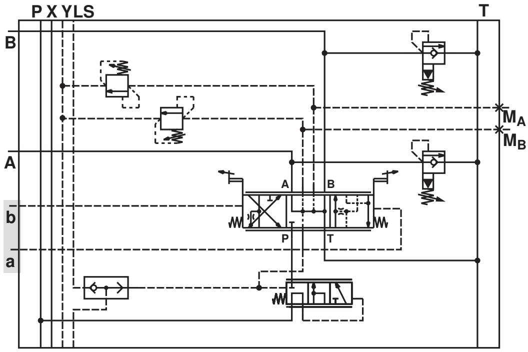
hydraulic

Ordering details:

S	… M …	J	…–…	H	–	H…	H…

Brief description

- Hydraulic actuation of main piston.
  If not actuated, centering in center position by means of springs



Servo-hydraulic

Ordering details:

S	Z Z Z	J	…–…	S	–	Q	Q

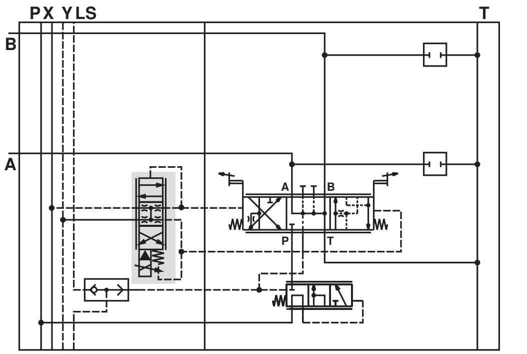
Brief description

- Voltage: min. 7 VDC
- Current type: direct current
- Rated current: ± 20 mA
- Max. current: ± 25 mA
- Dither signal (recommended):
  - Frequency *f*: 100 Hz +10 %
  - Amplitude I_{ss}: 5 mA

⚠ Caution!

Design by technical sales.

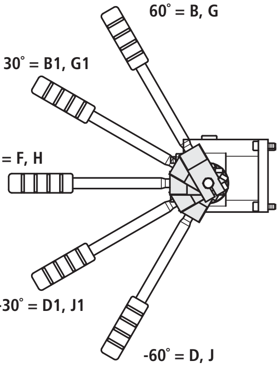
Observe the design information for control oil supply with servo-hydraulic operation on page 17.



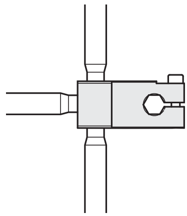
Directional control valve elements: Actuation types cover B-side

Mechanical actuation with hand lever

Clamping piece with lever
(Example: Lever connection in pos. 2)



Lever connection on clamping piece



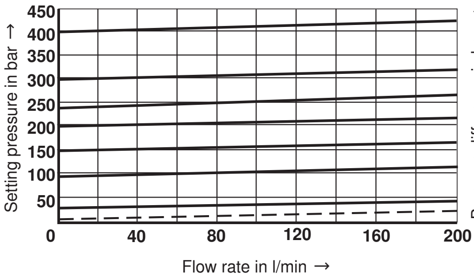
		top, 60°		top, 30°		straight, 0°		bottom, -30°		bottom, -60°	
Clamping piece with lever	– rotating	B	1	B1	1	F	1	D1	1	D	1
		B	2	B1	2	F	2	D1	2	D	2
		B	3	B1	3	F	3	D1	3	D	3
	– non-rotating	G	1	G1	1	H	1	J1	1	J	1
		G	2	G1	2	H	2	J1	2	J	2
		G	3	G1	3	H	3	J1	3	J	3
Clamping piece without lever	– rotating	T		T1		U		V1		V	
	– non-rotating	Q		Q1		S		C1		C	

Actuating force (on hand lever):
– mechanical < 20 N
– hydraulic, hand lever overlaid < 50 N

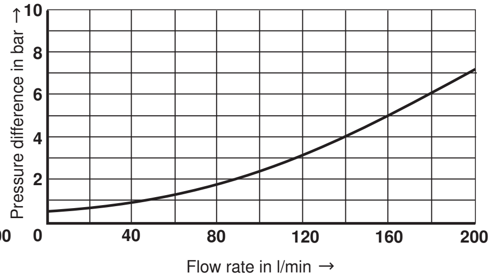
Further hand lever options (aluminium-free) on request.

Directional control valve elements: Secondary valves

Pressure function



Supply function



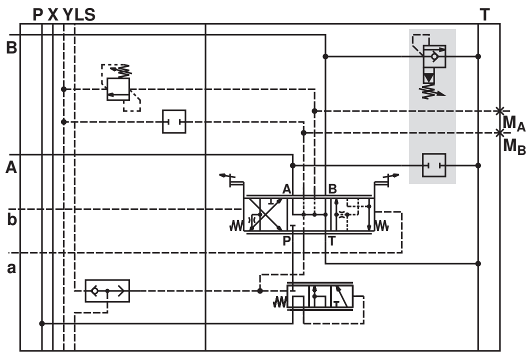
Pressure/supply valves, adjustable

Ordering details:

S	… M Q	J	…–…	H	–	Q	H200

Brief description

– Adjustable pressure/supply valve, pilot operated
– Pressure in bar behind H … required (3-digit)
– **Example: QH200**
  Q: Screw cap for consumer side A
  H200: pressure/supply valve, set to 200 bar for consumer port B
– Technical Data to RE 64642



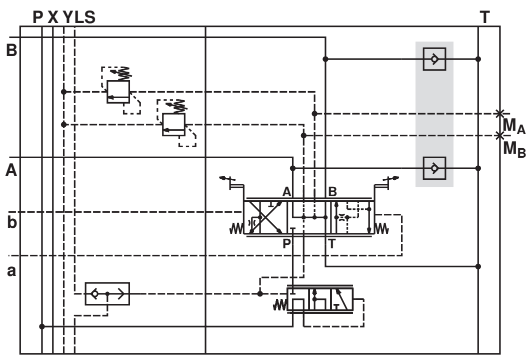
Supply valves

Ordering details:

S	… M …	J	…–…	H	–	E	E

Brief description

– Technical Data to RE 64642

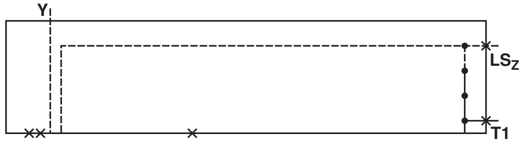


End elements

End element with LS relief

Ordering details:

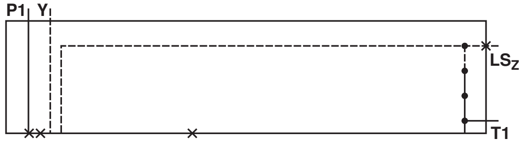
LA



End element with LS relief and additional P and T port

Ordering details:

LAPT



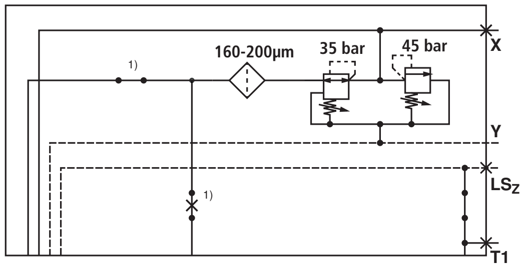
End element with LS relief and internal control oil supply

Ordering details:

LAY

Brief description

- draws oil from the P line, pressure reduced to 35 bar (firmly set), pressure relief valve set to 45 bar



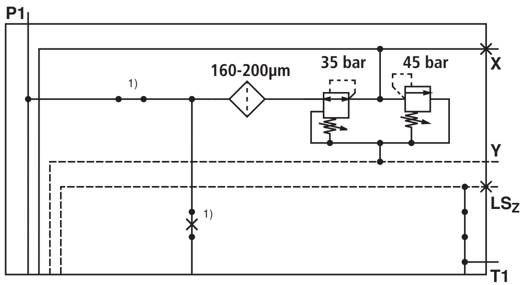
End element with LS relief, control oil supply and additional P and T port

Ordering details:

LAYPT

Brief description

- draws oil from the P line, pressure reduced to 35 bar (firmly set), pressure relief valve set to 45 bar



[1] The plug is changed if an input element with VR… or VZ… priority is used.

End elements

End element with LS relief and internal control oil supply with servo-hydraulic operation

Ordering details:

LAK

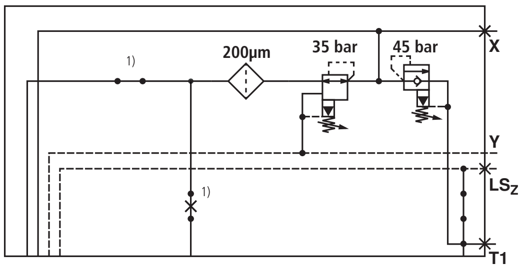
Brief description

– Draws oil from the P line, pressure reduced to 35 bar (firmly set), pressure relief valve set to 45 bar

[1] The plug is changed if an input element with VR… or VZ… priority is used.

⚠ Caution!

Observe the design information for control oil supply with servo-hydraulic operation on page 17.



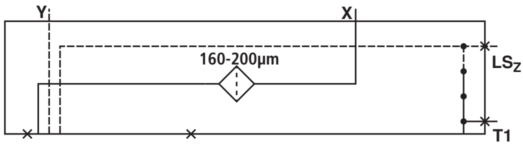
End element with LS relief and control oil supply

Ordering details:

LAX

Brief description

– External control oil supply necessary
$p_{st\ max}$ = 35 bar constant



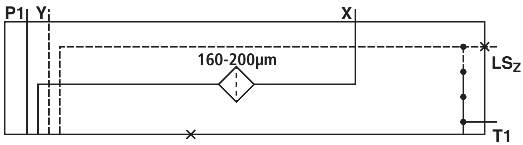
End element with LS relief, control oil supply and additional P and T port

Ordering details:

LAXPT

Brief description

– External control oil supply necessary
$p_{st\ max}$ = 35 bar constant



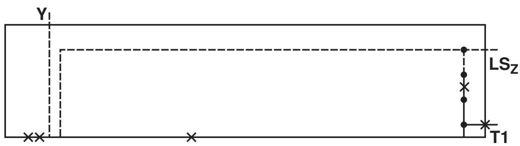
End element without LS relief

Ordering details:

LZ

Brief description

– Supply of LS signals connected in parallel
– LS relief must be ensured externally



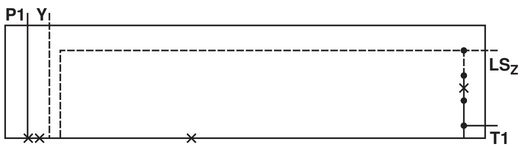
End element without LS relief and additional P and T port

Ordering details:

LZPT

Brief description

– Supply of LS signals connected in parallel
– LS relief must be ensured externally



End elements

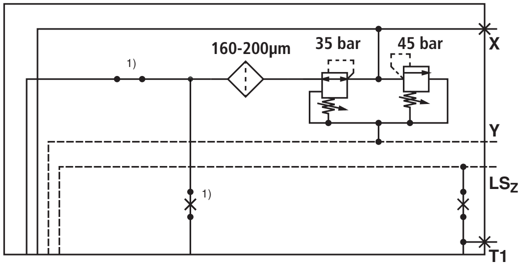
End element without LS relief, with internal control oil supply

Ordering details:

LZY

Brief description

- Draws oil from the P line, pressure reduced to 35 bar (firmly set), pressure relief valve set to 45 bar
- Supply of LS signals connected in parallel
- LS relief must be ensured externally



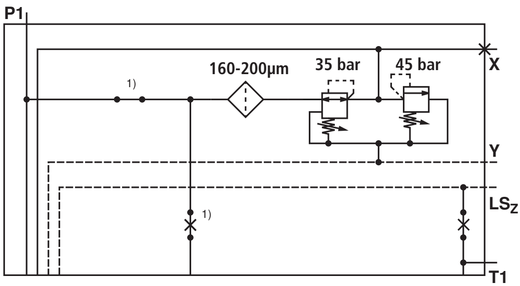
End element without LS relief, internal control oil supply and additional P and T port

Ordering details:

LZYPT

Brief description

- Draws oil from the P line, pressure reduced to 35 bar (firmly set), pressure relief valve set to 45 bar
- Supply of LS signals connected in parallel
- LS relief must be ensured externally



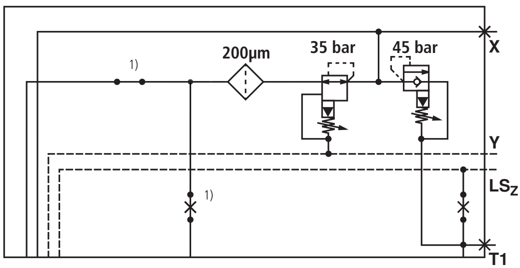
End element without LS relief and internal control oil supply with servo-hydraulic operation

Ordering details:

LZK

Brief description

- Draws oil from the P line, pressure reduced to 35 bar (firmly set), pressure relief valve set to 45 bar
- Supply of LS signals connected in parallel
- LS relief must be ensured externally



⚠ **Caution!**

Observe the design information for control oil supply with servo-hydraulic operation on page 17.

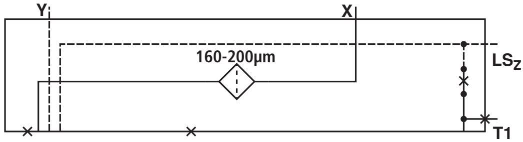
[1] The plug is changed if an input element with VR… or VZ… priority is used.

End elements

End element without LS relief, with control oil supply

Ordering details:

LZX



Brief description

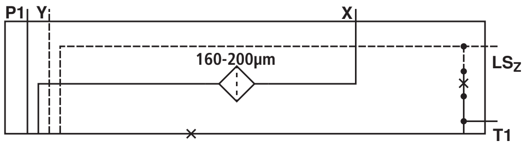
– Supply of LS signals connected in parallel

– External control oil supply necessary $p_{st\ max}$ = 35 bar

End element without LS relief, with control oil supply and additional P and T port

Ordering details:

LZXPT



Brief description

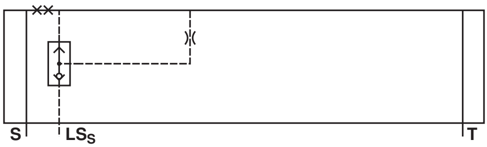
– Supply of LS signals connected in parallel

– External control oil supply necessary $p_{st\ max}$ = 35 bar

End element with external priority port

Ordering details:

LVZ



Brief description

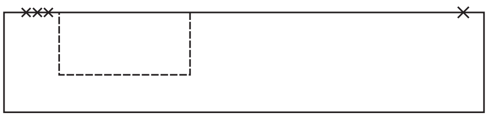
– For the connection of external priority consumers

End elements for combination with central input element

End element for central input element, deflection plate

Ordering details:

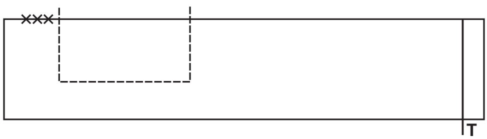
LU



End element for central input element, deflection plate with additional T port

Ordering details:

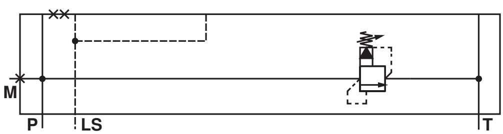
LUT



End element for central input element, deflection plate and additional P and T port

Ordering details:

LUPT	…



Brief description

– Pressure in bar required (3-digit)

Unit dimensions: Line connection

Input element, side	Closed Center	**P**	G 1
		T	G 1
		LS, LS_S, LS_1, LS_{P1},	G 1/4
		Y	G 1/4
		M	G 1/4
		S	G 1
	Open Center	**P**	G 1
		T	G 1 1/4
		LS	G 1/4
		X, Y	G 1/4
		M	G 1/4
Input element, central	Closed Center	**P**	G 1 1/4
		T	G 1 1/4
		LS	G 1/4
		LS_S, LS_1, LS_2	G 1/4
		X, Y	G 1/4
		S	G
Directional control valve element	with secondary valves	**A, B**	G 3/4
		a, b	G 1/4
		M_A, M_B	G 1/4
		M_a, M_b	G 1/8
End element		**P**	G 3/4
		T1	G 3/4
		LS	G 1/4
		LS_Z	G 1/4
		X, Y	G 1/4
	for LAK, LZK	**X, Y**	G 3/8

P = Pump
P1 = Connection, subordinate
A, B = Consumer
a, b = Control line
T, T1 = Tank
X = Pilot supply
Y = Tank, non-pressurised
LS = Load Sensing (LS)
LS_Z = LS supply
LS_{P1} = LS connection subordinate consumer
LS_S = LS priority consumer
M = Test port pump
M_A, M_B = Test ports LS pressure
M_a, M_b = Test ports control pressure
S = Priority consumer

M10 securing screws
in accordance with EN ISO 4762 or EN ISO 4014:

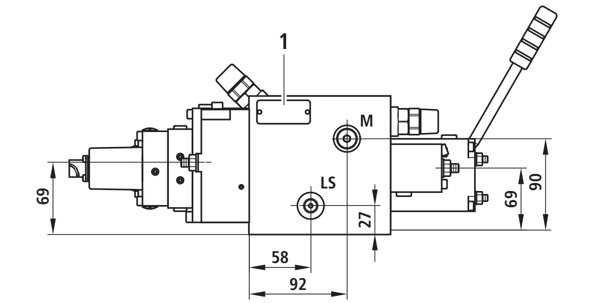
Property class:	8.8	10.9
Tightening torque	41 ± 2 Nm	60 ± 3 Nm

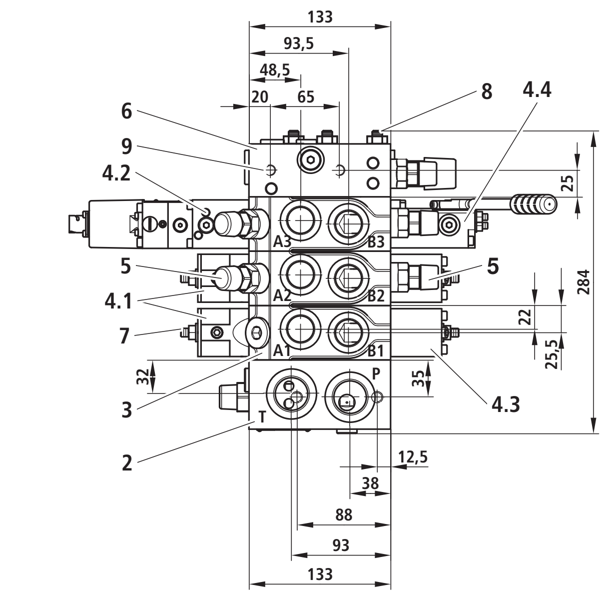
Connections in accordance with ISO 1179-1

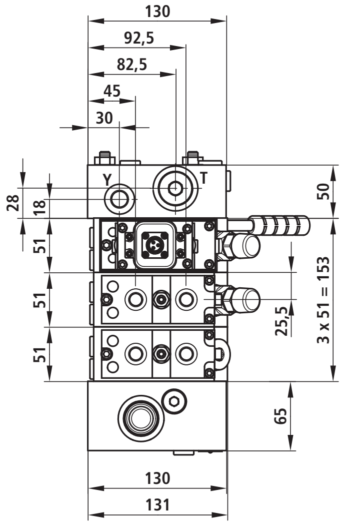
6

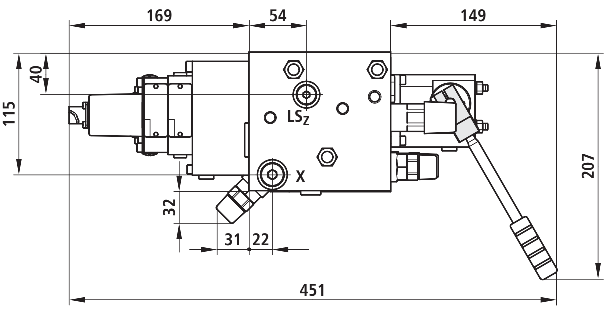
Unit dimensions: Control block with side input element

(in accordance with the ordering example on page 13, dimensions in mm)





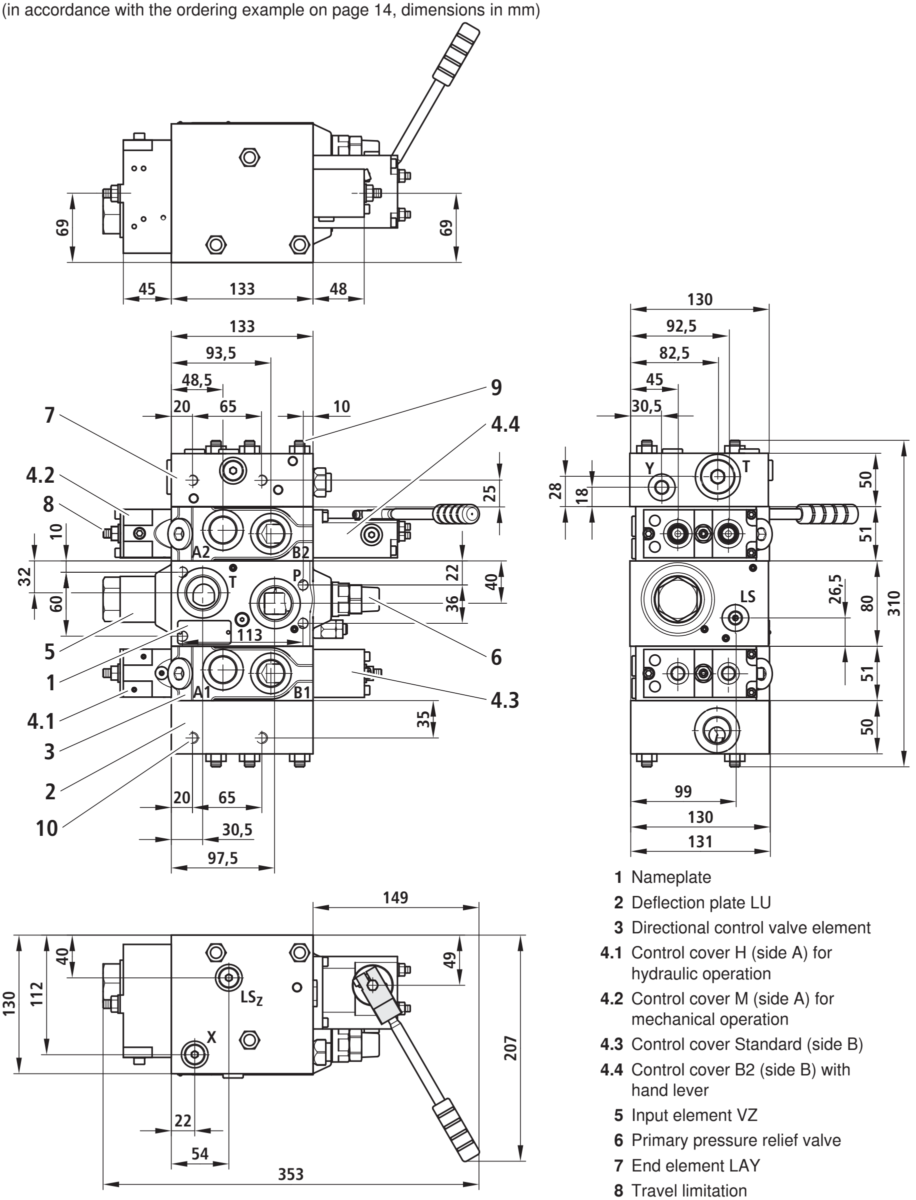




1 Nameplate
2 Input element J…X
3 Directional control valve element
4.1 Control cover H (side A) for hydraulic operation
4.2 Control cover S (side A) for servo-hydraulic operation
4.3 Control cover Standard (side B)
4.4 Control cover G2 (side B) with hand lever
5 Primary pressure relief valve
6 End element LAK
7 Travel limitation
8 Tie rods
9 Mounting thread 4 x M10; 15 deep

Unit dimensions: Control block with central input element and priority valve

(in accordance with the ordering example on page 14, dimensions in mm)



1 Nameplate
2 Deflection plate LU
3 Directional control valve element
4.1 Control cover H (side A) for hydraulic operation
4.2 Control cover M (side A) for mechanical operation
4.3 Control cover Standard (side B)
4.4 Control cover B2 (side B) with hand lever
5 Input element VZ
6 Primary pressure relief valve
7 End element LAY
8 Travel limitation
9 Tie rods
10 Mounting thread 4 x M10; 15 deep

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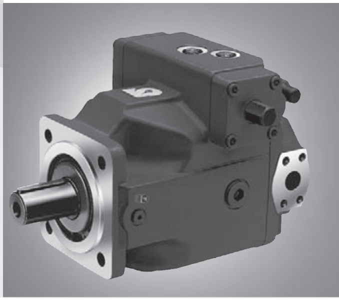
Axial Piston Variable Pump A4VSO for Explosive Areas II 3G c T4

RE 92050-01-X-B2/05.10
1/32

Part II Data sheet



Series 10, 11 and 30
Size NG40 to 250
Nominal pressure 350 bar
Maximum pressure 400 bar
Open circuit

Contents

Details on explosion protection

– Range of applications according to ATEX Directive 94/9/EC
– Gas: II 3G c T4 in accordance with
  - DIN EN 13463-1:2009-07
  - DIN EN 13463-5:2004-03

Features

– Variable axial piston pump of swashplate design for open-circuit hydrostatic drives
– Flow is proportional to drive speed and displacement.
– The flow increases as the angle of the swashplate is adjusted from zero to its maximum value.
– Good suction behavior
– Low noise level
– Long service life
– Modular system
– Short control times
– Variable through drive possibilities
– Optical swivel angle indicator
– Freely variable installation position

For descriptions of control device, please refer to separate data sheets RE 92060, RE 92064, RE 92080

Ordering code for standard program

	A4VS	O			/			–	A		B	25	
01	02	03	04	05		06	07		08	09	10	11	12

Hydraulic fluid / version

		40	71	125	180	250	
01	Mineral oil (without code)	●	●	●	●	●	
	High-speed version	–	–	–	–	●	H

Axial piston unit

02	Swashplate design, variable	A4VS

Operation mode

03	Pump, open circuit, nominal pressure 350 bar, maximum pressure 400 bar	O

Size

04	Displacement $V_{g\,max}$ in cm^3	40	71	125	180	250

Control device

			40	71	125	180	250	
05	Without control		●	●	●	●	●	OV
	Pressure control	For further notes on selecting the control, please refer to page 10 and RE 92060	●	●	●	●	●	DR.
	Pressure control for parallel operation		●	●	●	●	●	DP.
	Flow control		●	●	●	●	●	FR..
	Pressure and flow control		●	●	●	●	●	DFR.
	Power control with hyperbolic characteristic	For further notes on selecting the control, please refer to page 11 and RE 92064	●	●	●	●	●	LR2..
	Power control with remotely controllable power characteristic		●	●	●	●	●	LR3..
	Hydraulic control, pressure-dependent	For further notes on selecting the control, please refer to page 11 and RE 92080	●[1]	●[1]	●	●	●	HD...

Series

		40	71	125	180	250	
06	Series 1, Index 0 (Index 1 for HD)	●	●	–	–	–	10 (11)[1]
	Series 3, index 0	–	–	●	●	●	30

Direction of rotation

			40	71	125	180	250	
07	Viewed from drive shaft	clockwise	●	●	●	●	●	R
		counter-clockwise	❍	❍	❍	❍	❍	L

Seal and ATEX version

08	FKM (fluor-caoutchouc) seals and ATEX version II 3 G T4	A

Drive shaft

09	Parallel keyed shaft DIN 6885	P
	Splined shaft DIN 5480	Z

Mounting flange

			40	71	125	180	250	
10	Metric, on basis of ISO 3019-2	4-hole	●	●	●	●	●	B

1) Version with HD control only in series 11

● = Available ❍ = On request – = Not available

Ordering code for standard program

	A4VS	O			/			–	A		B	25	
01	02	03	04	05		06	07		08	09	10	11	12

Service line ports

		40	71	125	180	250	
11	Port B and S: SAE flange port B and S offset 90° to the side, metric fixing thread. 2nd pressure port B_1 opposite B – plugged with flange plate on delivery.	●	●	●	●	●	25

Through drive[1]

				40	71	125	180	250	
12	Without auxiliary pump, without through drive			●	●	●	●	●	N00
	With through drive for mounting axial piston unit			●	●	–	–	–	K...
	Universal through drive			–	–	●	●	●	U...
	Flange[2]	Coupling for splined shaft	For mounting						
	125, 4-hole	32x2x14x9g	A4VSO for explosive areas, NG40	●	●	●	●	●	31
	140, 4-hole	40x2x18x9g	A4VSO for explosive areas, NG71	–	●	●	●	●	33
	160, 4-hole	50x2x24x9g	A4VSO for explosive areas, NG125	–	–	●	●	●	34
	160, 4-hole	50x2x24x9g	A4VSO for explosive areas, NG180	–	–	–	●	●	34
	224, 4-hole	60x2x28x9g	A4VSO for explosive areas, NG250	–	–	–	–	●	35

Features of the ATEX version

The ATEX version is an advanced development of the A4VSO for compliance with Directive 94/9/EC (ATEX). External features distinguishing it from the standard pump RE 92050 are the ground connection, the Ex marking and the CE marking on the name plate. Please refer to ATEX operating instructions RE 92050-01-X-B1.

Note

When ordering, please state which device group, category, explosion group, temperature class and ignition protection type are required for your planned ATEX application.

Note

Potential equalization: the pump must be grounded. For grounding points, please refer to the drawings starting on page 12. Compared to the standard pump, there are restrictions in the technical data relating to temperature, case pressure and bearing flushing / installation position.

Note

In order to avoid mechanically generated sparks from contaminants made of aluminum with iron oxide and/or particles of rust of the surface[3], the pump is painted as standard with corrosion protecting. Please state the required colour when ordering.

Note

The service life of the bearings must be calculated. The load cycle forms the basis for this. Please contact us.

6

1) All attachment pumps must correspond to the ATEX classification for the application concerned.
2) Metric in accordance with ISO 3019-2
3) See DIN EN 13463-1, 6.4.2.1

● = Available ❍ = On request – = Not available

Technical data

Hydraulic fluid

Prior to project planning, please refer to the detailed information in our data sheet RE 90220 (mineral oil) concerning the choice of hydraulic fluids and application conditions.

The variable pump A4VSO for explosive areas can also be approved for other hydraulic fluids. If applicable, this will require a special approval procedure.

Operating viscosity range

The unit can be operated in the operating viscosity range 16...100 mm²/s without restricting the technical data.

We recommend you to choose the operating viscosity (at operating temperature) in the optimum range for efficiency and useful life of

ν_{opt} = opt. operating viscosity 16 to 36 mm²/s,

related to the tank temperature (open circuit).

Limits of viscosity range

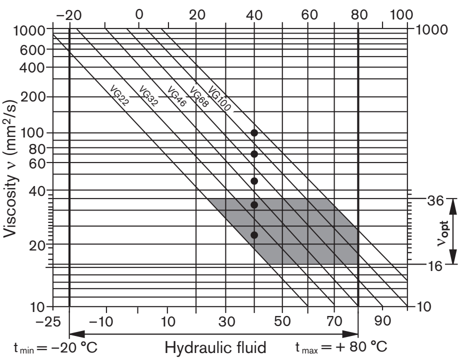
The following borderline operating conditions for viscosity apply:

ν_{min} = 10 mm²/s
short-term (t < 3 min)
at max. permissible case drain temperature
t_{max} = +80 °C

ν_{max} = 1000 mm²/s
only for pulling away (cold start, an operating viscosity of less than 100 mm²/s should be achieved within 15 min)
t_{min} to −20 °C

For detailed information about use at low temperatures, see RE 90300-03-B.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct selection of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature, in an open circuit the tank temperature.

The hydraulic fluid should be selected so that within the operating temperature range, the operating viscosity lies within the optimum range (ν_{opt}) (see shaded section of the selection diagram). We recommended that the higher viscosity class be selected in each case.

Temperature range (cf. selection diagram)

t_{min} = −20 °C

t_{max} = +80 °C

Example: At an ambient temperature of X °C, an operating temperature of 60° C is set in the circuit. In the optimum operating viscosity range ($\nu_{opt.}$, shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, is always higher than the tank temperature. At no point of the component may the temperature be higher than 80 °C, however. When determining the viscosity in the bearing, it must be taken into account that the temperature of the hydraulic fluid in the bearing (depending on the pressure and rpm) is about 5 K higher than that of the case drain fluid at port T.

Note

Ignition temperature of the hydraulic fluid: the pump is approved for temperature class T4 in accordance with DIN EN 13463-1. Only hydraulic fluid with an ignition temperature of at least 185 °C may be used.

Technical data

Bearing flushing

In the following operating conditions, bearing flushing is necessary for reliable continuous operation:

– Operation with borderline conditions for temperature and viscosity

For vertical installation (drive shaft up) and for above-tank installation (regardless of the shaft position), bearing flushing is specified for lubricating the front bearing and the shaft seal.

Bearing flushing is realized at port U in the area of the front flange of the variable pump. The flushing fluid flows through the front bearing and emerges from case drain port together with the pump case drain fluid.

For the individual sizes, the following minimum flushing flows are necessary:

Size		40	71	125	180	250
Flushing flow	q_{Sp} ltr./min	3	4	5	7	10

For the flushing flows stated, there is a pressure differential of about 2 or 3 bar between port U (including fitting) and the case drain fluid chamber (series 10 and 11 or series 30, respectively).

Notes on series 30

If using an external bearing flushing, screw the throttle screw in port U in to the stop.

Filtration of the hydraulic fluid

The finer the filtration, the higher the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, cleanliness level of at least 20/18/15 according to ISO 4406 is necessary for the hydraulic fluid.

Case drain pressure

The permissible case drain pressure (case pressure) depends on the rpm.

Max. case drain pressure (case pressure)

$p_{L\ abs\ max}$ ____________ 2 bar absolute

These data are guideline figures; a restriction may be necessary under certain operating conditions.

Flow direction

S to B

Technical data

Operating pressure range

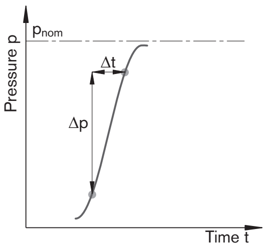
Pressure at the service line port B (pressure port)

Nominal pressure p_{nom} ________________ 350 bar absolute

Maximum pressure p_{max} ________________ 400 bar absolute
Total operating period ____________________________ 300 h
Single operating period____________________________ 1 s

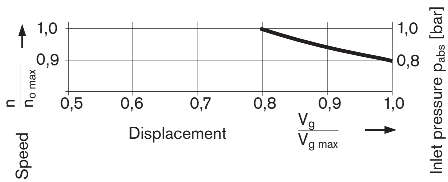
Minimum pressure (high-pressure side) __________15 bar
for lower pressure, please contact us.

Rate of pressure change R_A _______________ 16000 bar/s



Pressure at suction port S (inlet)
Minimum suction pressure $p_{S\ min}$ ___________ 0.8 bar absolute
Maximum suction pressure $p_{S\ max}$ __________ 30 bar absolute

Minimum pressure (inlet)
In order to avoid damage to the axial piston unit, a minimum pressure must be guaranteed at the suction port S (inlet). The minimum pressure is dependent on the speed and displacement of the axial piston unit.



The inlet pressure is the static inflow pressure or the minimum dynamic value in case of pre-tension.

Note:

For max. permissible rpm $n_{o\ max.\ perm.}$ (rpm limit), please refer to page 7.

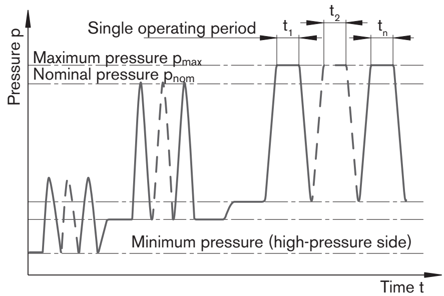
Definition

Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure on the high-pressure side (B) that is required in order to prevent damage to the axial piston unit.

Rate of pressure change R_A
Maximum permissible rate of pressure build-up and pressure reduction during a pressure change over the entire pressure range.



Total operating period = $t_1 + t_2 + ... + t_n$

Technical data

Table of values (theoretical values, without efficiencies and tolerances; values rounded)

Size		NG		40	71	125	180	250	250 H[1]
Displacement		$V_{g\ max}$	cm^3	40	71	125	180	250	250
rpm[2]									
max. at $V_{g\ max}$		$n_{o\ max}$	rpm	2600	2200	1800	1800	1500	1800
Flow									
at $n_{o\ max}$		$q_{vo\ max}$	ltr./min	104	156	225	324	375	450
at $n_E = 1500$ rpm		$q_{VE\ max}$	ltr./min	60	107	186	270	375	375
Power									
at $n_{o\ max}$, $V_{g\ max}$ and $\Delta p = 350$ bar		$P_{o\ max}$	kW	61	91	131	189	219	262
at $n_E = 1500$ rpm, $V_{g\ max}$ and $\Delta p = 350$ bar		$P_{E\ max}$	kW	35	62	109	158	219	219
Torque									
at $V_{g\ max}$ and $\Delta p = 350$ bar		T_{max}	Nm	223	395	696	1002	1391	1391
	$\Delta p = 100$ bar	T	Nm	64	113	199	286	398	398
Rotary stiffness	Drive shaft P	c	kNm/rad	80	146	260	328	527	527
	Drive shaft Z	c	kNm/rad	77	146	263	332	543	543
Moment of inertia for rotary group		J_{GR}	kgm^2	0.0049	0.0121	0.03	0.055	0.0959	0.0959
Maximum angular acceleration[3]		α	rad/s^2	17000	11000	8000	6800	4800	4800
Filling capacity		V	L	2	2,5	5	4	10	10
Mass approx. (with pressure controller)		m	kg	39	53	88	102	184	184

1) High-speed version
2) The values shown are valid for an absolute pressure $p_{abs} = 1$ bar at suction port S and for operation with mineral operating materials with a specific mass of 0.88 kg/l.
3) The scope of application lies between the minimum required and maximum permissible speed.
It applies for external stimuli (e. g. engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).
The maximum value applies for a single pump only.
The load capacity of the connection parts must be considered.

Note

Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. We recommend testing the loadings by means of experiment or calculation / simulation and comparison with the permissible values.

Calculation of characteristics

Flow $$q_v = \frac{V_g \cdot n \cdot \eta_V}{1000} \quad \text{[ltr./min]}$$

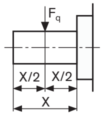
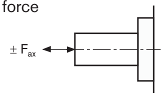
Torque $$T = \frac{V_g \cdot \Delta_p}{20 \cdot \pi \cdot \eta_{mh}} \quad \text{[Nm]}$$

Power $$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_V \cdot \Delta p}{600 \cdot \eta_t} \quad \text{[kW]}$$

V_g = Displacement per revolution in cm^3
Δp = Differential pressure in bar
n = Speed in rpm
η_V = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_V \cdot \eta_{mh}$)

Technical data

Permissible radial and axial loading on drive shaft

Size				40	71	125	180	250
Maximum radial force (at distance x/2 from shaft collar)		$F_{q\ max}$	N	1000	1200	1600	2000	2000
Maximum axial force		$\pm F_{ax\ max}$	N	600	800	1000	1400	1800

Characteristics

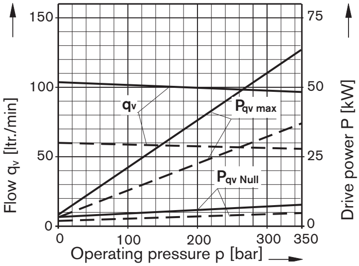
Drive power and flow

(operating material: hydraulic oil ISO VG 46 DIN 51519, t = 50 °C)

Total efficiency: $\eta_t = \dfrac{q_v \cdot p}{P_{q_v\,max} \cdot 600}$

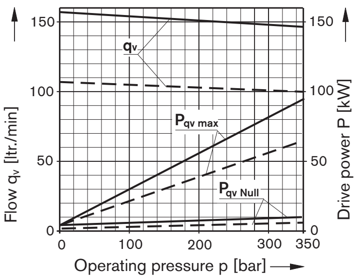
Volumetric efficiency: $\eta_v = \dfrac{q_v}{q_{v\,theor}}$

Size 40



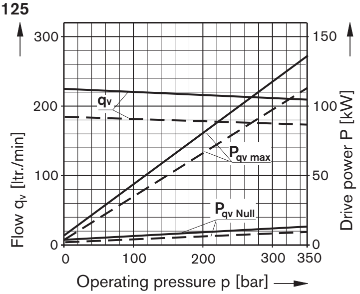
——— n = 2600 rpm
– – – n = 1500 rpm

Size 71



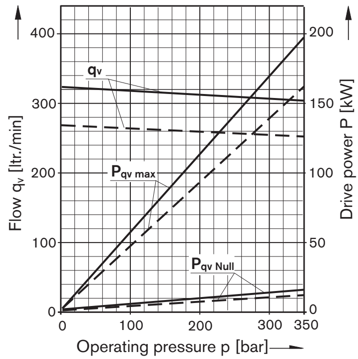
——— n = 2200 rpm
– – – n = 1500 rpm

Size 125



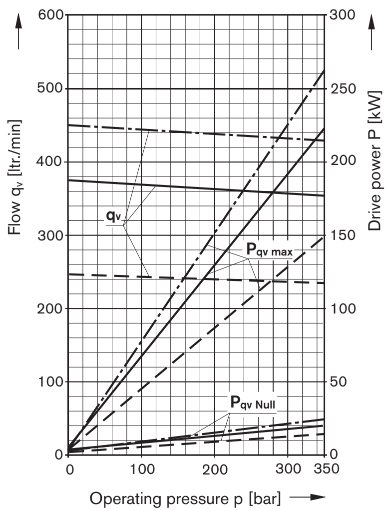
——— n = 1800 rpm
– – – n = 1500 rpm

Size 180



——— n = 1800 rpm
– – – n = 1500 rpm

Size 250



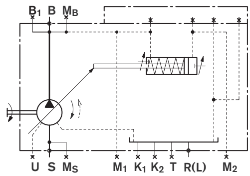
–·–·– n = 1800 rpm
——— n = 1500 rpm
– – – n = 1000 rpm

6

Overview of control devices[1)]

Without control OV

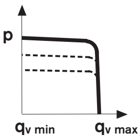
Control on DR basis without valve. The control piston is relieved on one side to the tank. The $V_{g\ max}$ limitation can be adjusted from 50 to 100%. The pump with OV control acts like a fixed pump in operation.

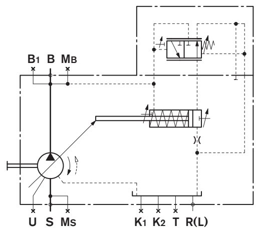


Pressure control DR (see RE 92060)

The DR pressure controller limits the maximum pressure at the pump outlet within the control range of the pump. The pressure can be freely set on the control valve.
Setting range 20...350 bar

Alternatively
Remotely controllable (DRG)

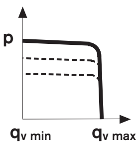


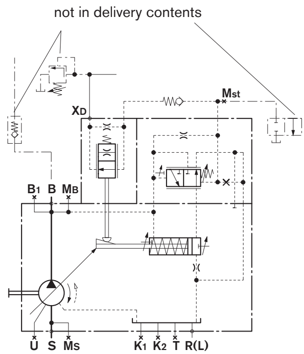


Pressure control for parallel operation DP (see RE 92060)

Suitable for pressure control for several axial piston units A4VSO for explosive areas in parallel operation.

Alternatively
Flow control (DPF)

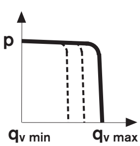


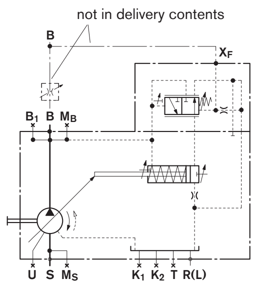


Flow control FR (see RE 92060)

Governs the flow rate (volume flow) in a hydraulic system.

Alternatively
Remotely controllable pressure control (FRG)
Connection from X_F to tank plugged
(FR1, FRG1)





1) Note

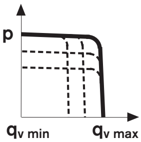
All additional components from RE 92060 and RE 92064 must correspond to the ATEX classification for the application concerned.

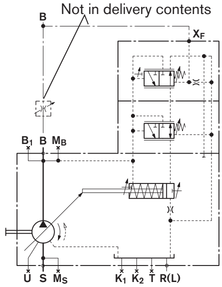
Overview of control devices[1)]

Pressure and flow control DFR (see RE 92060)

This controller keeps the flow of the pump (volume flow) constant even under changing operating conditions.
A mechanically adjustable pressure controller overlies the flow control.

Alternatively
Connection from X_F to the tank plugged (DFR1)



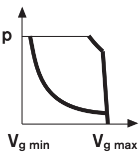


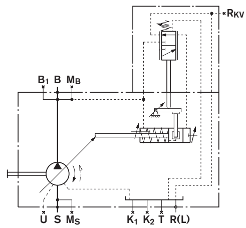
Power control LR2 with hyperbolic characteristic (see RE 92064)

The hyperbolic power control keeps the specified drive power constant at the same drive speed.

Alternatively
Pressure control (LR2D), remotely controllable (LR2G);
Flow control (LR2F, LR2S);
Hydraulic two-point control (LR2Z)

Not available from RE 92064:
LR2.Y (electric relief valve)

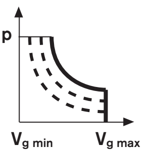


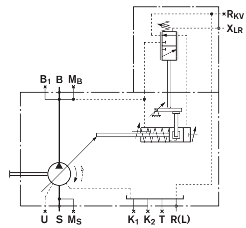


Power control LR3 with remotely controllable power characteristic (see RE 92064)

This hyperbolic power control keeps the specified drive power constant, whereby the power characteristics are remotely controllable.
Alternatively
Pressure control (LR3D), remotely controllable (LR3G);
Flow control (LR3F, LR3S);
Hydraulic two-point control (LR3Z)

Not available from RE 92064:
LR3.Y (electric relief valve)



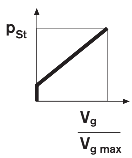


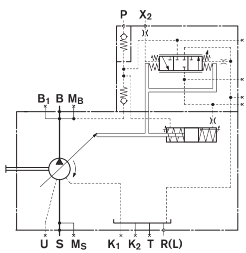
Hydraulic control HD, pilot-pressure related (see RE 92080)

Stepless adjustment of the pump displacement according to the pilot pressure. The control is proportional to the specified pilot pressure (difference between pilot pressure and case pressure).

Alternatively:
pilot characteristics (HD1, HD2, HD3);
pressure control (HD.B);
remotely controllable pressure control (HD.GB);
power control (HD1P)

Not available from RE 92080:
HD..T and HD..U (DBEP6 mounted)





1) Note

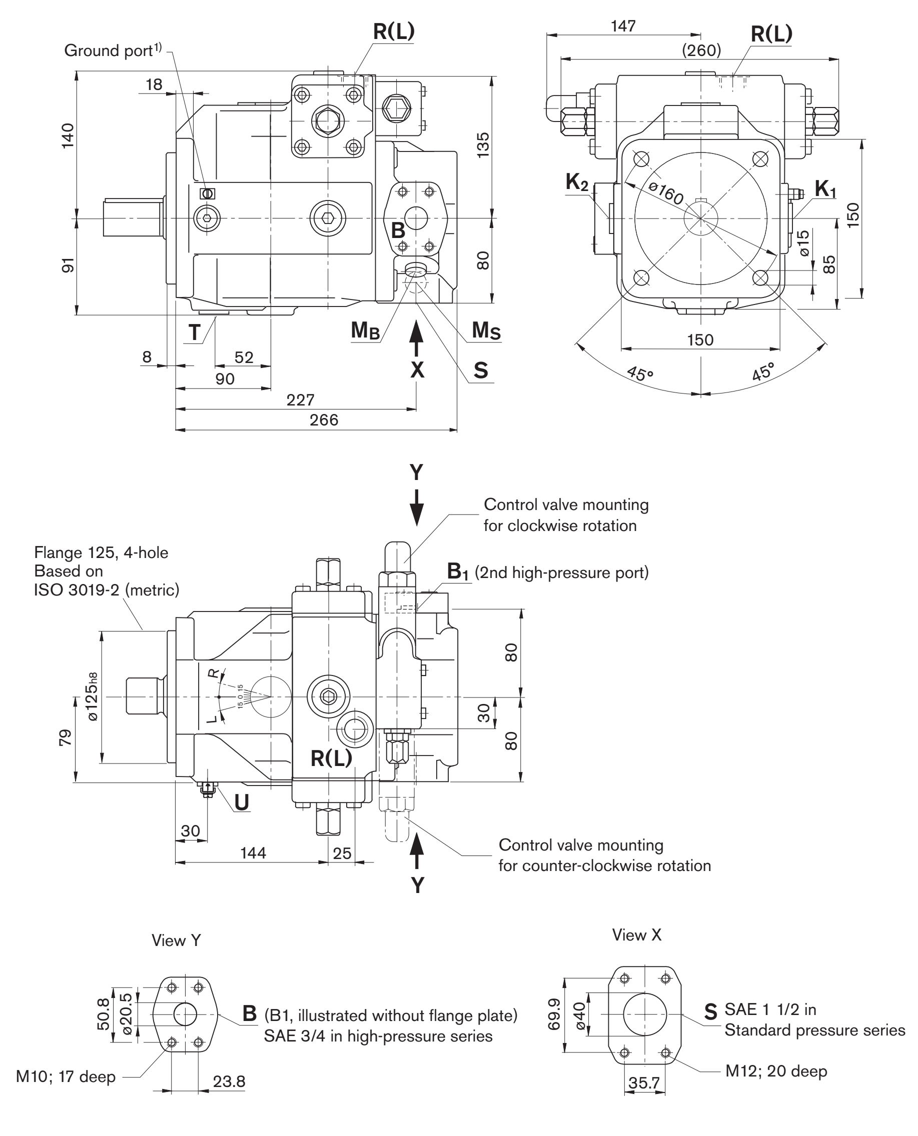
All additional components from RE 92060 and RE 92064 must correspond to the ATEX classification for the application concerned.

Dimensions size 40

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Pressure control (example)

(for precise dimensions of the control unit, please refer to separate data sheets)



For dimensions of drive shafts and ports, please refer to page 13

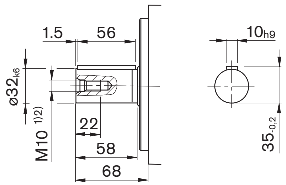
1) Ground terminal configured for up to 2 x 4 mm^2. Minimum cross section for ground wire 2,5 mm^2.

Dimensions size 40

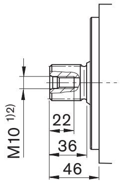
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft

P Parallel keyed shaft DIN 6885
AS10x8x56



Z Splined shaft DIN 5480
W32x2x14x9g



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State
S	Suction Fixing threads	SAE J518[4] DIN 13	1 1/2 in M12 x 1.75; 20 deep	30	O
K_1, K_2	Flushing	DIN 3852[5]	M22 x 1.5; 14 deep	2	X
T	Fluid drain	DIN 3852[5]	M22 x 1.5; 14 deep	2	X
M_B	Measuring, pressure B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_S	Measuring pressure S	DIN 3852[5]	M14 x 1.5; 12 deep	30	X
R(L)	Fluid filling + air bleeding (case drain port)	DIN 3852[5]	M22 x 1.5; 14 deep	2	O
U	Flushing	DIN 3852[5]	M14 x 1.5; 12 deep	5	X[6]
for version 25					
B	Service line (high-pressure series) Fixing threads	SAE J518[4] DIN 13	3/4 in M10 x 1.5; 17 deep	400	O
B_1	2nd service line (high pressure series) Fixing threads	SAE J518[4] DIN 13	3/4 in M10 x 1.5; 17 deep	400	X[7]

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general instructions on page 32 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Metric fixing thread differing from standard.
5) The spot face can be deeper than specified in the appropriate standard.
6) For above-tank installation and for all installation positions with “drive shaft up” a bearing flushing must be installed.
7) Plugged and high-pressure-proof with flange plate. Depending on application, B and/or B_1 must be connected. The unused port must be plugged with a flange plate.

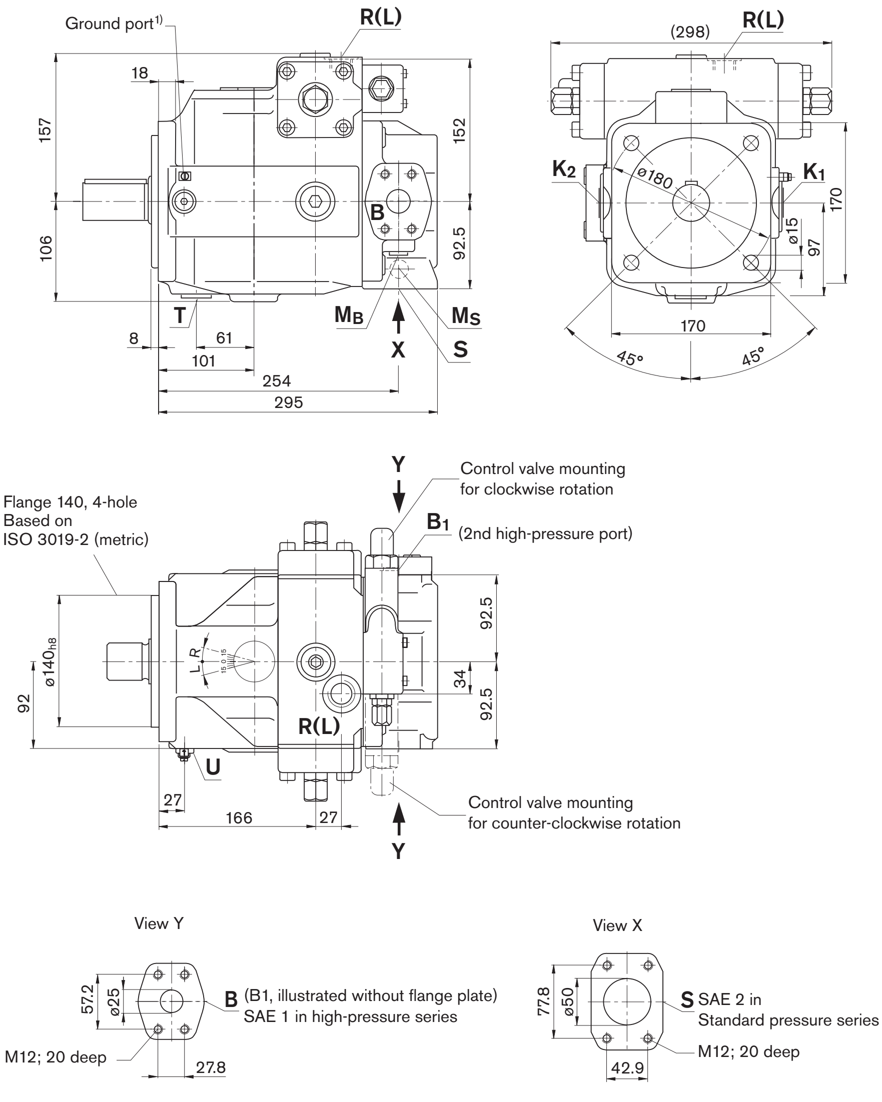
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 71

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Pressure control (example)

(for precise dimensions of the control unit, please refer to separate data sheets)



For dimensions of drive shafts and ports, please refer to page 15

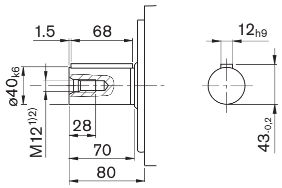
1) Ground terminal configured for up to 2 x 4 mm². Minimum cross section for ground wire 2,5 mm².

Dimensions size 71

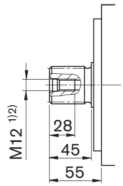
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft

P Parallel keyed shaft DIN 6885
AS12x8x68



Z Splined shaft DIN 5480
W40x2x18x9g



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State
S	Suction Fixing threads	SAE J518[4] DIN 13	2 in M12 x 1.75; 20 deep	30	O
K_1, K_2	Flushing	DIN 3852[5]	M27 x 2; 16 deep	2	X
T	Fluid drain	DIN 3852[5]	M27 x 2; 16 deep	2	X
M_B	Measuring pressure B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_S	Measuring pressure S	DIN 3852[5]	M14 x 1.5; 12 deep	30	X
R(L)	Fluid filling + air bleeding (case drain port)	DIN 3852[5]	M27 x 2; 16 deep	2	O
U	Flushing	DIN 3852[5]	M14 x 1.5; 12 deep	5	X[6]
for version 25					
B	Service line (high-pressure series) Fixing threads	SAE J518[4] DIN 13	1 in M12 x 1.75; 20 deep	400	O
B_1	2nd service line (high pressure series) Fixing threads	SAE J518[4] DIN 13	1 in (plugged with flange plate) M12 x 1.75; 20 deep	400	X[7]

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general instructions on page 32 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Metric fixing thread differing from standard
5) The spot face can be deeper than specified in the appropriate standard.
6) For above-tank installation and for all installation positions with “drive shaft up” a bearing flushing must be installed.
7) Plugged and high-pressure-proof with flange plate. Depending on application, B and/or B_1 must be connected. The unused port must be plugged with a flange plate.

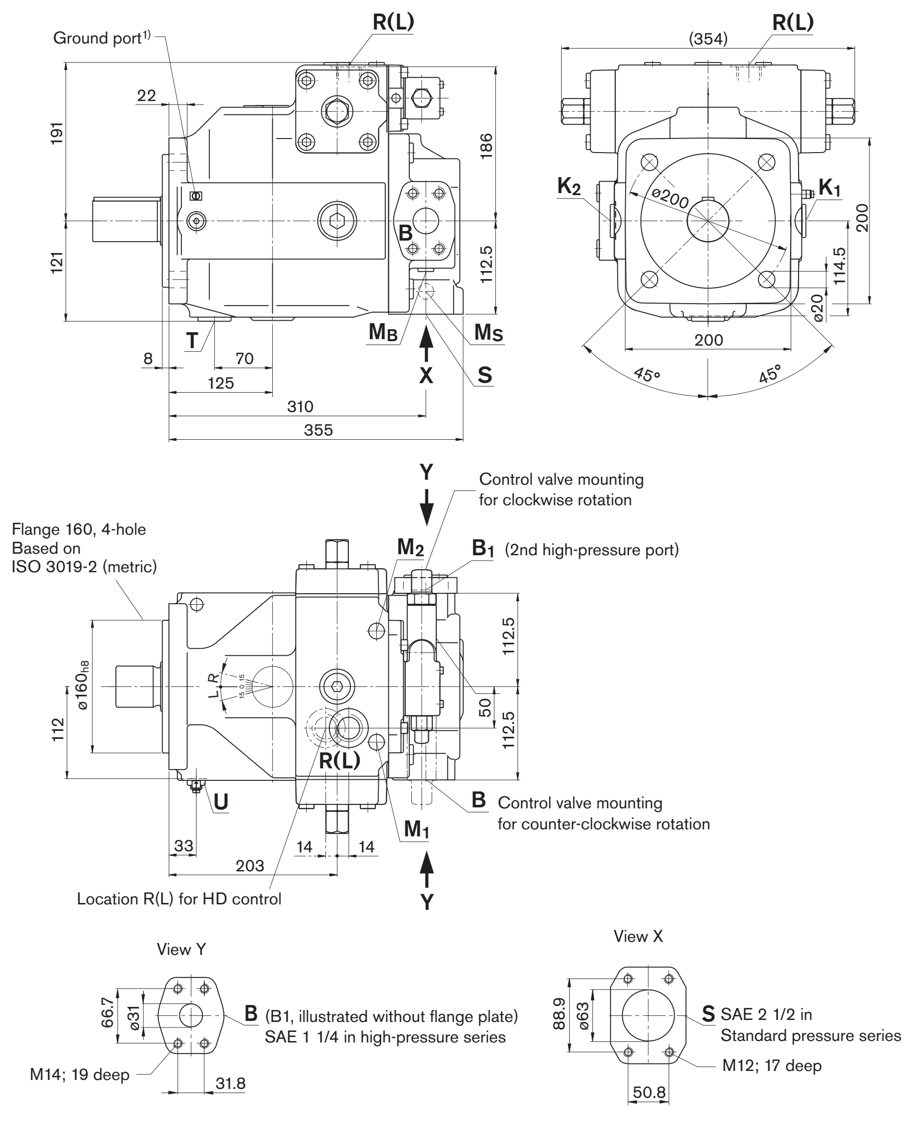
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 125

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Pressure control (example)

(for precise dimensions of the control unit, please refer to separate data sheets)



For dimensions of drive shafts and ports, please refer to page 17

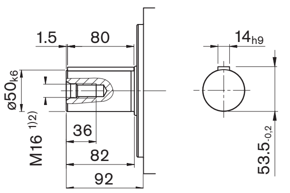
1) Ground terminal configured for up to 2 x 4 mm². Minimum cross section for ground wire 2,5 mm².

Dimensions size 125

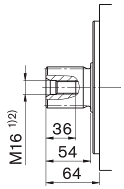
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft

P Parallel keyed shaft DIN 6885
AS14x9x80



Z Splined shaft DIN 5480
W50x2x24x9g



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State
S	Suction Fixing threads	SAE J518[4] DIN 13	2 1/2 in M12 x 1.75; 18 deep	30	O
K_1, K_2	Flushing	DIN 3852[5]	M33 x 2; 18 deep	2	X
T	Fluid drain	DIN 3852[5]	M33 x 2; 18 deep	2	X
M_B	Measuring, pressure B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_S	Measuring pressure S	DIN 3852[5]	M14 x 1.5; 12 deep	30	X
R(L)	Fluid filling + air bleeding (case drain port)	DIN 3852[5]	M33 x 2; 18 deep	2	O
U	Flushing	DIN 3852[5]	M14 x 1.5; 12 deep	5	X[6]
M_1, M_2	Measuring control pressure	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
for version 25					
B	Service line (high-pressure series) Fixing threads	SAE J518[4] DIN 13	1 1/4 in M14 x 2; 19 deep	400	O
B_1	2nd service line (high pressure series) Fixing threads	SAE J518[4] DIN 13	1 1/4 in (plugged with flange plate) M14 x 2; 19 deep	400	X[7]

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general instructions on page 32 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Metric fixing thread differing from standard
5) The spot face can be deeper than specified in the appropriate standard.
6) For above-tank installation and for all installation positions with “drive shaft up” a bearing flushing must be installed.
7) Plugged and high-pressure-proof with flange plate. Depending on application, B and/or B_1 must be connected. The unused port must be plugged with a flange plate.

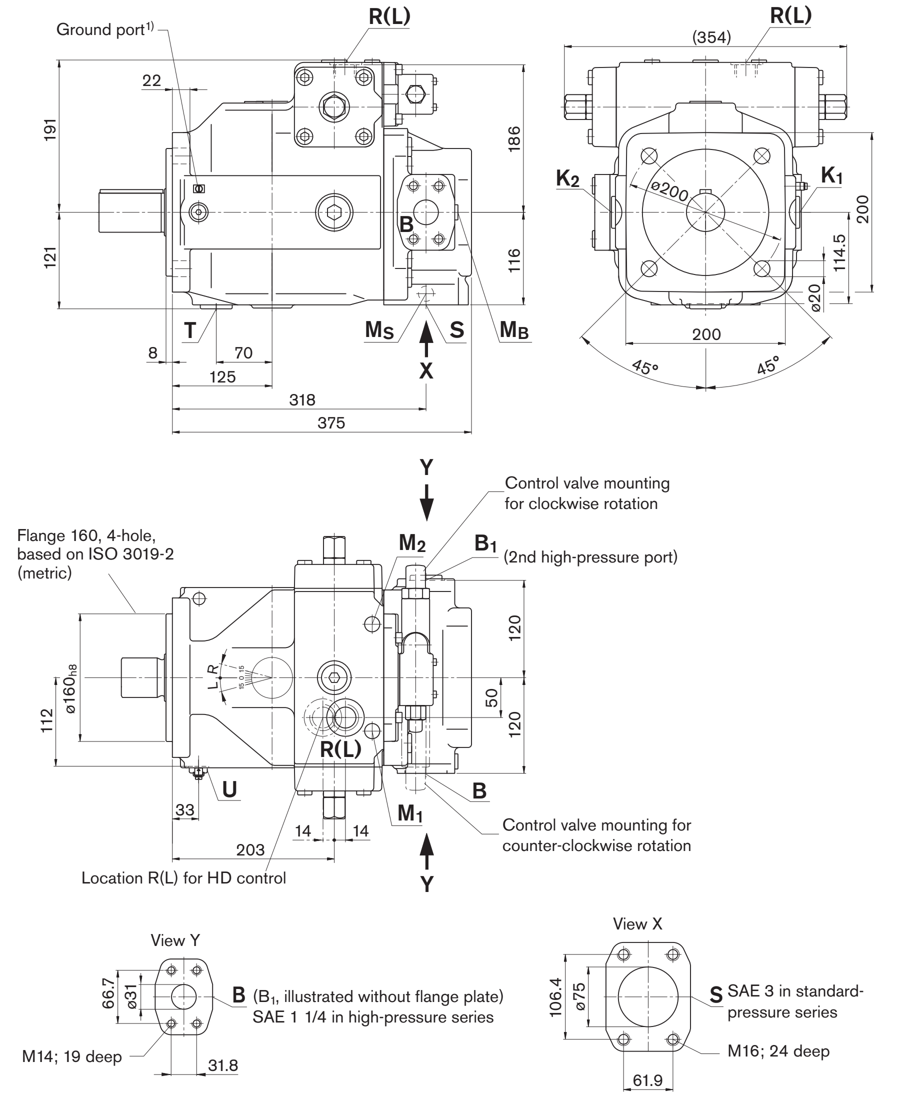
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 180

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Pressure control (example)

(for precise dimensions of the control unit, please refer to separate data sheets)



For dimensions of drive shafts and ports, please refer to page 19

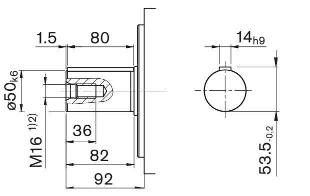
1) Ground terminal configured for up to 2 x 4 mm². Minimum cross section for ground wire 2,5 mm².

Dimensions size 180

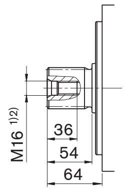
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft

P Parallel keyed shaft DIN 6885
AS14x9x80



Z Splined shaft DIN 5480
W50x2x24x9g



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State
S	Suction Fixing thread S	SAE J518[4] DIN 13	3 in M16 x 2; 24 deep	30	O
K_1, K_2	Flushing	DIN 3852[5]	M33 x 2; 18 deep	2	X
T	Fluid drain	DIN 3852[5]	M33 x 2; 18 deep	2	X
M_B	Measuring, pressure B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_S	Measuring pressure S	DIN 3852[5]	M14 x 1.5; 12 deep	30	X
R(L)	Fluid filling + air bleeding (case drain port)	DIN 3852[5]	M33 x 2; 18 deep	2	O
U	Flushing	DIN 3852[5]	M14 x 1.5; 12 deep	5	X[6]
M_1, M_2	Measuring control pressure	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
for version 25					
B	Service line (high-pressure series) Fixing threads	SAE J518[4] DIN 13	1 1/4 in M14 x 2; 19 deep	400	O
B_1	2nd service line (high pressure series) Fixing threads	SAE J518[4] DIN 13	1 1/4 in (plugged with flange plate) M14 x 2; 19 deep	400	X[7]

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general instructions on page 32 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Metric fixing thread differing from standard
5) The spot face can be deeper than specified in the appropriate standard.
6) For above-tank installation and for all installation positions with “drive shaft up” a bearing flushing must be installed.
7) Plugged and high-pressure-proof with flange plate. Depending on application, B and/or B_1 must be connected. The unused port must be plugged with a flange plate.

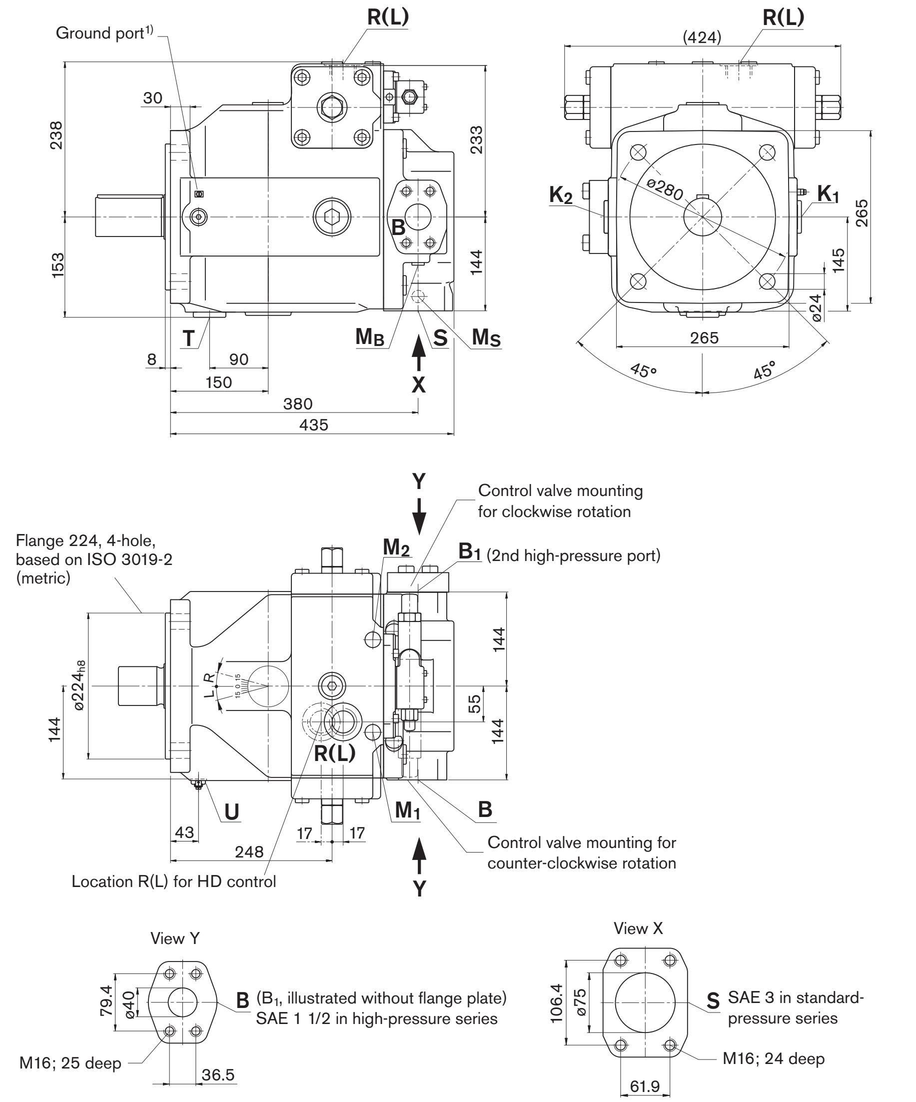
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 250

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Pressure control (example)

(for precise dimensions of the control unit, please refer to separate data sheets)



For dimensions of drive shafts and ports, please refer to page 21

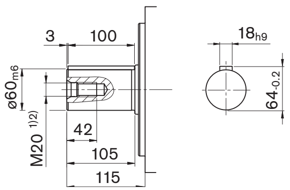
1) Ground terminal configured for up to 2 x 4 mm². Minimum cross section for ground wire 2,5 mm².

Dimensions size 250

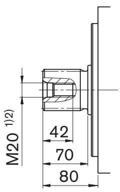
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft

P Parallel keyed shaft DIN 6885
AS18x11x100



Z Splined shaft DIN 5480
W60x2x28x9g



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State
S	Suction Fixing threads	SAE J518[4] DIN 13	3 in M16 x 2; 24 deep	30	O
K_1, K_2	Flushing	DIN 3852[5]	M42 x 2; 20 deep	2	X
T	Fluid drain	DIN 3852[5]	M42 x 2; 20 deep	2	X
M_B	Measuring, pressure B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_S	Measuring pressure S	DIN 3852[5]	M14 x 1.5; 12 deep	30	X
R(L)	Fluid filling + air bleeding (case drain port)	DIN 3852[5]	M42 x 2; 20 deep	2	O
U	Flushing	DIN 3852[5]	M14 x 1.5; 12 deep	5	X[6]
M_1, M_2	Measuring control pressure	DIN 3852[5]	M18 x 1.5; 12 deep	400	X
for version 25					
B	Service line (high-pressure series) Fixing threads	SAE J518[4] DIN 13	1 1/2 in M16 x 2; 25 deep	400	O
B_1	2nd service line (high pressure series) Fixing threads	SAE J518[4] DIN 13	1 1/2 in (plugged with flange plate) M16 x 2; 25 deep	400	X[7]

1) Center bore according to DIN 332 (thread according to DIN 13)
2) Please observe the general instructions on page 32 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Metric fixing thread differing from standard
5) The spot face can be deeper than specified in the appropriate standard.
6) For above-tank installation and for all installation positions with “drive shaft up” a bearing flushing must be installed.
7) Plugged and high-pressure-proof with flange plate. Depending on application, B and/or B_1 must be connected. The unused port must be plugged with a flange plate.

O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

6

Through drive[1)]

The axial piston unit A4VSO for explosive areas can be supplied with through drive, corresponding to the ordering code on page 3.
The through drive version is identified by the code K/U 31...35.

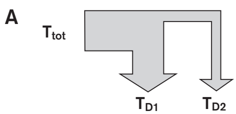
It is advisable to couple no more than three single pumps in series.

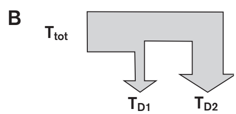
1) All attachment pumps must correspond to the ATEX classification for the application concerned.

Permissible drive and through-drive torques

Size	NG		40	71	125	180	250
Splined shaft							
Max. permissible overall drive torque on shaft of pump 1 (pump 1 + pump 2)	$T_{tot\ max}$	Nm	446	790	1392	2004	2782
A Permissible through-drive torque	$T_{D1\ max}$	Nm	223	395	696	1002	1391
	$T_{D2\ max}$	Nm	223	395	696	1002	1391
B Permissible through-drive torque	$T_{D1\ max}$	Nm	223	395	696	1002	1391
	$T_{D2\ max}$	Nm	223	395	696	1002	1391
Shaft key							
Max. permissible overall drive torque on shaft of pump 1 (pump 1 + pump 2)	$T_{tot\ max}$	Nm	380	700	1392	1400	2300
A Permissible through-drive torque	$T_{D1\ max}$	Nm	223	395	696	1002	1391
	$T_{D2\ max}$	Nm	157	305	696	398	909
B Permissible through-drive torque	$T_{D1\ max}$	Nm	157	305	696	398	909
	$T_{D2\ max}$	Nm	223	395	696	1002	1391

Torque distribution





Single pump with through drive

If no other pumps are to be fitted at the factory, the simple model designation is sufficient.

The delivery contents include:

– For all through drives: coupling, fixing screw, seal and if applicable an intermediate flange

Combination pumps

By mounting additional pumps, the user can make use of independent circuits.

If the combination pump comprises **2 Rexroth axial piston pumps** and if this is **supplied pre-assembled**, the two model designations are to be linked with “+”.

Order example:
A4VSO 125 DR / 30 R – APB25U33 + A4VSO 71 DR / 10 R – AZB25N00

Overview of attachments[1)]

Through drive – A4VSO for explosive areas			Attachment for 2nd pump	Through drive
Flange	Coupling for splined shaft	Short code	A4VSO for explosive areas NG (shaft)	Available for NG
Flange, ISO 3019-2 (metric)				
125, 4-hole	W32x2x14x9g[2)]	**K/U31**	40 (Z)	40 to 250
140, 4-hole	W40x2x18x9g[2)]	**K/U33**	71 (Z)	71 to 250
160, 4-hole	W50x2x24x9g[2)]	**U34**	125 (Z)	125 to 250
			180 (Z)	180 to 250
224, 4-hole	W60x2x28x9g[2)]	**U35**	250 (Z)	250

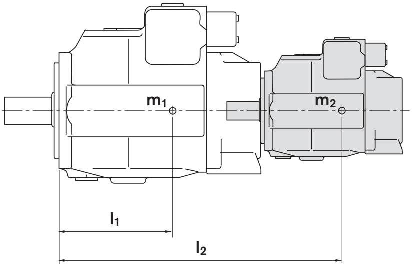
1) All attachment pumps must correspond to the ATEX classification for the application concerned.
2) In accordance with DIN 5480

6

Permissible moment of inertia[1)]

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Based on mounting flange on primary pump



m_1, m_2 [kg] Pump mass

l_1, l_2 [mm] Distance from center of gravity

$$T_m = m_1 \cdot l_1 \cdot \frac{1}{102} + m_2 \cdot l_2 \cdot \frac{1}{102} \text{ [Nm]}$$

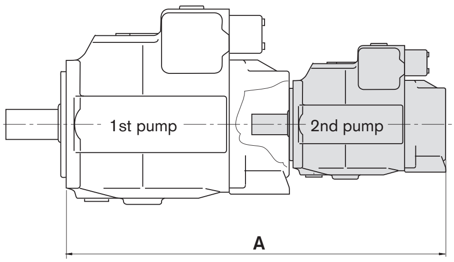
Size			NG40	NG71	NG125	NG180	NG250
Permissible moment of inertia	$T_{m\ perm.}$	Nm	1800	2000	4200	4200	9300
Permissible moment of inertia for dynamic mass acceleration 10 g $\triangleq$ 98,1 m/sec^2	$T_{m\ perm.}$	Nm	180	200	420	420	930
Mass (A4VSO...DR...A)	m	kg	39	53	88	102	184
Distance from center of gravity	l_1	mm	120	140	170	180	210

1) All attachment pumps must correspond to the ATEX classification for the application concerned.

Dimensions of combination pumps[1)]

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

A4VSO for explosive areas + A4VSO for explosive areas



Overall length A

A4VSO for explosive areas (1st pump)	A4VSO...DR...–A...N00 (2nd pump)				
	NG40	**NG71**	**NG125**	**NG180**	**NG250**
NG40	554	–	–	–	–
NG71	582	611	–	–	–
NG125	635	664	724	–	–
NG180	659	688	748	768	–
NG250	719	748	808	828	904

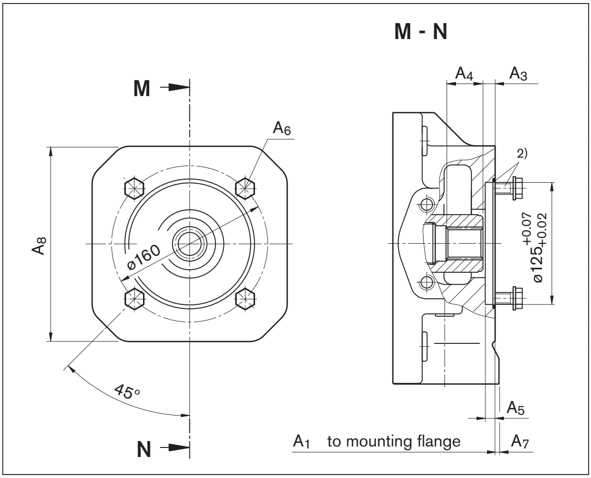
1) All attachment pumps must correspond to the ATEX classification for the application concerned.

Through drive dimensions[1)]

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

K31 **Flange** ISO 3019-2 125, 4-hole
Coupling in accordance with DIN 5480 N32x2x14x8H

for mounting an A4VSO for explosive areas, NG40 with splined shaft

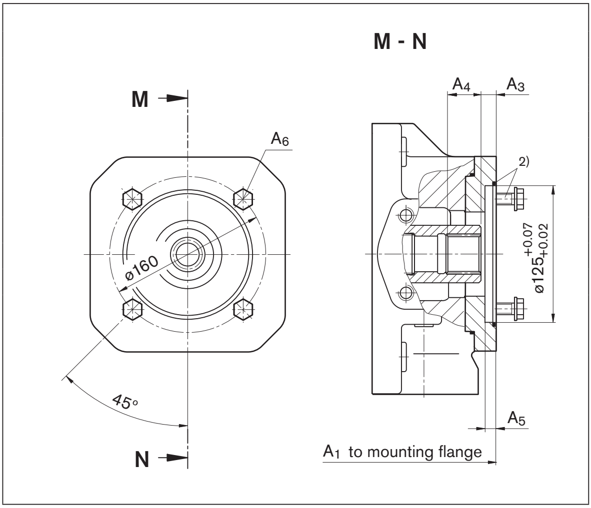


NG	A_1	A_3	A_4	A_5	A_6 [3)]
40	288	12.5	40	9	M12
71	316	12.5	33.6	9	M12

NG	A_7	A_8
40	–	–
71	–	–

U31 **Flange** ISO 3019-2 125, 4-hole
Coupling in accordance with DIN 5480 N32x2x14x8H

for mounting an A4VSO for explosive areas, NG40 with splined shaft



NG	A_1	A_3	A_4	A_5	A_6 [3)]
125	369	12.5	35.6	9	M12
180	393	12.5	35.6	9	M12
250	453	12.5	38	9	M12

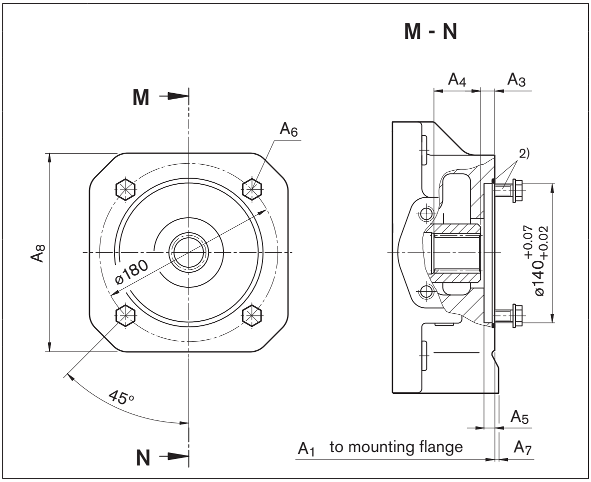
1) All attachment pumps must correspond to the ATEX classification for the application concerned.
2) Fixing screws and O-ring are included in the delivery contents.
3) Thread according to DIN 13, observe the general instructions on page 32 for the maximum tightening torques.

Through drive dimensions[1)]

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

K33 **Flange** ISO 3019-2 140, 4-hole
Coupling in accordance with DIN 5480 N40x2x18x8H

for mounting an A4VSO for explosive areas, NG71 with splined shaft

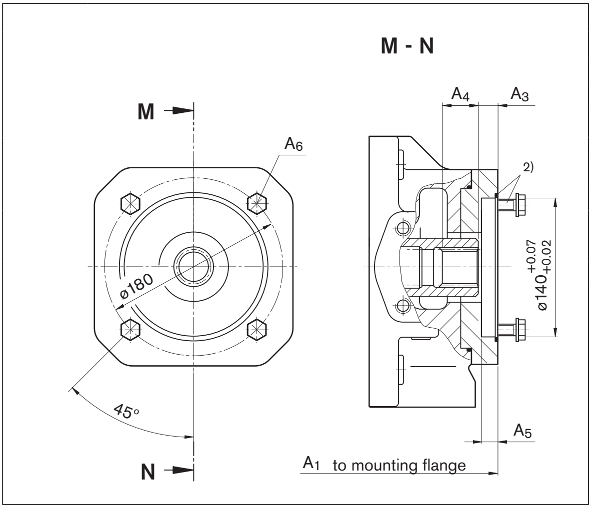


NG	A_1	A_3	A_4	A_5	A_6 [3)]
71	316	11.5	42.8	9	M12

NG	A_7	A_8
71	–	–

U33 **Flange** ISO 3019-2 140, 4-hole
Coupling in accordance with DIN 5480 N40x2x18x8H

for mounting an A4VSO for explosive areas, NG71 with splined shaft



NG	A_1	A_3	A_4	A_5	A_6 [3)]
125	369	12.5	43.8	9	M12
180	393	12.5	43.8	9	M12
250	453	12.5	48.9	9	M12

1) All attachment pumps must correspond to the ATEX classification for the application concerned.
2) Fixing screws and O-ring are included in the delivery contents.
3) Thread according to DIN 13, observe the general instructions on page 32 for the maximum tightening torques.

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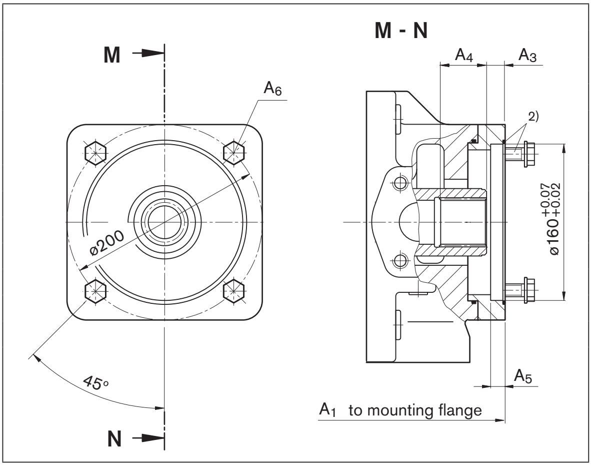
Through drive dimensions[1)]

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

U34 **Flange** ISO 3019-2 160, 4-hole
Coupling in accordance with DIN 5480 N50x2x24x8H

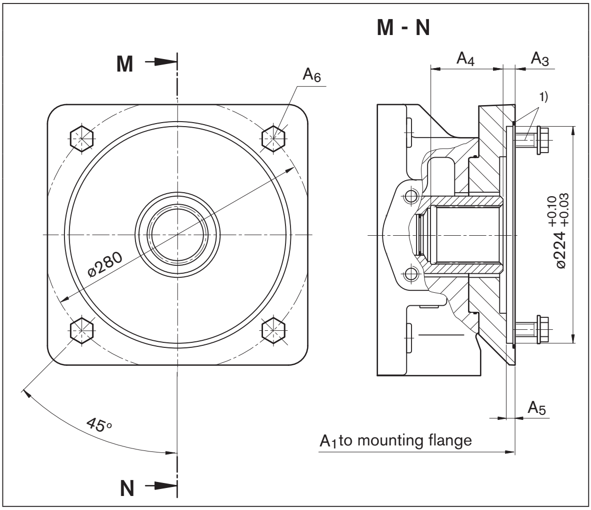
for mounting an A4VSO for explosive areas, NG125 or 180 with splined shaft



NG	A_1	A_3	A_4	A_5	A_6 3)
125	369	12.5	51.6	9	M16
180	393	12.5	51.6	9	M16
250	453	12.5	54	9	M16

U35 **Flange** ISO 3019-2 224, 4-hole
Coupling in accordance with DIN 5480 N60x2x28x8H

for mounting an A4VSO for explosive areas, NG250 with splined shaft



NG	A_1	A_3	A_4	A_5	A_6 3)
250	469	12.5	75	9	M20

1) All attachment pumps must correspond to the ATEX classification for the application concerned.
2) Fixing screws and O-ring are included in the delivery contents.
3) Thread according to DIN 13, observe the general instructions on page 32 for the maximum tightening torques.

Notes

Notes

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.

To achieve favorable noise values, all connecting lines (suction, pressure and case drain ports) are to be decoupled from the tank using flexible elements. Avoid using a check valve in the case drain line. Case drain fluid is to be fed directly to the tank without reducing the cross-sectional area.

For vertical installation (drive shaft up) and for above-tank installation (regardless of the shaft position), bearing flushing is specified for lubricating the front bearing and the shaft seal, see page 5.

For horizontal installation, the highest available ports T, K_1, K_2, or R(L) is to be used for filling and then as case drain port.

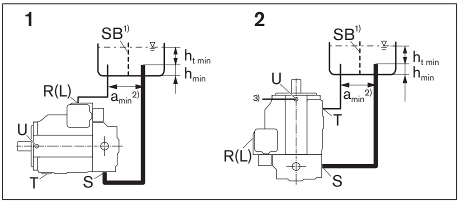
If it is located outside the tank, a minimum pump inlet pressure (suction pressure) of 0.8 bar absolute must be observed.

Installation position

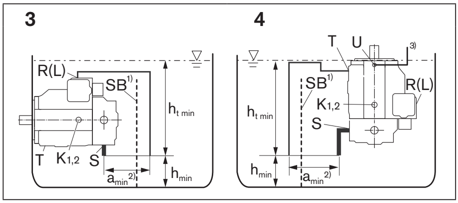
See examples below. Additional installation positions are available upon request.

Recommended installation position: 1

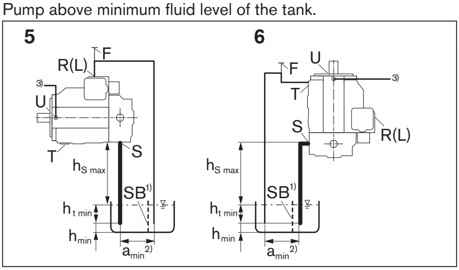
Below-tank installation (standard)
Pump under minimum fluid level in tank.



Tank installation
Pump installed under minimum hydraulic fluid level in tank.
The pump is completely below the hydraulic fluid.



Above-tank installation
Pump above minimum fluid level of the tank.



1) Swashplates (SB) prevent hot case drain fluid from being sucked directly back in again.
2) When designing the tank, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.
3) Install bearing flushing. For minimum flushing flow, please refer to page 5.

$h_{S\,max} = 800$ mm, $h_{t\,min} = 200$ mm, $h_{min} = 100$ mm

Installation position	Air bleed	Filling
1	R(L)	S + R(L)
2	T	S + T
3	via the highest port R(L)	automatically via the open port R(L), by position below hydraulic fluid level
4	via the highest port T and bearing flushing U	automatically via the open port T, by position below hydraulic fluid level
5	F (R(L))	F (R(L))
6	F (T)	F (T)

General instructions

– The A4VSO pump for explosive areas is designed to be used in open circuits.

– Project planning, installation and commissioning of the axial piston unit require the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding operating instructions completely and thoroughly. If necessary, these can be requested from Rexroth.

– The service line ports and function ports are only designed to accommodate hydraulic lines.

– During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).

– Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

– Pressure ports:
The ports and fixing threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

– The data and notes contained herein must be adhered to.

– The following tightening torques apply:

- Threaded hole of the axial piston unit:
The maximum permissible tightening torques $M_{G\ max}$ are maximum values of the threaded holes and must not be exceeded. For values, see the following table.

- Fittings:
Observe the manufacturer's instruction regarding the tightening torques of the used fittings.

- Fixing screws:
For fixing screws according to DIN 13, we recommend checking the tightening torque individually according to VDI 2230.

- Locking screws:
For the metallic locking screws supplied with the axial piston unit, the required tightening torques of locking screws M_V apply. For values, see the following table.

– The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.

– Independent of the setting, the system is to be protected against pressure overload.

Ports Standard	 Threaded size	Maximum permissible tightening torque of the threaded holes $M_{G\ max}$	Required tightening torque of the locking screws M_V	WAF hexagon socket of the locking screws
DIN 3852	M14 x 1.5	80 Nm	35 Nm	6 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M27 x 2	330 Nm	135 Nm	12 mm
	M33 x 2	540 Nm	225 Nm	17 mm
	M42 x 2	720 Nm	360 Nm	22 mm

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